HELMeTO 2022

4th International Conference on
Higher Education Learning Methodologies and Technologies Online
HELMeTO2022

September 21-23, 2022
Palermo, Italy

Book of Abstracts

Sponsored by

National Research Council of Italy
Institute for Educational Technologies

Università degli Studi di Palermo

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Autori vari
HELMeTO 2022 - Book of Abstracts

Editore STUDIUM s.r.l. a socio unico
Prima edizione Settembre 2022

ISBN 978-88-99978-52-5

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Table of Contents

General Track 2 - Learning technologies, data analytics and educational big data mining as well as their applications

Special Track 1 - Improving education via XR and AI

Special Track 2 - Educational Approaches and Innovative Applications to Counteract Social Media Threats

Special Track 3 - Hybrid Learning and Accessibility in higher education

Special Track 4 - E-learning for providing "augmented" mathematics education at University level

Special Track 5 - STEAM Education old and new challenges in distance teaching/learning approaches in Higher Education

Special Track 6 - Online Faculty Development: Next Steps for Practice and Future Research

Special Track 7 - Artificial Intelligence and Multimodal Technologies in Education (AI&MTEd '22)

Special Track 8 - Experience-based training activities for online higher education

Special Track 9 - Intelligent Analytics for Process-aware Higher Education

Special Track 10 - The digital innovation of university teaching observed through the prism of emotions

Special Track 11 - Empowering soft skills and digital competencies in higher education

Special Track 12 - Manufacturing Education for a Sustainable fourth industrial revolution

Message of the General Chairs of HELMeTO 2022

Dear friends,

the 2022 edition of HELMeTO confirmed a growing interest in the topics of higher education learning methodologies and technologies, as well as the relevance of the interdisciplinary approach that characterizes our community. This increased interest, drive us to translate HELMeTO event from a workshop to a conference, hosting a higher number of contributions from several countries and bringing a more international perspective on the topics.

Exactly, we received 126 extended abstract submissions from more than 400 authors and 24 countries (Italy, Israel, United States, Japan, Turkey, Slovakia, Germany, Ireland, Spain, Portugal, Morocco, Greece, Algeria, Brazil, Czechia, Malta, India, Estonia, Bulgaria, Netherlands, United Kingdom, Slovenia, Sweden, Poland).

The presentations and the talks highlighted the complex relationship between technologies and pedagogical approaches. These discussions also pointed out new emerging topics such as the potential role of learning analytics, artificial intelligence, augmented and virtual Reality, big data analytics, and the key role of tutorship and learning design in online learning. A great discussion is also taken on the impact of the Covid-19 emergency on the online education through a dedicated session already introduced from HELMeTO 2020.

However, the emergency has forced universities to adopt solutions for distance learning very quickly, often without being able to provide adequate planning or build up specific technical and didactic skills to develop e-learning courses. In the last years, online learning topics escalated in the agendas of all the educational institutions around the world: schools, universities, education ministries, and policy makers and education has changed dramatically, with the distinctive rise of e-learning. It is a common idea that even if several education institutions return in the last month to their traditional learning models, the integration of information technology in education will be further accelerated and online education will eventually become an integral component of education. This extraordinary situation is well represented by most of the accepted contributions explicitly dedicated to the reaction of academic institutions to the Covid-19 impact on their courses.

The 2022 edition of HELMeTO also signed the so-desired return to the on-site since HELMeTO 2020 and 2021 were fully online, given the Covid-19 emergency. The event is taken in Palermo at the Department of Mathematics and Computer Science of the University of Palermo and organized in collaboration with the Institute of Educational Technology of the National Research Council of Italy.

September 17, 2022
Palermo

The General Chairs:

Marta Cimitile

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HELMeTO 2022 Editorial: Introduction to the Scientific Contributions

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Keywords: Distance Learning, Virtual Learning Environment, Online Learning, eLearning

The 4th International Conference on Higher Education Learning Methodologies and Technologies Online (HELMeTO2022) brings together dozens of high-quality contributions distributed in 14 tracks. This book of abstracts binds together all the accepted contributions to the conference, grouped in two general tracks and twelve special tracks. Indeed, the wide broad of theoretical approaches, technologies, and practical cases makes this volume an excellent overview on the current international context of online learning, and it could provide a guideline for scholars and researchers on online learning and the future of education from pedagogical and technological aspects.

This editorial, therefore, does not intent to provide a systematic review of every publication but a general overview of every track so that the reader can better decide what to pursuit further. To this extent, general Track 1 is focused on *"Online pedagogy and learning methodologies"*. It presents how to design a survey, how to implement social learning for professional development, the outcome of using a machine-learning app on peer assessment, or the after-effect of COVID-19 in Higher Education. General Track 2 is focused on *"Learning technologies, data analytics and educational big data mining as well as their applications"*. It presents prediction both, in course quality and in students' success. It also presents analytics on a specific MOOC and on university data cultures, as well as a deep analysis on digital tools and the related roles.

Special Track 1 is focused on *"Improving education via XR and AI"*. It presents the design and use of virtual reality, augmented reality, and mixed reality through a number of cases and topics, such as climate change, didactics, computer science, science, immersive technologies, behaviour, and cooperative learning and peer tutoring.

Special Track 2 is focused on *"Educational Approaches and Innovative Applications to Counteract Social Media Threats"*. It presents virtual learning companions, social media filters and awareness, as well as the related narratives, and the use of games.

Special Track 3 is focused on *"Hybrid Learning and Accessibility in higher education"*. It presents blended learning deployed in a number of ways, such as webinars, programming languages, accessibility, specific training, inclusive design, technology-enhanced learning, quality and interaction. It also concentrates on different forms of Blended learning that suit different learners, cultures and institutions.

Special Track 4 is focused on *"E-learning for providing "augmented" mathematics education at University level"*. It presents the use, design, application, and assessment of Maths education through many settings: online tools, feedback and formative assessment, asynchronous interaction, in-service teachers, pre-service teachers, and affective outcomes.

Special Track 5 is focused on *"STEAM Education old and new challenges in distance teaching/learning approaches in Higher Education"*. It presents Science, Technology, Engineering, Arts, and Maths, in diverse settings and approaches, such as accessibility (with a different angle to Special Track 3), calculus, botanical gardens, animal biology, collaborative learning, interdisciplinary approaches, physics, chemistry hydrodynamics, and reasoning. It presents STEAM in different context and its possibilities in online education.

Special Track 6 is focused on *"Online Faculty Development: Next Steps for Practice and Future Research"*. It presents a wide range of topics on the matter, starting with co-teaching and sustainability, and following with transformative learning and technology-enhanced assessment. It also deals with mediation.

Special Track 7 is focused on *"Artificial Intelligence and Multimodal Technologies in Education (AIMTEd '22)"*. It presents significant works on flow perception, cognitive load and usability evaluation; conversational agents, facial recognition, cultural and learning facts, and a recommender.

Special Track 8 is focused on *"Experience-based training activities for online higher education"*. It presents a diverse catalogue of field experiences on how to deal with teaching during the COVID-19 pandemic, gamification, scheduling algorithms, and a specific case of the Italian coding league.

Special Track 9 is focused on *"Intelligent Analytics for Process-aware Higher Education"*. It mainly presents research on Fuzzy logic and models, as well as predictive approaches for academic performance and drop-out. Additionally, a case on flipped classroom strategy.

Special Track 10 is focused on *"The digital innovation of university teaching observed through the prism of emotions"*. It presents socio-affective engagement and scenarios, rehabilitation programmes, public emotions, and self-assessment through gamification, as well as the use of video in perception.

Special Track 11 is focused on *"Empowering soft skills and digital competencies in higher education"*. It presents cognitive and non-cognitive skills, as well as other skills, such as digital, communication and leadership ones. It also deals with self-reflection pre-service Primary school teachers, and future learning scenarios.

Finally, Special Track 12 is focused on *"Manufacturing Education for a Sustainable fourth industrial revolution"*, and it combines up-to-date research on transformation, educational programmes and sustainability, engineering education, and the so-needed connection between society and industry.

All in all, this book of abstracts covers a general approach to online learning methodologies and technologies in Higher Education, which is the core of HELMeTO since its inception. The book integrated the theoretical and practical experiences in online technologies and learning.

General Track 1

Online pedagogy and learning methodologies

The effect of COVID-19 pandemic on online learning. A survey on a sample of Italian undergraduates.

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1 Introduction

The COVID-19 pandemic created a risk to all educational system levels, ranging from primary to university grades, due to social restriction measures of isolation worldwide [1]. Online Learning (OL) was challenging for many undergraduates because of the lack of Internet connectivity or digital devices and a suitable home study environment [2]. Uncertainty, plan modification, and delays in the graduation and post-graduation plans timeline are reported by literature [3] and lower scores in the final examinations, especially in all students with low Internet connectivity or limited access to devices [4,5]. In Italy, university institutions switched to OL in March 2020, in the middle of the semester, with multiple direct consequences for students forced not to attend classes and laboratories physically and limited the traditional face-to-face contact with their teachers and between themselves. The present paper reports a survey to describe the impact of OL during the COVID-19 pandemic on a sample of undergraduates considering their study environment, learning habits and strategies, academic achievement, social interaction, and mental health troubles since these variables have had little attention to date [4; 6].

2 Method

A total sample of 1069 undergraduates attending courses for the first-level degree (78.5% female; M_{age}=21.72; SD = 4.05) participated in the survey after recruiting by a snowballing procedure. The link of the present survey was posted on the online classrooms of the researchers' university courses and social media of students' associations over twelve weeks during the COVID-19 second-wave Italian lockdown phase (March-May 2021). First, all participants were assessed using psychological measures for self-efficacy (i.e., General Self-Efficacy Scale- *Italian adaptation*) [7], academic motivation (i.e., Academic Motivation Scale) [8], and trait anxiety (i.e., Spielberger State-Trait Anxiety Inventory - *Short form*) [9]. Then, they filled out an online questionnaire named COVID-19 Online Learning Scale (COLS-19), developed ad-hoc for the present stud exploring: the study environment, learning habits and strategies before/during the COVID-19 pandemic; academic achievement; social interaction and mental health problems. All participants completed the survey during their online classrooms with an average of about 30 minutes. Data were collected automatically by MS Forms. According to the Declaration of Helsinki, all participants gave written consent about the anonymity of data handling and were not compensated financially or through additional university credits. The Bioethics Committee of the University of Palermo has approved the current study (n. 38/2021).

3 Results

Descriptive statistics were calculated for psychological measures and COLS-19 variables. Then, a series of factorial multivariate analyses of variance were performed on COLS-19 scores using HIGH/LOW scores for psychological measures (i.e., self-efficacy, academic motivation, and trait anxiety) as between-subjects factors and BEFORE/DURING the COVID-19 pandemic as the within-subjects factor. All data analyses applied the IBM SPSS 26.0 software package (IBM Corp. Released 2011, IBM SPSS Statistics for Macintosh, Version 20.0. Armonk, NY: IBM Corp). Results show a significant effect of the COVID-19 pandemic on most of the study variables related to OL due to individual differences in psychological measures. We found that during the OL activities due to the COVID-19 pandemic, individuals with higher scores on self-efficacy increased the use of taking notes more than those with lower scores ($F=3.2$; $p<.05$). Contrarily, undergraduates with low academic motivation less respected their time schedules during their study activities ($F=4.01$; $p<.01$) and decreased their learning strategies by taking fewer notes during the OL classrooms ($F=4.7$; $p<.01$). Data also showed that people with high trait anxiety used the summarising strategy during the OL classrooms less than before the pandemic ($F=3.3$; $p<,05$).

4 Conclusion and Discussion

The present study, in line with literature underscoring the impact of stress appraisals on the mental health of students navigating the COVID-19 pandemic [10], shows a strong interrelation between psychological skills for managing learning habits and strategies, academic achievement, social interaction, and mental health problems during the switching to OL after the COVID-19 pandemic. Psychologists and educators need to deliver autonomy-supportive programs that teach students how to cope with anxiety from attending OL classes, also improving their academic outcomes. Results of the present study need to consider some limitations: 1) the cross-sectional design applied in this work does not allow us to make cause-and-effect inferences. Thus, future research could replicate the study with other methodologies such as longitudinal studies to monitor better the learning strategies applied by undergraduates; 2) the convenience sample, even if it plays a valuable role in social science research [11], is not balanced by gender; still, it is hoped to replicate the work by balancing the male-female ratio; 3) a non-random population sample was applied. Thus, we cannot generalise to the entire general population of university students; so future cross-cultural studies on more representative samples from different universities are needed to corroborate our results.

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On line Peer Assessment with Heterogeneous groups of students formed by a Machine-learning-based application

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Abstract

Many Universities promote innovative teaching that allows an improvement of learning in terms of knowledge and soft skills, including the student as an active actor in the training process. Collaborative activities such as peer assessment are effective teaching methodologies since they improve learning outcomes by promoting active learning [1]. They also develop the students' social skills such as decision making, communication, collaborative and critical thinking [2][3].

Peer assessment is a collaborative learning method based on a critical analysis of an exercise assigned by the teacher, previously done by peers [4] and then carried out by the learners. The literature shows how peer assessment supports and improves learning, both for the students who receive the feedback and those who give it, because the activity triggers self-assessment and critical reasoning with a focus on the tasks produced by both [5].

Since the academic year 2017/2018, a collaborative activity of peer assessment, used as an evaluation process with a training function, was included in the online laboratory of Genomics for the master's degree course in Biological Sciences of the University of Camerino, thanks also to the use of digital technologies.

This experimental procedure was entirely conducted online, using the University's Moodle e-learning platform. From the analysis of the students' perceptions related to this collaborative activity carried out in the past editions, some critical issues emerged on the composition of the reviewers' groups that are not always well distributed [6].

Ensuring the heterogeneity of the students in terms of cognitive resources, characteristics and behaviours is essential for maximizing success in group works [7]. In university courses, forming optimal heterogeneous groups of students for collaborative activities is not always easy. Usually, different approaches don't always guarantee the formation of heterogeneous groups, such as random selection, automatic selection, and teacher selection [8]. The last approach could better guarantee the formation of heterogeneous groups. It consists in the selection of students, by the teacher, based on pre-established characteristics, such as knowledge, skills, interests and learning style [9]. However, for the university teachers, the identification of different profiles of students who attend the classroom, influenced by certain characteristics and behaviours, is complicated, not only for the high number of participants, but also for the

relatively short duration of the courses that do not always require a mandatory attendance. Different works show how the use of models help teachers to define students' behaviours related to their learning process [10]. Some Machine Learning algorithms, such as Clustering, reveal their usefulness for their ability to group similar student's types through specific behavioural indicators such as "presence coefficient", "study coefficient", and "activity coefficient" [11]. The weakness in the online learning environments is the lack of a specific software that easily allows the creation of these groups automatically, facilitating the teacher's work.

For this purpose, a computer-based application was created to allow the artificial-intelligent creation of heterogeneous groups, using unsupervised Machine Learning techniques [12] applied to the Learning Analytics produced by the students during their attendance of an online course in Moodle [13].

The software firstly defines different clusters of students (each cluster includes students with similar behaviours in the online path) and then heterogeneous groups (each group includes students belonging to different clusters). For the first part K-means clustering algorithm was chosen for its effectiveness in grouping students based on online behaviour in e-learning courses [14]. Instead for the realization of heterogeneous groups an algorithm specifically developed was used, that includes in each group at least one student for each cluster, ensuring heterogeneity. This software application was implemented in the academic year 2020/2021 in the Genomics online laboratory (composed by international students from: Africa, India, China, and Italy), in order to automatically create heterogeneous groups of students for the collaborative activity of the peer assessment.

The aim of this work is to check the improvement of the effectiveness of the peer assessment activities using heterogeneous groups (created by the software developed), compared to random groups, answering to the following questions:

1. Does peer assessment based on heterogeneous groups enhance the improvement of students' performance compared to the same activity based on random groups?
2. Does the use of the heterogeneous groups influence an improvement in students' perceptions compared to the same activity that required random groups?

The results obtained from the quantitative and qualitative analysis of the peer assessment process, on two different editions of the Genomics online laboratory (2017/2018, using random groups; 2020/2021, using heterogeneous groups realized by the intelligent software), were compared to reply to research questions. In detail we analysed:

1. The improvements of the grades related to the reports produced by the students after the peer assessment process;
2. The questionnaire on the perception of the students regarding the collaborative activity of the peer assessment.

A uniform and substantial improvement both for the reports (after the feedbacks) both for the students' perceptions (related the quality of the feedback received) was obtained in the Genomics laboratory edition 2020/2021 that used the intelligent software, described in this work, for the creation of heterogeneous groups of students.

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Development of a Remedial Course for Students Who Attend Classes of Circuit Theory

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1 Introduction

This paper describes a remedial program that has been designed to help students who attend classes of Circuit Theory. It is an asynchronous self-learning course that contains a number of modules, corresponding to the main topics taught in a standard Bachelor course of 8 ETCS. However, the underlying idea has general validity and can be applied in any discipline. Evidence of its efficacy is reported based on the performance of the students at the final exam.

2 Course Organization and Students' Recruitment

The course is implemented on the Moodle platform and is organized in asynchronous weekly modules, dedicated to the topics presented during the class lectures. Each module consists of three main items:

- A "check-in" test that is used to preliminarily assess the student's level of preparation. The test consists of randomized problems, similar to exam tests. It can be attempted only once and, if the result is below a pre-set threshold, the student must attend the remedial learning units covering the topic.
- "Learning units", consisting of one or more short instructional videoclips that briefly summarize the main theoretical concepts, and a set of exercises. Some exercises are solved and discussed in the video clips, whereas additional practice problems are left to the students in the form of quizzes. The access to the learning units is conditional on failing the corresponding check-in test. This is achieved through a dedicated Moodle feature.
- A "check-out" test, having the same structure of the check-in test, that is used to ascertain the student's progress. The test can be attempted only after all lesson activities have been successfully completed, which is tracked using the "activity completion" feature in Moodle, and for a maximum of three times, in order to earn the associated credit, as mentioned later on.

The remedial program was implemented for the courses of Circuit Theory in the Bachelor program of Biomedical Engineering at Polytechnic of Turin, Italy, during academic year 2021-22. Eventually, 13 modules were designed, each covering roughly the material of one week of lectures and made available at the end of it.

The participants were recruited on a voluntary basis at the beginning of the semester. Students who already attended classes in the past years, and failed the exam, were warmly encouraged to enroll. A bonus of up to 4 points on the final exam score, out of a maximum of 30 points according to the Italian grading system for university exams, was introduced to further encourage participation, and could be earned based on the cumulative performance at check-in and check-out tests. Specifically, for each of the 13 modules, a full score of 4/13 points was awarded if the check-in test was passed, whereas 2/3 or 1/3 of the above score was earned by the students who had to follow the remedial program and passed the check-out test on the first attempt or with multiple attempts, respectively. Eventually, 185 students enrolled in the remedial course, out of a total of 406 students enrolled in the regular classes. This was a satisfactory result, which led to two fairly balanced populations and allowed for a comparative assessment.

3 Analysis of Results

The students who attempted the final exam in the first available session were 256. Out of these, 141 completed a significant part of the remedial course. A small number of students, who only took a minimal part of it, were excluded from the following analysis.

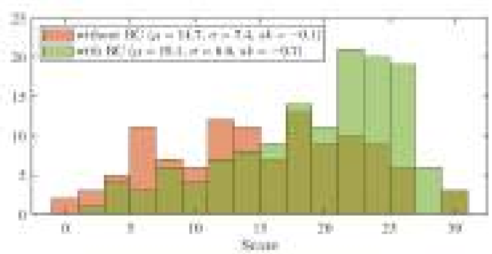

Fig. 1. Comparison between the scores obtained by the students who have (green) or have not (red) attended the remedial course.

The histogram in Fig. 1 illustrates the results achieved by the students. The score distribution of the population who followed the remedial course (in green) is shifted towards the highest grades compared to the score distribution of the remaining students (in red). Indeed, as reported in the legend, the average μ of the green distribution is 19.1, compared to 14.7 of the red distribution. Therefore, a remarkable average improvement of over 4 points out of 30 was achieved by the students who followed the remedial program. Furthermore, it is interesting to note that the skewness coefficient sk is negative for students who have followed the remedial course, which indicates that their score distribution is biased towards the highest scores, whereas it is close to zero for the remaining students, denoting a symmetric dispersion around the average.

Externalizing Practical Knowledge Through Online Co-creation in Healthcare Education: A Methodological Study

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1 Introduction

In learning contexts that involve a practice, such as nursing and caregiving, it is expected that students will acquire skills to integrate and appropriately apply practical knowledge[1]. As a matter of general education, there are challenges in connecting knowledge with practice[2]. Since on-the-job training cannot create a targeted situation, it needs to be designed within the educational environment. Therefore, it is necessary to consider when and how an instructor should intervene. In this study, we constructed an online co-creation environment that allows learners to express their knowledge utilization, and developed a method to externalize practical knowledge.

2 Methods

The co-creation environment was designed to encourage the integration of appropriate medical and experiential knowledge (collectively referred to as practical knowledge) through case creation activities. Groups of two to four learners interact with each other for 30-40 min to collaboratively edit a description. One group is assigned a caregiving topic and a short text about the care recipient. The group creates a specific description, relying on its experimental knowledge and incorporating a real-life episode of a care recipient. The other group reads the description created by the creative group and assesses the caregiver's condition based on its medical knowledge.

These learning activities provide a case description together with dialogue data. To indicate whether the creator's intentions were conveyed to the evaluator, in this study, the dialogue data were transcribed using Speech to Text and keywords were extracted based on a medical taxonomy of dementia. Utilizing these keywords, a knowledge graph was manually created using dialogue analysis. The knowledge graph is based on ConceptNet[3] of relationships between nodes, making it possible for us to summarize the conceptual relationships of the learners' dialogue.

3 Result

Fig. 1 shows an example of the "alcoholism" description visualized with a knowledge graph. The left side presents the description of the creation group and the right side that of the assessment group. The gray nodes represent the knowledge expressed in only one group. The assessor is able to associate "drinking more" with "poor appetite" and link it to the effect related to "delirium," thus showing appropriate use of medical knowledge. In contrast, the creator is able to express the image of the condition, but does not clearly link it to alcohol dependence, which can be assessed as a lack of explanation. The creator themself is aware in their reflection that the symptoms are not connected to the episodes, and it is confirmed that the points at which the instructor should intervene are clear.

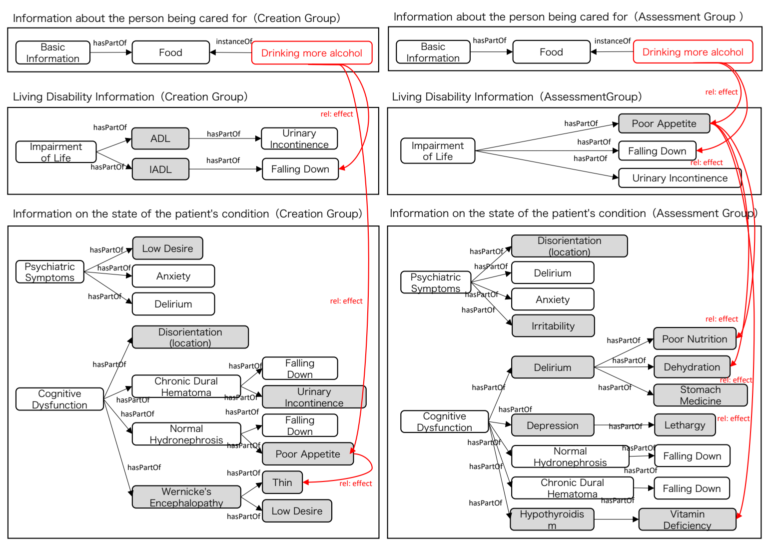

Fig. 1. Knowledge graph that extracts and conveys terms expressing the state of care, based on creative sentences and dialogue data.

4 Conclusion

The results indicate that the co-creation environment is effective for externalizing practical knowledge. The knowledge graphs enable the assessment of the state of association between the medical knowledge and practical knowledge of caregivers, thus possibly allowing instructors to provide more appropriate interventions during learning. Future studies should examine issues such as automating the creation of the graphs and developing appropriate methods for providing advice during interventions.

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Boost students' engagement in Higher Education with Peer Teaching

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1 Introduction

This study aims to analyse the students' intrinsic motivation in the context of Peer Teaching. Peer Teaching is a long and well-established educational methodology based on socio-constructivism theory [1]. It encompasses various practices joined by the active involvement of students in teaching their classmates [2]. The common goal is to increase students' engagement and make them take a more active role in knowledge acquisition. [3, 4, 5]. The rise of the information society has provided new elements that reinforce this methodology's strengths, potential, and educational relevance. The global interconnection has transformed the ways to acquire knowledge and understanding, amplifying the social dimension of learning [6, 7]. Young generations are more proactive in constructing their knowledge by exploring the huge, unstructured, and hyper-connected Internet content, interacting in virtual and augmented reality environments, and simply meeting and exchanging knowledge with people having the same interests in social networks. This makes increasingly dissonant to silently attend lectures for the students. In addition, also the spread of the COVID-19 pandemic has challenged the transmissive teaching model, highlighting the well-known weaknesses [8, 9, 10, 11] and reinforcing the need to renovate teaching in Higher Education by going beyond the emergency solutions such as "dual teaching".

Moving from this perspective, a teaching innovation process has been carried out involving the undergraduate non-compulsory course of the "Social, Work and Communication Psychology" degree program at the University of Padua, Italy. The students have been divided into groups and involved in designing, managing, and evaluating teaching activities for their classmates. The three traditional elements of the teaching-learning process (lecture, study, exam) have changed by adopting a *Student-Generated Content* approach [12, 13] to define the contents of the course, *Peer Teaching* [14] to carry the course out, and *Peer-and-Self-assessment* [15, 16] for evaluation purposes.

2 Course methodology

The course content has been divided into units, each assigned to a group of students. Exploiting Moodle collaborative functionalities, they had to design, hold, and evaluate teaching activities for their classmates, involving them in studying the topic online through digital resources; active- and peer-learning with works production; individual assessment by test, written text, and works evaluation. The final course mark is derived

from a full peer assessment process by adding these grades.
In two papers [17, 18], a more detailed and in-depth analysis of the course methodology is reported. In another study [19], students' perceptions of their improvements in knowledge and skills on the course topics are investigated.

3 Study

According to the Self Determination Theory (STD) [20, 21], students have high intrinsic motivation towards learning if they perceive *competence* over the topic, *autonomy* in accomplishing the tasks, and *relatedness* with others as they learn. The research tool was a five items survey [22] with a 5-point Likert scale delivered to the students at the end of every unit (seventeen times). The three motivational components of SDT were investigated with three items. The other two items analysed the feeling of confidence in accomplishing the tasks required by the course, balancing the *challenge* of the tasks and the *support* provided by the learning community (teacher, classmates, learning resources). If students feel high *challenge* and high *support* (3 to 5 in the Likert scale) a high level of engagement and the right conditions to promote learning are supposed. The other three conditions where *challenge* or *support* or both are low (1 or 2 on the Likert scale) highlight that students do not feel a good engagement in the learning process.

Analysing the data provided by the survey unit by unit, it is possible to monitor the ongoing students' engagement. For brevity, Figure 1 shows the overall Challenge/Support matrix of the entire course, indicating a good combination of the two conditions.

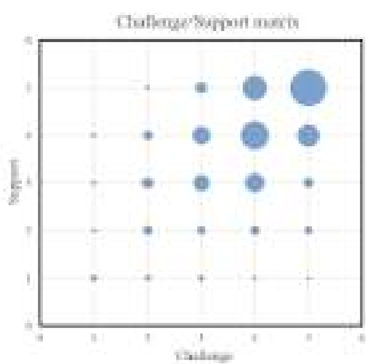

Figure 1 Challenge/Support matrix.

With respect to the other three items, the Mean and the Standard deviation were 4.15 and 0.974 for *Competence*, 3.83 and 1.15 for *Relatedness*, 4.23 and 0.931 for *Autonomy*, attesting a good level of the three motivational components.

The course's peer teaching methodology appears to engage and motivate students toward learning. The research tool seems useful and handy to analyse ongoing students' engagement and motivation and provide valuable feedback for the teacher, not only for the presented teaching methodology.

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The impact of Covid-19 on Italian Higher Education in the context of the European scenario

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1 Introduction

The Covid-19 emergency led most, if not all, higher education institutions around the world to move towards online learning. While there is a wide literature and a solid theoretical framework for online learning, including the active learning paradigm, the relevance of open learning resources, the key role of the Virtual Learning Environments and of the e-tutoring, most of the higher education institutions had to switch to some sort of emergency online learning suddenly, in many cases without consistent contingency plan [1].

A wide number of research has been published about the impact of covid-19 pandemic on higher education, some were focused on specific experiences of a course, an institution, or a country, whereas others are a reflection on online learning itself in the extraordinary condition of the pandemic lockdown or systematic review of the published papers on the emergency online learning in HE [2, 3].

Even the European Union released a report: "The impact of COVID-19 on higher education: a review of emerging evidence" [4] aimed at providing a synthesis of the emerging evidence on the impact of the pandemic disruption on higher education in Europe, the report focuses three thematic areas: teaching and learning; the social dimension of higher education (inclusion and vulnerable/disadvantaged learners); and student mobility. Based on survey report, paper and publications, the report synthesizes emerging evidence into three levels of impact: (1) immediate impact: how the pandemic affected institutions and learners in 2019/2020; (2) short-term impact: how the pandemic is affecting or is likely to affect the 2020/2021 academic year; (3) medium-term impact: how the effects of the pandemic are likely to affect higher education systems, institutions and students by 2025).

Italian National Agency for the Evaluation of Universities and Research Institutes (ANVUR) has made available the raw data of two questionnaires about the Covid-19 [5] emergency online learning response in Italian universities, published between 14 December 2020 and 8 February 2021, the first to the governance of Italian universities, the second to teachers and researchers involved in university teaching. The present analysis is intended to compare the outcomes from the Anvur questionnaires with the European framework pictured by the EU Report above mentioned.

2 Data analysis

Anvur developed two questionnaires: one for the university's governance and one for professors and lecturers. The target for the first questionnaire was the 85 Italian Universities (11 online universities excluded), of which 56 answered (about the 51%,). The target for the second questionnaire was the about 56 thousand academic personnel in service (lecturers on contract not included), of which about 17 thousand answered (about the 29,5%). The EU report is based on 14 rapid-response surveys carried out in 2020 by universities, higher education organizations and single researchers, as well as over 50 papers, reports, and publications.

The results of the Anvur governance questionnaire in the first pandemic emergency lockdown are substantially in line with the data reported in the EU report. All the universities that replied to the questionnaire have activated remote teaching solutions, in most cases these are synchronous lessons respecting the planned schedule totally or in large part (more than 94%). In almost all cases, the solutions for distance learning were arranged centrally by the university (more than 96%). The training was carried out centrally, aimed at everyone and almost always in a way strictly connected to the emergency (more than 80%), with the definition of guidelines always at the university level (about 78%).

On the other hand, the prospect for the future differs, while the EU report highlights an interest in keeping distance teaching at least partly, Italian universities seem more oriented towards maintaining distance teaching solutions as an integration of face-to-face teaching (75% in synchronous mode and 65% in asynchronous mode) but not to activate fully remote courses. The online mode is instead considered as an improvement that will be maintained in the future in relation to teacher / student communication (94.6%) and administrative services for students (87.5%).

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Social Learning for Professional Development. A In-house Service Learning experimentation in Initial Teachers Training

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Service Learning, as a social work practice with whom developing students skills, is a well-known methodology, in Higher Education too [1, 2, 3, 4, 5, 6, 7, 8].
This paper **aimes** to verify if this methodology could allow to develop professional responsibility of teachers in their Initial Training. Our Hypothesis is that Service Learning could offer to the students the opportunity to perform in advance the very important action and skills of mentoring other colleagues, in the personal and social dimensions of taking care and making the difference.
The **research field** is offered by the first two years of a *Service Learning Program* implemented within the Course degree in Primary Education at the Università Cattolica del Sacro Cuore, in Milan. Starting from October 2019, senior students (4th and 5th year) can act as peer tutors to support juniors ones (2nd and 3rd year). The service is non compulsory: each student, both who is going to become a tutee and a tutor, can applicate to the Program. This was designed to be held through a blended solution; due to Covid-19 emergency, it has been carried out totally online since the pandemic lockdown on March 2020. The *experimentation* involved 132 pairs of students.
The **focus** was on "peer tutors senior" reflections and meanings originated from the experience of providing younger colleagues with competencies developed within the academic context and curricula. The research investigated peer tutor answers from an internal perspective, focusing on a crucial ethic field that is often missed by higher education curricula, as it cannot be explicitly taught, even if it represent the necessary condition to train professional teachers able to manage future challenges and scenarios unknowed in advance.
From a **methodological point of view**, the research was held through a Mixed Methods Design [9], more precisely through a Mixed Methods Case Study Design. We analyzed:
- all peer tutors diaries (132), with notes, comments and metacognitive considerations about their experiences;
- 10 explicitation interviews [10], held with peer tutors who accepted to discuss about the meanings of their experiences, starting from what they already wrote in the diaries;
- materials and artifacts created by peer tutors for sharing comments and suggestions with their colleagues that could be interested to do the same experience in the near future.
The corpus of all these texts and verbatims was analyzed with T-Lab.

Clustering process allowed us to draw a map of the themes characterized by the co-occurrence of the semantic traits present in the diaries. Keywords of each cluster were then analyzed for building up a framework within peer tutors could have exercised their professional responsibility. T-Lab outcomes were discussed by comparing them with the texts extracted from diaries, interviews verbatims and with the artifacts produced.
The **result** of the research, at this time, is: 1) a first map of topics and key-words coming from individual representations and feelings of peer tutors who took part to the experimentation; 2) a firs hypothesis about how this kind of experience could be useful to develop mentoring skills in a professional development perspective.
The research is going on, both on the quantitative side (trying to confirm what this study allowed to argue) and with the comparison of this research results with data coming from 2021 and 2022 editions of Service Learning Program.

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Online Teaching and Learning for all? Experiences during the COVID-19 pandemic

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1 Introduction and Methodology

The education of nearly 1.6 billion learners in more than 190 countries in all continents was heavily disrupted by the COVID-19 pandemic [1]. In a bid to slow down the progress of the virus, schools were closed and teaching shifted online. Some teachers found themselves in an entirely new territory whilst others who had previously used online learning albeit in a blended approach faced the challenge of interacting with their students in a totally online environment. The closure of schools also removed access to laboratories and tangible resources which the teachers were accustomed to using prior to the pandemic. This paper gives a voice to such teachers and reflects on how the investment in technology might need to change in order to mitigate similar situations in the future.

The investment in educational technology has been increasing year on year throughout the European Union. Most of this investment involved the improvement of internet connectivity in schools [2]. There was also a substantial investment in hardware ranging from tangible user interfaces and interactive toys used in the early year phases of schooling [3, 4], to devices used in the latter years of the primary phase [5]. Robotic kits and codable toys found their ways into most European schools pushed by the stance to improve coding skills of students to foster higher-order thinking and problem solving [6]. In line with Constructivist and Constructionist epistemologies [7, 8], these devices are mostly being used in child-centred activities, with the children taking leading roles in coding the devices and tinkering with the code.

Although research on fully online teaching and learning pre-pandemic is abundant, this research tends to focus on courses with an adult audience. Research on online teaching and learning in the K-12 scenario tends to be based on blended forms of online learning with the exception of some research on virtual schools [9, 10]. Shifting schools to an online modality came with its own set of challenges in the technological, pedagogical and social domains [11–14]. Connectivity to the internet wasn't always reliable, and students also faced access issues to electronic devices. Pedagogically, the teachers' and students' lack of digital skills; the lack of structured content versus the abundance of online resources; learners' lack of interactivity and motivation and teachers' lack of social and cognitive presence also posed significant challenges. The social challenges were related to the lack of human interaction between teachers and students, the lack of physical spaces at home for lessons to take place and the lack of support of parents who are frequently working remotely in the same spaces. The social challenges disproportionally effected the most vulnerable students. Teaching online also resulted in an increase and change in workload for teachers [15]

The purpose of this paper is to respond to calls by scholars [16] to understand how technology was used during the pandemic in K-12 situations and to identify gaps in existing research. The following research questions will be addressed:

RQ1: In what ways did the use of blended learning before the COVID-19 pandemic help teachers and students when shifting to a fully online mode?

RQ2: How did the change to a fully online mode effect teachers of subjects that required access to specialised equipment usually found in laboratories/workshops to conduct lessons?

In order to generate date for this study a series of online focus groups were held with educators in schools, members of the school management and parents. This paper focuses on the data generated by the focus groups attended by teachers teaching in secondary schools (students aged 11 to 16). Recruitment was done through calls for participation posted on teachers' groups in Facebook. The online focus groups allowed us to collect rich, detailed data through a semi structured approach. Since these focus groups were done when the schools were closed, the video communication platform Zoom was used to conduct these focus groups in an online environment. The interviews were transcribed and then thematically analysed using the method outlined by Braun and Clarke [17].

2 A brief overview of findings

The teachers participating in this study taught various subjects in class, ranging from languages to sciences and vocational subjects. Teachers who were already using a blended approach before being forced into emergency remote teaching commented that the experience prior to the pandemic helped them and the students shift to a totally online modality . Notwithstanding this benefit, they commented that before the pandemic, the students viewed the blended approach as something novel and new. This excitement quickly expired once they used this modality for most subjects. All teachers agreed that the students experienced a more extensive workload when all subject areas assigned work to be conducted online. Teachers accustomed to using the laboratories and workshops during their lessons observed that they changed their plans shifting content which required labs and workshops to the time when schools reopened. This meant that inevitably some topics had to be cut short once the length of the school closure increased.

The feedback provided by the teachers and the experiences they narrated are essential to help shape the debate on the type of technological resources needed in schools post-pandemic. Their feedback highlights the importance of further professional continuous development (CPD) in using online methodologies with children. It also highlights the importance of investment in online tools to mitigate the absence of laboratories and workshops when schools are closed.

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E-tutoring in Higher Education: research and experimentation

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1 The research

The three-year research aims to study the role of the e-tutor in online teaching in the Higher Education sector and to contribute to the definition of an implementation framework and active methodologies for interactive teaching aimed at improving the activity exercise of the student in the course of study.

In the past year a systematic review of the scientific literature was carried out with the aim of justify the research question, review and structure the research question and offer a systematic view of the scientific literature produced with respect to the specific research question, indispensable for directing the subsequent research path.

These goals can be considered achieved because they have made it possible to under- stand the effective role of the e-tutor in the scientific landscape of Higher Education, in addition to the nature of the practices and tasks of this role.
From a summary of the systematic review of the scientific literature carried out, what can be said about the professional figure of the e-tutor is that it has a supporting role for e-learners, although the range of tasks may differ according to the different organizations of high school education.

The systematic review of the scientific literature has exalted two key concepts for this research:
- the role of the e-tutor in the scientific landscape of Higher Education (2016-2021);
- the lack of papers, case studies and results on the state of the art on the use of e-tivities in the *didattica interattiva*[2] of Higher Education.

About the first concept, in the context of this research, the description of the e-tutor is as a person who supports the online learning processes of their students aiming at inclusion and personalization, as a condition of the possibility of success of the student.
The e-tutor, therefore, is an e-moderation expert who acts as a transversal function of orientation, of support for the use of online tools and of support for remote socialization [1], in addition to interact directly with learners to support their learning process

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[1] The work is developed together by both the authors.

[2] Didattica interattiva is the complex of teacher's presence, usually through demonstrations or additional explanations in FAQ, mailing lists or Web forums (demonstrations or operational suggestions on problem-solving, exercises etc.); short interventions by the participants (for example in a discussion or a group: web forums, blogs, wikis); structured e-tivities (individual or in a group) through reports, exercises, case studies, problem-solving, web searches, projects, production of artifacts created by students, with related feedback, evaluation forms such as surveys or tests.

[2].

Instead, about the lack of case studies and papers that study the practice of e-tivities in Higher Education online courses, we intend to proceed as follows.

2 Future research and experimentation

The future research plan consists of an experimentation that provides the redesign of *didattica interattiva* proposal of three courses of the eCampus university of the Psychology Faculty, in particular in the course of Education Sciences, according to Bloom's Taxonomy[3] [3] and the Middlesex University of London CeA scheme [4], experienced in 2018.

Above these two schemes, the guide of the etutor will be the G. Salmon scheme for e-tivities [5].

The goal of this experimentation is to experiment with the intersection of two already validated practices to support the organization of the practical work of the etutor, to create a good practice in the use of e-tivities in online courses in the context of Higher Education.

The experimentation will take place from the end of September 2002 to the end of January 2023, and will be offered in three courses of the eCampus university of the faculty of psychology, in particular in the course of education and training sciences.

We intend to create a practice scheme for the e-tutor that involves crossing the Bloom taxonomy scheme and the CeA scheme experimented by Middlesex University in a mathematics course to promote self-learning amongst the students via e-learning environment where e-lectures/e-tutorials are developed followed by e-assessments.

The e-tutor, therefore, will take care of the supplementary didactic proposal with lecture workshops, seminar workshops and practical workshops that accompany the verbs remember, understand, apply, analyze, evaluate and create the Revised Bloom's Taxonomy.

The evaluation of the effectiveness of the experimentation will be carried out with the UKPSF Professional Standard Framework scheme [6,7] and, as regards student satisfaction, the TAM (Technology Acceptance Model) scheme [8,9] will be used. Both tools are already used and validated in the scientific landscape.

[3] In 2001, the original proposal (1956) created by Benjamin Bloom was slightly modified into the so-called Revised Bloom's Taxonomy (RBT).

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Audio-visual atelier between media education and teaching

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1 Introduction

An extensive scientific debate highlights the functions of the audio-visual in the media-educational and didactic fields, distinguishing some specific cognitive, imaginative, and emotional characterizations. With respect to this debate, this contribution intends to introduce CAVE, a meeting space for three university communities that experiment with the use of audio-visuals in the field of scientific research and teaching. Particular attention is paid to the audio-visual from the point of view of the creative atelier, intended as a training space for observation, design, manipulation and experimentation with a specific reference to higher education.

2 Theoretical framework

In Bettetini's definition [1, p. 7], "the audio-visual is a significant product, aimed at communicative exchanges, normally defined by the human senses directly involved in its use (hearing and sight), rather than by its characteristics and the elements that constitute it". Specifically, he identifies as its main characteristics: the *syncretism* and *heterogeneity of the codes*. When he speaks of syncretism, he alludes to the fact that the audio-visual destroys "deep-rooted distinctions between different expressive modes" [1, p. 8] and integrates them "into an articulated and basically homogeneous unity" [1, p. 8]. In reference to Kress [2], the audio-visual could thus be defined as multimodal. Instead, the heterogeneity of the codes refers to the complex textual structure of the audio-visual, to the system of codes that make it a semantic universe to be transferred to the viewer. What qualifies audio-visual is, then, audiovision, the act of looking and listening with everything that determines it. The audio-visual, as a complex and dynamic system [3], part of a large ecosystem, increasingly characterized by a digital nature, meets in the context of education the ideal horizon for a regeneration of its essential functions in post-media society [4]. The educational re-reading therefore leads to analyzing the identity of the media as a gradual process of identification [5], which is established over time, without ever being definitive, through an intersection between discursive, iconic, sound, symbolic and forms of embodiment [6] [7].

3 CAVE Project

The work developed by the CAVE research group is part of the debate on the audiovisual theme, a word that in the English language means "cave", but which also functions as an acronym in the Italian language: Audiovisual Centers for Education. These centers are: CREMIT (Research Center on Media Education, Innovation and Technology) of Catholic University of Milan; CINEDUMEDIA (Interdepartmental Research Center for Cinema, Education and New Media) of University of Turin; MODE (Digital Museum of Education) of University of Bologna. The aim of the project is to promote reflection on some possible models of audiovisual storytelling [8] [9], useful for stimulating learning and practice, while supporting the production of video-prototypes on an experimental basis, shared on YouTube channel of CAVE.

The video assumes first an *observation* function when it allows you to gather data, to read it, to look at it from a certain distance, allowing you to review what has been done. The video, then, becomes particularly significant when it takes on the function of *narration*, as well as *documentation*, becoming part of a widespread practice in educational contexts. Initially a simple recording of data, documentation today takes on an increasingly metacognitive role, through video: it becomes a memory, a trace of what has been done, a reflection on practices. The narrative aspect, on the other hand, recalls the possibility of telling what happened from a subjective point of view. Finally, today, the video enters the teaching process and, according to an *enactive approach* to learning, it is proposed as a challenging material to help build critical thinking [10].

4 Creative atelier from an audiovisual perspective

The idea behind the research work of CAVE is to consider the audio-visual from the point of view of the creative atelier. The objective is to develop a current and coherent Visual Media Education with respect to the education and training needs in the post-media society [11] [12], with a particular reference to higher education. A creative atelier is a training space intended for observation, design, manipulation, and experimentation. The atelier builds new audio-visual storytelling paths, which can be followed in multiple directions, giving rise to a non-univocal fruition, but rather a reticular and associative type, which opens multiple interpretative possibilities. The different codes of communication and conceptual processing, in close synergy with languages and with corporeality, are functional to an aesthetic experience whose perceptual value is manifested in a new sensorial conjunction between the audio-visual object and the subjects that co-participate in its creation in a collective process. In the case of the online repository of training videos, proposed in the YouTube channel of CAVE, the videos made available act as a stimulus for the atelier intended as an opportunity for the design of new training situations. In this sense, the atelier offers ideas for discussion and metacognitive feedbacks on the experiences regarding the online teaching-learning process and that are made possible by the structural polyvocity of the audio-visual.

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Performative teaching in higher education: from systematic review to the construction of a survey

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1 Framing

Over time, the term "performativity" has been loaded with multiple meanings and nuances; this happened with reference to historical time and the relative culture that made use of it and, even more easily, according to the type of scientific approach with which it was approached: communication sciences starting from the contributions of Austin in 1965 [1] up to Habermas in 1989 [2] or the vision of semiotics that questions the relationship between text and viewer.

The aim of this work will be to show how the term approaches online teaching by asking whether it is still possible to speak of teaching as the "art of life" [9] even when experienced in a repeatable environment such as digital. The paradigm of performativity in the didactic world has a large literature that mostly sees the performing arts under various aspects. First of all, theater is used as a metaphor for training or is studied as a tool for social aggregation, as in the case of the tradition of theater workshops in schools or university courses, or as a community integration

Similarly, in the field of the pedagogy of performance there is a large literature thanks to the numerous researches that implement the theatrical technique in the teaching of a foreign language.

2 Goals, tools and methods of investigation

The goal of this work does not claim to definitively clarify what performativity is, but rather to approach it by trying to define its dimensions in order to present the tool.

The theme of performativity and didactic communication is such a topical and relevant theme also in the light of the Covid-19 pandemic and the consequent adaptation of the way of teaching. We thus enter the scientific debate from a different perspective [3-7] which sees performativity not only as a means, but as a construct that allows the development of didactic action, in which the protagonists act in a contemporary and simultaneous way: students and teachers. Performer and spectators, teacher and student, interactively co-construct the practice, negotiating it pragmatically in its development and the meaning of the practice is never fully defined precisely because it is constantly transformed. We will not refer only to didactic practices based on the active and laboratory participation of the learner, since even in the frontal lesson (as in fact it is a monologue or any performance) there is an interaction consisting of looks, actions, gestures, proxemics; this means you give feedback. In the current

[1] The authors share the structure of the article. Eleonora Mazzotti wrote paragraph 1 and Salvatore Messina wrote paragraphs 2.

scenarios of pedagogical research, we find studies that "postulate a holistic and protean vision and a complex and biopsychosocial perspective of corporeality" [8, p. 186]

The body, in this context, becomes the premise for interaction with the environment itself, which allows us to consider the relationship as central to the didactic event. It is valued by all the studies on enactivism [9] in which knowledge and learning are not predetermined, but become possible thanks to the co-construction of meaning and interaction between action, environment and subject.

In this framework, “structural matching” [11] in the classroom manifests itself,, between teacher and learner.

The body in action is therefore generative of an unexplored perceptual space, a mechanism that puts into action by “tuning” its own didactic action exactly at the same time in which the lesson is taking place on the basis of a series of micro-reactions perceived on the scene. In the didactic experience this allows the postulation of the paradigm of performativity [7-10] the theatrical event exists in itself, but is built on the basis of an embodied action between teachers and students.

The general goal of the work is to investigate the teacher's representations regarding the performative by studying how this new competence of the teacher can be structured, codified and then learned.

In light of the interdisciplinary literature, in order to study the performative paradigm, and consistently with the general goal, we proceeded with:

- the construction and validation with statistical indices [9, 11] experts [12] of a structured survey with the aim of detecting who, of the sampled teachers, is able to grasp the peculiar aspects of the performative in the didactic field (ob1);
- the construction of a semi-structured questionnaire for interviews to detect elements of depth in the didactic-performative field (ob2);
- video coding of the interactions of teachers with their students during synchronous lessons in an online environment, according to the constructs of Creswell & Clark [13] (ob.3);
- semi-structured interviews with actors who have experienced online performance experiences, during the periods of the Covid-19 pandemic, in order to investigate the strategies implemented to perform in the absence of an on-site audience (ob4).

The mixed methodology (surveys, in-depth interviews and video coding) that we have chosen to use offers a holistic interpretation that allows us to effectively investigate a multiple construct such as that of performativity, in complex contexts such as school at different levels of school.

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How did university students adapt to the "new normal" of teaching and learning during the pandemic? A qualitative study.

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Abstract

Context of the study. The spread of Covid-19, and the consequent sudden transition to online teaching and learning, forever changed the landscape of higher education. There is little doubt that this passage proved very difficult for students, due to many reasons, including organizational, methodological, emotional, and psychological factors. On the one end, they had to adapt to a different mode of interacting with educational content, teachers and fellow students [1–4]; on the other, they had to do so in the context of a worldwide pandemic, whose impact on students' psychological well-being and mental health is only starting to be appreciated [2, 5, 6]. In particular, several studies suggest that students' experience has been strongly influenced by their ability to develop resilient behaviors towards adversities [5–9]. We previously reported [10], through the analysis of a questionnaire administered to more than 600 Italian university students in the spring of 2020, that undertaking online courses helped students cope with the difficulties and the stress of the unprecedented pandemic situation; furthermore, students' opinion of their experience with emergency remote teaching (ERT) was positively associated with several factors, including organization and quality of online content and interaction with teachers, whereas the need to reorganize their study habits was associated negatively. However, this quantitative approach highlighted a strong heterogeneity in students' answers, likely reflecting the great variability of individual experiences, both in reacting to the pandemic situation and in adapting their learning habits and strategies to face the unprecedented challenge. Since this "acute" phase of ERT, however, what was an emergency situation became a "new normality": for an entire cohort of students, their entire experience of higher education mostly consisted in online or blended forms of teaching and learning.

Rationale and design of the study. To understand the spectrum of different phenomena/observations/reflections that influenced and determined student's adaptation to this new form of academic life, including strategies that could foster students' resilience

and coping mechanisms, we designed a semi-structured interview protocol addressed to a representative subset of students from the University of Foggia (UniFG). We selected students of the 2019-2020 cohort, that is, students whose university career coincided with the pandemic- and post-pandemic shift towards online learning. This study was part of a larger, FISR-funded inter-university project, aimed at investigating the effects that emergency situations, such as the Covid-19 pandemic, can have on the cognitive and emotional states of university students, to develop better university teacher training protocols. To this aim, the project included both quantitative and qualitative methods of investigation. The semi-structured interviews protocol consisted of two parts: the first included questions concerning students' biographical information, overall experience with distance learning, stress management and coping strategies used during the pandemic, general happiness during and after the peak of the pandemic, and reflection on personal development and possible "silver linings" emerging from their pandemic experience. The second part focused on the interviewee academics results, preferred study methods, and learning strategies developed during the pandemic period. Interviewees have been recruited on voluntary basis, through answering an online questionnaire, and selected based on the following criteria: genre, worker/non worker status, living in the urban center/periphery, and familiar income, to ensure that the sample covered as much as possible the heterogeneity of individual situations and experiences for that cohort of students. Interviews were realized at distance through the Skype Web 4 software. 20 semi-structured interviews have been realized from January to March 2022 with students from Area 11 of the Department of Human Studies of the University of Foggia. After recording, the interviews were transcribed manually, with the help of Otranscribe software, to offer a better transcription quality and to allow the insertion of metadata. Preliminary text mining and quali-quantitative linguistic analysis (including frequency and dispersion analysis, collocation analysis and dialogic syntax) have been performed with SketchEngine software to identify the most common elements of the students' discourse concerning distance learning, with a more throughout qualitative analysis of interview content is still ongoing.

Preliminary results. As an example of the findings emerged from this in-depth approach toward students' experience is a better understanding of the importance that students attribute to being able to access recordings of online lessons. Students, especially those that were already used to taking notes during lessons in presence, cherished the possibility of watching and re-watching lessons at their own pace as well as the possibility to go over key passages multiple times, developing in the process original strategies to integrate them in their study routine. Overall, a better understanding of students' experience in adapting to this "new normality" of higher education can be an extremely valuable resource not only for reflecting on the factors that influenced students' attitudes and beliefs towards online and blended teaching and learning, but to provide crucial context to inform instructional design for higher education, to orient university teacher training, as well as to inform methodological choices concerning the organization of courses, the balance between in-presence and online learning, the use of learning management systems, etc., with the final goal of designing better opportunities for teacher-student, student-student and student-content interaction in this new blended environment. Therefore, a better understanding of how university students adapted to the post-pandemic university scenario is instrumental to building the university of the future.

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General Track 2

Learning technologies, data analytics and educational big data mining as well as their applications

Redefining Digital Distance Learning and Roles of Ten Digital Learning Tools in Support of Distance Learning Processes

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1 Introduction

Over the past decade, information and communication technologies have radically transformed every aspect of organizational activities in society, including education, from a bricks-and-mortar world to an online world. The adoption of e-learning occurs not only in higher educational institutions in the U.S.A. and in other parts of the world, but also in K-12 educational environments as well as in the corporate environment.

Fig. 1 shows the digital distance learning (DDL) and its components. According to Basak, et al. [1], digital learning is "a term that is increasingly replacing e-learning and it concerns the use of information and communication technology (ICT) in the open and distance learning." The basic building blocks of the DDL are e-learning and m-learning. There are many similarities and differences, and there are also many benefits and disadvantages [1]. A consensus has not been reached yet in defining e-learning, m-learning, and DDL [2-5].

2 Aims

The aims of our paper are twofold. First, we present information technology-driven definitions of e-learning, m-learning, and digital distance learning, since they are understood from many angles and a consensus has not been reached yet in defining them.

Second, we analyze the use of the ten digital technology tools in support of students learning process and outcomes from a systems view of e-learning success [6].

3 Digital Distance Learning

The DDL is conceptualized as a learning mode that consists of (1) e-learning, (2) m-learning, and (3) digital technology tools. A recent literature review of Pinto and Leite [7] identified ten most frequently used digital technologies (see Fig. 1) by students in higher education: learning management systems (LMS), publish and share tools, collaborative systems, social networking tools, interpersonal communication tools, content aggregation tools, 3D virtual world, assessment and feedback tools, mobile tools, and ICTs. The advent of mobile technologies has created opportunities for the delivery of learning via mobile devices [8]. The defining characteristics of digital learning are the use of a wide spectrum of digital technology tools to increase the students' learning outcomes as well as to bolster students' learning experience [1, 9].

We analyze the use of the 10 digital technology tools in support of students learning processes and outcomes from a systems view of e-learning success [6]. Especially, the focus of our analysis is on the roles of each of digital technology tools in the learning/cognitive process, student self-regulated learning processes, and two types of dialogue/interaction processes to increase the learning outcomes and students satisfactions (See Figure 2).

Fig. 1. Digital Distance Learning and Its Components (Source: [10, p.15]

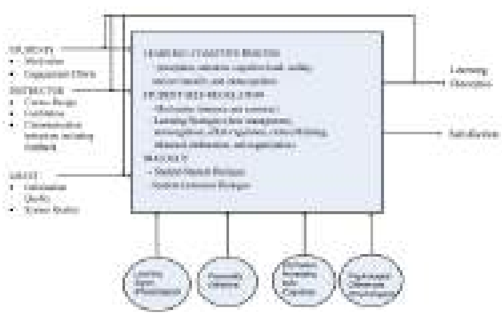

Fig. 2. System's View of E-Learning System (Source: [6])

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A macro-level analytics of MOOC features in a regional platform: course design, scheduling, participation

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A strict connection exists between research on MOOCs and on Learning Analytics because of the great amount of data recorded on MOOCs platforms and analysed through LA methods [1]. Learning at scale (L@S) environments host courses and resources realized by a few experts/tutors for a huge number of learners. The research on these environments used data to answer educational questions, and even if it perhaps did not conduct the hoped disruption in education, it provided pieces of evidence in studies on educational policies, students' behaviours, and social phenomena. Interdisciplinary studies about course design with experimental approaches on more learning platforms contribute to using educational data to offer new directions in learning science [2]. MOOCs platforms are an example of L@S environments where the sequence of learning activities is delivered by teachers and not by algorithms or peers [2]. Researchers discuss the teaching models to make MOOCs not a repository of resources but real and effective courses. At the same time, business models related to MOOCs platforms, level of openness as access to platform and reuse of materials, dropout rates or involvement of weak categories are at the centre of the scientific debate and also public opinion together with the consideration of the great opportunities for learners to attend open courses produced all over the world. Between chances and contradictions, MOOCs were able to make academics react to and experiment with new solutions and ideas for online courses [3].

Italian MOOCs ecosystem seems to be dynamic (about one thousand MOOCs produced by 28 universities till 2021), more open for content licenses and accessibility mechanisms than similar countries, and fragmented, probably for the lack of a national policy [4]. In the Italian scenario, EduOpen platform represents the only network of universities and entities (28) that offers MOOCs in a unique environment. Since 2016, 360 courses were delivered on EduOpen (approximately one-third of all those produced in Italian academic context), attended by more than 110 thousand who acquired about 90.000 attendance certificates. High completion rates (to 68%) were reported since the first years of activities and attributed to the intense use of EduOpen MOOCs in degree courses and teachers' training. This confirms that regional platforms, of course less investigated than international ones, can collect the educational needs, language, and culture of learners/countries and contribute to defining democratizing policies in MOOCs participation [5,6].

According to MOOC and Learning Analytics Cycle (MOLAC) by Hendrik Drachsler and Marco Kalz [1], based on Simon Buckingham Shum's scheme [7], we propose a macro-level analytics of features of EduOpen MOOCs. Starting from inter-institutional practises of course production, it aims to give insights for the whole network using micro-, and meso- elements, just like students' behaviours and course format and design.

What dimensions can we identify in the design features of EduOpen MOOCs? Considering relevant events link platform updates in 2018 and Covid19 pandemic, did the course features change during the years? Given these premises and in-progress development plans, what future can be imagined for the network?

In our analysis, we tried to reply to these questions, using courses (all those produced till now) as statistical units, and not metric variables related to three areas:

- *design*: sector (humanities/sciences), training hours, belonging to a pathway, delivery mode (self-paced/tutored), activities for hours, posts number for students;
- *scheduling*: starting year, opening time, language, multiple editions;
- *participation*: number of participants, completion rate.

For multivariate analysis, we choose the interdependence technique called multiple correspondences analysis (MCA), where not metric variables are used to define a latent structure in a dataset based on the distances between categories of the variables. MCA is a technique for data reduction that allows to plot points representing categories in a small number of dimensions to produce perceptual maps [8,9]. MCA is used on the whole variables and some subsets referred to specific research questions.

Results related to the mechanism of designing MOOCs and participating in the course during the years will report together with a definition of dimensions that characterize courses with different features (for example, those that have more editions and those that have no end date); future data-driven trends and development for the network will be described.

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Exploring data cultures in two universities: Contextualised data practices and needed literacies

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1 Introduction

"Smart technologies", based on the rapid evolution of technological infrastructures that compute digital data and hence improving the systems' capacity to learn from internal and external information processing, have entered into Higher Education [1]. Teachers and students faced with "smart" technologies have different understandings, opinions and concerns regarding smart technologies, and this diversity of stances has been characterised by Sarah Hayes as "postdigital positionings"[2]. Technology cannot be disentangled from human meaning making processes, including who the developers are and which power logics activate through the technological devices; who the users are, their experiences, their needs and their feelings of being oppressed or having degrees of agency. Therefore, disclosing the many meanings and practices assigned to human data interaction in designing "smartness" is key [3,4].

Nonetheless, the complexity and fragmentation in the debates around data practices in Higher Education must be acknowledged. From one hand, data abundance and its enhancement in higher education has been connected to personalised learning experiences, inform teachers' decisions and decrease their workload, improve quality measures, etc [6,7]. The idea of digital data as a source of information shaping systems' outputs that are not interfered by human subjectivities has been a relevant driver of such enthusiastic response [8]. From the other hand, the socio-technical studies raised critical awareness on the downwards of human data interaction and the need of deconstructing the materiality of data as an alleged "objective" entity [9,10]. This entailed an ethical reflection, considering the way data is defined, coded, assembled and reshaped in order to respond to the algorithms adopted to provide the systems' smart (automated, adaptive) responses [11]. Indeed, digital data is categorised, assembled, "polished" and structured through algorithms that are claimed to be "mathematical concepts" [12].

In Higher Education, the idea of addressing better academic government and pedagogical practices through academic and learning analytics (an applied example where human data interaction plays a central role) has been recently a matter of debate [13,14]. What has been contested is the embedded techno-determinist approach towards data mining techniques and the poor exploration data-driven practices adherence to pedagogical constructs and educational values [15,16].

Data-driven practices might also exacerbate the reductionisms embedded in the idea of Higher Education Institutions (HEIs)' "performance", measured through limited quantified indicators ending up in international rankings [17,18]. Moreover, the mentioned data practices vary from one university to another, in the configuration of what has been called "data cultures" in Higher Education institutions [5,19,20]. Exploring and understanding such data cultures might encompass a more contextualised dialogue between the stakeholders, and the detection of needed capabilities to develop fair data cultures from Higher Education to society. In this context, fair means digital ecosystems where designers acknowledge the standpoint of participants, who in turn take active part in defining, developing, testing, and controlling human-data interactions.

2 The Study

The present study explores data practices in teaching and learning as expressions of data cultures in two universities. The study is based on a survey that focuses on data practices concerning four relevant areas of practice: a) Data as an Educational Resource; b) Data Supporting Teaching and Learning; c) Students' Empowerment through Data; d) Promoting Students' Data Literacy. These four areas are built on four scales containing 17 items altogether. The items are based on statements referring to key data practices for several data literacy frameworks and can be considered as a preparation to deal with data in society. Most importantly, some relevant statements refer to critical engagement and interaction with smart learning ecosystems.

The survey was distributed to all the university teaching staff of both universities: nearly 8000 emails were sent, 795 responses were collected, and 601 were finally processed as complete records for the study. Data collected was analysed through descriptive and inferential statistics comparing multivariate sample means (MANOVA) between the two cases.

All the scales produced significant results at the .01 cut-off level, displaying the different data cultures. The items contributing to such a result are explored in relation to the teachers' and students' data literacy present capabilities and learning needs. Furthermore, each of the universities revealed well distinct institutional profiles, which would support the hypothesis that data practices are entangled into the institutional culture or "data cultures".

To conclude, the potential strategies at the institutional level, particularly regarding faculty development, are discussed and contextualised within an integrated system, which can be deemed not only technologically advanced but also effective and ethically sustainable in the usage of data.

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Exploiting Student Participation for Early Prediction of Course Quality in Universities

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1 Motivation

The role of *quality assurance and continuous improvement* is essential in supporting higher education systems in responding to emerging needs and challenges, while ensuring student qualifications and experience remain at the forefront of institutional missions [1, 2]. Each university therefore includes periodic evaluation processes aimed to improve the education quality. These processes are often part of a formal quality assurance model planned through internal procedures and often subject to an external verification from third-party agencies.

So far, quality assurance processes for universities tend to survey students' opinions on the delivered courses via questionnaires at the end of the semester. Subsequently, didactic managers collect and analyze the provided answers and discuss the results with individual instructors and the board of instructors. Since this formal evaluation process is performed once the semester is finished, (the board of) instructors receive feedback some months after the courses ended. Unfortunately, this time gap allows to intervene just before starting the next course iteration. To address these limitations, recent processes have injected machine learning into course quality evaluation, but focused on a narrow set of courses and relied on fine-grained student logs not available for all courses [3–5].

2 Methodology

In this extended abstract, we investigate whether the way students participate in course lectures is predictive of the quality of that course, according to the indicators originally evaluated by the university through standardized questionnaires. Compared to detailed student behavior logs (e.g., video watching events and quiz solving events), student attendance logs are a transparent, ubiquitous, and general evidence. As our method, we implemented a supervised classification pipeline. We first collected student participation logs and extracted relevant features. We finally trained classifiers on each quality indicator separately.

Data Collection. Our study considers over 500 thousand student participation logs coming from a public university with more than 25,000 students, 6 faculties, 89 degree programs, and 1,230 courses. Each lecture of a course has been delivered synchronously in a virtual room. Students enrolled in a course could login to the virtual room and enter the one associated to the lecture to attend. For each lecture, the date and time of entry and exit of students from the virtual room have been traced, from March to June 2020. A log record included the course id, the lecture id, the student id, the entry timestamp, and the exit timestamp.

We also collected the quality indicators of all courses of that semester, resulting from the students' answers to the university questionnaire. For each individual course, ten quality indicators about the content (*study workload*, *course material*, *novelty*, *syllabus coherence*), instructor (*punctuality*, *motivation*, *clarity*, *availability*, *tutoring*) and *overall satisfaction* were considered. Each indicator ranged between AA (very positive) and F (extremely bad).

Feature Extraction. For each course, we extracted a range of features. Course-level features included course properties that might influence the quality perceived by the student (e.g., the time of the day the course lectures were delivered, the kurtosis and skewness of the distribution of the number of students attending the lectures so far). Lecture-level features model the student participation across lectures (e.g., the average time the students spent in that lecture, the average lecture proportion followed by the student, the number of students who attended that lecture). Student-level features are related to student characteristics that can influence their attendance (e.g., the number of courses the student is attending, whether the student tends to join late or leave early a lecture).

Classification. For each quality indicator, we trained a separate Random Forest (RF) classifier, passing the extracted features as an input and the corresponding quality indicator as a target. The evaluation process consisted in a nested stratified 10-fold cross validation. We monitored the balanced accuracy as a metric.

3 Results and Discussion

In a first analysis, we investigated whether the student participation features extracted from the full sequences of attendance records can be used to predict the aggregated quality indicators of a degree program. Our results showed that not all indicators could be predicted with a reasonably good accuracy. The obtained balanced accuracy ranged between 62% (for *motivation*) to 82% (for *study workload*). In general, participation features were predictive of the quality related to content indicators, such as *study workload*, *course material*, and *overall satisfaction*, but not to instructor indicators, such as *punctuality* and *motivation*.

In a second analysis, we analyzed whether the same student participation features are predictive of the aggregated quality indicators of a degree program early. Our results highlighted that, even after just six lectures, models' performance was close to that of models trained on the full sequence. Specifically, the obtained balanced accuracy of models trained with features until the forth and the sixth lecture was the lowest for *motivation* (54%; 60%) and the highest for *study workload* (75%; 82%). Based on the results, our pipeline could enable an early intervention to improve the quality of the provided university education.

Future work will embrace our findings to analyze predictiveness at course level and across faculties, study level, and teaching modalities. We also plan to embed predictions into dashboards for supporting the interested stakeholders.

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Predicting students' academic success: the role of students' social-relational skills and synchronous activities

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Focused and accurate information can help to build models to prevent school drop-out and improve the educational success of students [1]. Factors determining academic success can relate to aspects of teaching and the educational model as well as to students' characteristics. Study skills, motivation and self-efficacy can affect time management skills and educational success itself [2]. Luppi and Benini (2017) have shown on a sample of students of the nursing course that the socio-cultural factors of the students, detected through the "Learning Strategies Questionnaire QSA", are crucial to determine the working attitudes of the students and are essential to evaluate their learning experience. [3].

In the literature, there are several uses of multiple regression models [4] and logistic regression models [5] in order to predict the academic performance of students in a university course or the probability of drop out by observing their behavior in online learning environments. Indeed, it has already been shown that as the participation of students in online course platforms increases, exam grades tend to increase on average and the probability of dropping out tends to decrease on average.

The study of students' behavior is particularly favored in virtual contexts. In these, in fact, a whole series of data from platform tracking can be collected. Learning Management System (LMS) is the online platform that students access to follow the lessons, download the teaching material and to communicate with each other and with the teacher. It automatically collects a large amount of data. These data are called logfiles and they can be used to understand learning behaviors and to predict students' academic results [6].

The present study takes place within the Telematics University of Studies (IUL). Among the many open source platforms available, IUL has chosen to use Moodle. Because of its characteristics [7], Moodle is one of the most widely used e-learning platforms in the university sector, widely disseminated, offers excellent technical support, and offers users the possibility of customizing its offerings.

The university provides a learning environment designed to promote a networked approach to knowledge and to foster the construction of knowledge through collaboration and sharing between participants [8]. This model is inspired by the Communities of Inquiry, which identify three areas of action for virtual communities: social presence, cognitive presence and teaching presence [9]. A previous study by researchers [10], through the study of students' log files it has been shown that the academic performance of students improves as participation on the online platform increases, both in synchronous and asynchronous mode

The aim of this study is to understand which factors can predict the educational success of students within an online university setting. In order to make the most of IUL's social construction of knowledge model, the use of a standardized test was introduced to measure students' social-relational competences as characteristics capable of influencing educational success. The Turning Potentials into Capacities (TPC) [11] is a multidimensional questionnaire that explores dimensions such as agenticity, i.e. the tendency to play an active role in contexts; sociability, which includes aspects such as pro-sociality and friendliness, trust; personal organization, which concerns knowing how to manage oneself in order to achieve goals, thus in relation to commitment, coherence with roles in social contexts; and openness, i.e. propensity for change and innovation.

This study aims to predict TPC test results on students' personal characteristics through some demographic variables and two variables representing students’ participation on the Moodle online platform. The statistical units considered are the students of the first year of the academic year 2020/2021 in the teaching of 'General Psychology’ of the degree course in Human Resources Psychological Science and Technique. The sample is formed by (n=46) students out of the total (N=131) enrolled in the course, who, chosen through a simple random sample, have completed the TPC questionnaire. To make the above predictions, a multiple linear regression model was implemented. The five TPC questionnaire dimensions were considered as dependent variables (prosociality, assertiveness, accuracy, commitment and reliability); some demographic information such as gender, age and geographical origin and the two variables of participation on the platform: the number of synchronous activities and the number of asynchronous activities carried out on the Moodle platform were considered as independent variables. For synchronous activities it is intended to participate in live lessons with the teacher. Information on the number of activities carried out by students on Moodle is obtained through the collection of the log files of the course.

The final dataset was obtained by aggregating three datasets. The first is the one provided by the analysis of the TPC questionnaires implemented in Moodle. The second is the one containing the demographic information of the students, obtained from GOMP, a portal that contains all the students’ information necessary for the enrollment in the IUL University. The third is the dataset that contains log files that count the synchronous and asynchronous activities carried out by students on the Moodle platform. It is obtained via the Moodle "Log" form.

From the most relevant results of the analysis, it emerged that among all the dimensions of the TPC there is a positive correlation, especially between assertiveness and commitment with a Pearson correlation coefficient $\rho = 0{,}61$ and between reliability and commitment with a Pearson correlation coefficient $\rho = 0{,}58$.

The regression model showed statistically significant dependence between all TPC dimensions and the number of synchronous activities carried out on Moodle. The relation between the five dimensions of the TPC and the number of synchronous activities is positive; this means that on average as the number of synchronous activities carried out increases, the score in the various dimensions also increases. With regard to assertiveness, two other statistically significant dependencies were found; the one with gender and the one with age. With regard to gender, it was found that for males the assertiveness score is on average higher than for females; as far as age is concerned, a positive dependence has been found, so as the age increases, on average, the assertiveness score also increases.

The university can be the context in which you can experiment innovative teaching methods [12], especially in online contexts where the learning environment lends itself to be particularly flexible. This study aims to consider a more holistic model for predicting educational success that takes into account both personal and learning environment information.

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Special Track 1

Improving education via XR and AI

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Investigating Mixed Reality's Influence on Climate Change in an Undergraduate Science Education Course

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1 Rationale

Climate change is a nuanced global issue with a scope that is often difficult to fully appreciate. This study compared two undergraduate courses focused on climate change on the Outer Banks of the North Carolina, USA coast. The purpose of this course was to examine global climate change in a local context that allowed for a deeper understanding of inequitable impacts on humans and the environment. Investigating the challenges facing North Carolina barrier islands, the class took a 6-day field trip to the Outer Banks of North Carolina and visited five sites where they used augmented reality (AR) to learn about the impact on climate change at those respected locations. Four weeks later, the class immersed in virtual reality (VR) of the five sites using the same information provided in the AR. To this end, our research questions became: How does using both AR and VR influence climate change understanding?

1.1 Relevant Literature

Socioscientific Issues (SSI) is not a new paradigm. SSI scholarship describes a plethora of instructional interventions that develop reasoning skills requisite for resolving complex issues. These interventions differ to the degree in which they capitalize on students' feelings and connections towards the people and places impacted by a given issue (e.g., climate change on the North Carolina Outer Banks in this study). The effectiveness of place-based SSI experiences appears to hinge on the immersive nature of the experiences [1] [2].

Integrating a technological innovation to a place-based SSI scenario has not yet been investigated. AR is relevant for this type of integration. AR is not a new topic but the recent advances in smartphone hardware and software make for a timely study on its efficacy toward SSI learning [3]. When comparing AR to VR, physiological responses showed that AR condition produced more individual excitement and activation than VR [4]. Krichenbauer et al. [5], showed faster task completion time in AR over VR. However, using a 3D input device, a purely VR environment increased task completion time by 22.5 percent on average compared to AR.

2 Methodology

2.1 Setting

The setting of the study was done with an honors science education course that focused on climate change and its local impact to the North Carolina coastline. Eight students participated in the study that first used a mobile AR app (*ActionBound*) with embedded events (images, videos, etc.) to teach about specific climate change impact on five distinct locations. A month later those same students immersed in a VR app (*VRProTour*) to review their location-based experience. The VR scenarios were created using 360-degree images with the same events embedded at the same five locations.

2.2 Data Collection & Analysis

Seven online questions were presented to the students immediately following the AR experience and five more questions were presented to those students after the VR experience. We conducted a constant comparative and inductive analysis [6] using keywords in context [7] on the responses. Inter-rate reliability was done and resulted in 100 percent agreement.

3 Results

Qualitative results suggest using AR and VR to learn about climate change enhanced the learning experiences. Themes unpacked from the responses suggest students liked the embedded videos, figures, diagrams, and accompanying text in both experiences. Statements such as, "Seeing it just helped me visualize things more instead of just talking or reading about it" and "The technology used allows for better understanding of the area because it shows a 360-degree view rather than just looking at one spot."

While most comments were positive, there were a few comments that spoke to the technology being a distraction. In the AR trial, one student stated the AR took from the real world because they were looking at the phone the whole time. A student in the VR trial indicated that although the embedded events were informative, you cannot get the same experience in VR as being at the location in person.

4 Discussion & Future Research

While the small sample in the study saw some flaws in using technology to learn about climate change, the responses was overwhelmingly positive. A place-based and technology enhanced SSI has real possibilities for future research. First, mixed reality (AR and VR) needs to be user friendly and ubiquitous. The apps used in this study did not have the features needed to completely immerse the students in the content as originally intended. That said, new applications released in recent months show promise for how we might find global cooperation in conductive similar studies.

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LOs within Moodle platform: IEEE-LOM and OAI-PMH integration

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1 Introduction

The current work was composed within ARETE project [1] aiming to support discoverability and reusability of Augmented Reality (AR) and the other types of learning content included in its Moodle digital repository [2]. AR technology has been presented as a valuable tool for enhancing student learning by many studies [3] [4]. ARETE project aims to support AR teaching and training applications by contributing to the development and evaluation of MirageXR platform: an authoring toolkit for creating XReality (XR) [5] learning content, compliant with the IEEE standard for Augmented Reality Learning Experience Model (ARLEM) [6] [7].

Although several initiatives in the past dealt with Learning Objects (LOs) and their reusability and interoperability failed because of the limited demand of the community due to the gap issue through the lack of a middleware application to facilitate the movement of the LOs' usability from the Learning Management Systems (LMSs). Therefore, MirageXR will be incorporated within ARETE's digital repository to establish the communication between the authoring tool and the Moodle server. Moreover, ARETE plans to address the limited demand from the community through the implementation of an open source marketplace for XR educational content.

Within this project, interoperability of XR objects is not referred to the exchange between LMSs, but the upload and shared content through MirageXR and ARETE's marketplace. Aiming at linking up content from various digital repositories in a way that a global search for learning resources becomes feasible, this paper presents the integration of IEEE-1484.12.1-2020 standard for Learning Object Metadata (IEEE-LOM) [8] and Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) [9] within ARETE's Moodle repository as harvesting solution for a federated network of ARLEM and other educational content repositories.

2 LOM and OAI-PMH Moodle integration plugins

LOM is a widely used data model for the description of LOs and similar digital resources [10]. The conceptual schema of the standard describes the structure of a metadata instance for a LO, while taking into account the diversity of cultural and lingual contexts in which the LOs and their metadata will be exploited [8]. As storage becomes cheaper, more and more resources are stored in repositories, making search for them more difficult. One way to facilitate object discovery is to create a union list (aggregations of metadata) thus allowing stakeholders to search locally. OAI-PMH protocol provides an application-independent interoperability framework based on metadata harvesting [9], thus allowing the creation of the said union list.

Considering that digital repositories can make their content more accessible through the availability of shared information, previous work on creating and exposing LO's metadata was enriched for the development of two plugins: the "LOM Moodle"; and the "OAI-PMH Moodle". The first one aims to facilitate the processes of creating LOM-based metadata for the description of the ARETE's LOs while the second one was developed to enhance the discoverability of resources by exposing and making public their metadata via the OAI-PMH framework. It is worth to be noted that both plugins have not yet been finalized and are based on previous work that targets on LOM metadata editing, generation and exposure via the OAI-PMH protocol. The two plugins are linked with each other in a way that "OAI-PMH Moodle" plugin requires the installation of "LOM Moodle" plugin.

Fig. 1. presents a draft architecture of the plugins installed in the ARETE's Moodle repository so far, concerning those that handle/create data and metadata for an AR activity and its exposure via OAI-PMH. "LOM Moodle" plugin aids on metadata editing and the automatic generation of LOM XML files, capable to describe AR experiences and other types of modules. LOM and OAI-PMH plugins give the opportunity to users (teachers or administrators), after initiating a course, an activity or a resource, to edit the respective metadata descriptor file and then to export it via the OAI-PMH protocol.

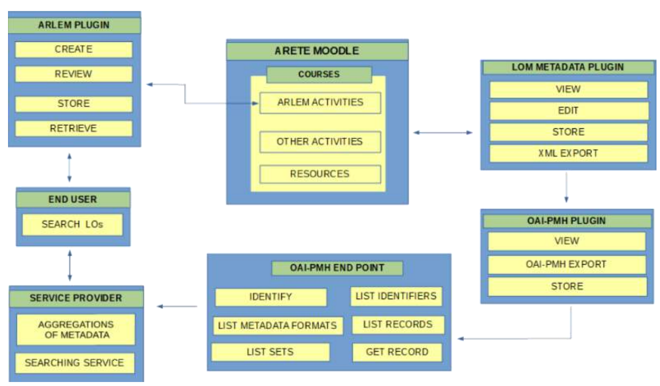

Fig. 1. Components of ARETE's Moodle repository

3 Conclusions and Future work

The integration of IEEE-LOM and OAI-PMH standards to ARETE Moodle repository is a feasible way to enhance the development of learning content by using relevant already existing resources that can be easily found and retrieved. However, the difficulty on finding service providers that could support harvesting of the resources' metadata and build search algorithms based on IEEE-LOM points to considering different approaches.

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Development of experiential learning, modelling and repetition processes in Virtual Reality applications. Theoretical analysis and didactic implications

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1 Modeling, repetition and experience in the learning process

Teaching and learning are extremely complex and interconnected processes that may be influenced by many cognitive factors, such as perception, memory, attention, focalization, language, and emotions. Cognitive neuroscience studies highlighted that it is extremely necessary to be aware of this implication, in order to support the learning process and to improve the teaching efficacy [1].

Due to the evolution of neuroscience, we know much about the structure, development and functioning of the human brain [2] and it is possible for all the actors in the educational field to understand the most important evidence about the brain, memory and learning process.

According to this idea and thanks to the progress in neuroscience and brain research in the last decades, a new interdisciplinary research field, neurodidactics [3; 4], was developed. Considering the different denominations present in the literature ('neuroeducation' proposed by Breuer, 'educational neuroscience' by Geake, 'brain-based education' by Caine, …) this perspective, despite some critical remarks [5], is useful for concentrating on practical suggestions aimed at the didactic process.

Although neurodidactics analyses many areas of the learning context, we believe the following is worth considering. Several studies confirm that the learning process is mainly supported by at least three scenarios, through which our brain works: modeling, repetition and experience [6].

The first scenario deals with the idea that students can learn how to behave by observing a professional working on an artefact or a teacher using a precise didactic method. Mainly this is the case of apprenticeships or modern school internships, and it is based on the identification of the mirror neurons and the comprehension of their functioning [7].

Repetition has a great impact on the memorisation process: when students consistently repeat a notion or a movement, the synaptic relations assigned to this work increase and the information that has to be learned moves from the short term memory to the long term one [8]. This idea is based on neuronal plasticity and supports lifelong learning theory in a neuroscientific perspective.

Finally, we know the essential contribution of the experience for the learning process. Kolb [9] defined experiential learning as the process in which knowledge is created through the transformation of the experience and it helps learners to develop new skills, attitudes or ways of thinking. Kolb based this idea on several models, including Dewey and Piaget that referred to “learning by doing” or “learning from experience”.

2 Immersive technology

According to the premises, several evidence could be considered to support teachers in improving their didactic efficacy, but it is only a partial point of view. On one hand the scientific studies provide several neurodidactic references suggesting practical advice; on the other hand, the research on new technology and the didactic devices add a further significant contribution. This is the case of the research on the application of Head-Mounted Display (HMD) technology and the Immersive Virtual Reality (I-VR) which is progressively spreading in our contemporary society, becoming more and more used.
The implementation of technology-aided education as a pedagogical method is not a recent phenomenon, and the studies about its efficacy have been carried out for almost half a century. As far back as the 1970s, Ellinger and Frankland [10] found that the use of early computers to teach economic principles produced comparative learning outcomes with traditional didactic methods (such as what is called chalk and talk).
Nowadays, despite the researchers focus on learning outcomes, intervention characteristics, design, and assessment measures associated with I-VR use has been sparse, the adoption of it (I-VR) as a pedagogical method is challenging and seems to be useful and effective. Jensen and Konradsen [11] confirmed that learners who used an immersive HMD were more engaged, spent more time on the learning tasks, and acquired better cognitive, psychomotor, and affective skills. Jang [12] confirmed the hypothesis that an immersive learning experience can promote self-confidence and make the task relevant to the user, driving engagement and motivation to learn. In addition, high fidelity graphics and immersive content using HMD have allowed students to explore complex subjects in a way that traditional teaching methods cannot [13].

3 Rationale and research questions

Neurodidacts and I-VR studies must be designed in a combined way, in order to increase the potential of the teaching and learning process, especially considering the contributions of the latest scientific research.
It is essential to complete an analysis in which to make a synthesis of the didactic concepts of modeling, repetition and experience with the potential of immersive reality in the context of higher education, trying to bring out the meaning of this proposal.
The analysis is proposed with the intent to improve the understanding of how I-VR can be used to facilitate the learning process by imitating a model, as well as the understanding of how virtual reality can be developed to support repetition or how to create an "authentic experience" referred to an immersive environment.
It is also essential to investigate what kind of decision-making [14] occurs in these learning situations
The analysis is still ongoing and will address both the feasibility of this topic and the weaknesses still inherent in VR technologies, in order to support the implementation of these scenarios and the design phase of an educational path.

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Augmented and Virtual Reality Experiences in Computer Science Education

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1 Introduction

In the field of learning innovation, there is a wide discussion on the use of Augmented Reality (AR) and Virtual Reality (VR) for creating immersive learning environments in educational settings. Some authors [1] [2] emphasize the advantages of using such technologies in education, for instance by explaining the opportunity of representing abstract concepts in a "tangible" way. Other researchers are less enthusiastic [3], emphasizing that, rather than focusing on the physical verisimilitude of a virtual scenario, it is more important to focus on the *cognitive realism* of an immersive learning scenario because learning environments and tasks create conditions for immersion, not technologies themselves. The authors believe that AR and VR must surely claim their space in school education: such technologies are interdisciplinaries and can be very motivating, from the point of view of both students and teachers.

This paper reports some educational experiences related to the process of creating, developing and testing AR and VR applications at the high school level. Such projects have been carried out in a three-year time frame during extracurricular activities in an Italian High School for technicians, called *"Girolamo Caruso"* and located at Alcamo, Sicily. The paper presentation has two main objectives: (a) sharing our experiences and reflecting on the possibility of integrating them into curricular teaching; (b) analyzing the perception that students have about AR and VR as a vehicle for increasing awareness of their own knowledge and the perceived relationship with their own education.

2 Experiences and Discussion

This section presents the most significant projects made by students and supervised by the authors. Such projects have been mainly realized by using the Unity (`www.unity3d.com`) platform and the Oculus Rift viewer.

Market exhibition. In the context of a market exhibition hold by local agro-food producers, we created an AR project that permits to see 3D reproductions of food by framing the product marker. The application also permits to access an interactive menu containing information on the product itself (e.g., historical notes, characteristics, ingredients).

Table 1. Opinions of students who have never used virtual reality technologies

Questions	Answers
Do you believe that working with VR technologies can be useful in improving your programming skills?	4.19
Do you think knowing how to use VR technologies can be useful for finding work in the future?	4.03
Would you like VR technologies to be introduced in your training curriculum?	4.19

Academic Museum of Technology. This project aimed at creating an interactive and immersive exhibition that can completely involve visitors, providing information in real time without the need for additional personnel and leaving the visitor free to deepen their knowledge on displayed objects by interacting with them. A physical and virtual location was created by showing vintage typewriters, electronic typewriters, first-generation cell phones and so on. A brief video is available at `https://www.youtube.com/watch?v=LDm9_QuW4Bc`.

Arduino Day. Using previous experiences as a starting point, a virtual scenario was created, allowing users to play a treasure hunt whose purpose was to recover doubloons and release them inside a chest. The game was enhanced with the possibility of interacting with an Arduino [4] board, in order to obtain a so-called "sensory virtual reality", being a virtual reality that can be modified when living the experience, by means of stimuli coming from real-world sensors. As a *proof-of-concept*, the VR project leveraged a brightness sensor that was used for reflecting the luminous changes of the real environment inside the virtual one, modifying the brightness of the virtual scenario in real-time during the experience. A brief video is available at the following link `https://www.youtube.com/watch?v=7ALZ9ConVK4`.

In order to analyze the perception that students have about their school education and in particular regarding the possibility of using AR and VR as a vehicle for increasing awareness of their knowledge, a questionnaire was proposed to involved students. Table 1 shows the answers given in Likert scale (1 = not at all, 5 = very much) by students who have never used technologies related to AR and VR (31 out of 64). Opinions provided by students are very clear regarding their desire to introduce/deepen VR technologies during their educational path.

3 Conclusion

This paper shares some of the most significant school experiences that have been carried out in relation to the production of AR/VR applications. These experiences have been mostly conducted as extracurricular activities. However, AR/VR and the newest technologies in general [5] excite students, by having a strong motivational impact on their training path. We therefore believe that one of the next challenge to be faced for computer science teaching (and not only) is that of being able to bring AR and VR into the frame of a curricular design.

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Teaching Science Concepts via Augmented Reality in the Fairy Tale Science Augmented (FAnTASIA) Project

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1 The Fairy Tale Science Augmented (FAnTASIA) Project and the educational package

The use of storytelling has long been covering a wide variety of subjects across different levels of education, from preschool and K12 to professional training [1]. While most of the research addressing this topic in K12, especially in primary education, has focused on the teaching of literacy skills and language acquisition [2], some attempts have been done to exploit the opportunities the use of storybook and tales has to offer for the teaching of STEM subjects [e.g., 3, 4]. Regardless of the specific content being delivered, storytelling methods are assumed to catch students' attention and involve both their cognitive and affective skills [1]. Educational literature has also collected evidence for effectiveness of the use of augmented reality (AR) technology in promoting greater academic achievement and engagement among students, compared with traditional and other digital media-related lessons [5, 6]. Primary education resulted to benefit most from the use of AR solutions and natural sciences, mathematics, and statistics were the most widely subjects taught using AR. Moreover, research has identified *in situ* interactive visualization as a common learning benefit coming from AR that seem to help students learn spatial relationships, such as astronomy configurations or spatial configuration of human organs [7].

Based on research findings, the main aim of the Fairy Tale Science Augmented (FAnTASIA) project [8] was to design a multi-lingual (i.e., English, Italian, and Greek) educational package that would integrate storytelling and AR technology to support the teaching of science concepts and skills in children aged from 5 to 12 years. The package is intended to promote children acquisition of the concept of spherical earth, the concept of the sun, the day/night cycle and the explanation of floating and sinking of solid objects. The use of the FAnTASIA package also supports children in learning of proper application of the scientific method to evaluate their hypothesis about real-world phenomena.

Children can use the educational package in class or at home, with the support of an adult. The package includes a fairy tale, a mobile application powered by Augmented Reality content, and a user manual created to guide adults in effectively using all educational materials. The fairy tale tells the story of an illiterate young shepherd who, during his adventures, will find the answers to many questions concerning the physical world; in this regard, children's acquisition of scientific concepts and skills through storytelling and project-based learning. The augmented reality content, supported by the FAnTASIA mobile app, allow children to visualize an additional realistic environment to test and adjust their hypotheses about the studied phenomena. In this regard, three augmented reality scenarios have been developed to support children's learning of the proposed scientific concepts (i.e., shape of the earth, day/night cycle, and floating and sinking).

2 Evaluation of the FAnTASIA educational package

The assumption guiding the development of the FAnTASIA educational package is that combining storytelling, as a long-standing effective pedagogical method, with new technological solutions represented by AR content can positively impact learners' acquisition of scientific concepts and skills and their motivation towards science learning, regardless of educational settings. The present paper describes the research design implemented to evaluate the effectiveness of the FAnTASIA package in promoting children's knowledge and cognitive skills and their development of a positive attitude towards science learning. To this aim, a pre-test/post-test quasi-experimental research design was used [9]; a sample of about 200 fourth-grade school students were enrolled and divided into two groups which used the educational package with and without support of augmented reality content, respectively. Students' performance was measured with three different questionnaires in terms of: 1) acquisition of scientific knowledge, scientific reasoning skills, and 3) attitude towards science learning.

The present paper focuses on teachers' evaluation of their experience with the use of the FAnTASIA educational packages (with and without the support of AR technology, respectively). Before any activities related to the research began, participating teachers first underwent a training session on the use of the educational package and the theoretical framework behind its implementation. At the end of the intervention, they were asked to complete a final questionnaire consisting of a set of questions, rated on a Likert-type scale, assessing 1) their overall experiences with and 2) the perceived learning impact of the FAnTASIA educational packages (with and without the support of AR technology). A total of 13 questionnaires were completed by teachers (7 for the AR e 6 for the non-AR conditions); findings from teachers' perspective are presented and discussed. The teachers' feedback described in this paper may be relevant for the design of effective training interventions targeting students attending master degrees, pre-service teachers, and teachers in training for professional development programs.

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A framework for improving Higher Education experiences by Deep Learning and Immersive Technologies

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1 Introduction

The last decade was characterized by the advent of many innovations that have been exploited for helping people from several perspectives. In particular, Artificial Intelligence (AI), Virtual Reality (VR), and Augmented Reality (AR) have brought outstanding benefits in many different fields.
Education can take advantage of the digital transformation to improve the students' learning experience. Correct use of the new technologies can foster the acquisition of new knowledge and the development of skills and competencies. In the same way, teachers can use innovative tools to increment the efficiency of the teaching process.

The state of the art shows several contributions that have investigated the use of Artificial Intelligence, and immersive technologies in learning environments, underlying both positive and negative aspects of their usage [1]. In this paper, we focus our attention on a particular AI field known as Deep Learning (DL), and on AR and VR. Our goal is to propose a framework that aims at defining a common structure to integrate DL with immersive technologies, and thus make clear how such innovations can be mixed to exploit their potentialities.

2 Literature Review

The literature shows several examples of successful applications of VR and AR systems in higher education contexts [2][3][4]. In particular, these technologies can facilitate user engagement, motivation, and concentration through the use of interactive features [5]. According to [6], the use of AR in maintenance training can help to reduce the time and errors of conservation activities. In anatomy, Argo et al. [7] developed an AR system that allows medical students to analyze human organs through the usage of a mobile device that displays the information of a 3D printed organ by framing it via the camera. Moreover, in the education environment, the students' data contain much information representative of the student behavior that can be extracted through DL. The application of DL to students' data is not limited to information extraction but it concerns several research areas. For instance, it is possible to develop an Intelligent Tutor to support students during a learning activity [8][9], to create Virtual Assistants to guide the experience of the students by using natural language [10][11], to predict the students' performance via Graph Neural Networks to avoid dropout and facilitating intervention strategies [12], with the integration in Learning Analytics tools.

3 Framework

The framework here presented defines a structure that combines cutting edge Artificial Intelligence techniques and immersive technologies. The framework provides a view of 3 different dimensions for an effective immersive smart learning experience. The first dimension regards the smart learning environment, that is the selection as well as the creation of DL-based systems to support the student. The framework helps to identify the benefits that the student achieves from the usage of specific intelligent systems, and at the same time correlated problems. Some of them concern the methodology to gather data, implementing natural language human-computer interfaces, automatic skill detection, question answering, and intelligent tutoring [13][14]. The second dimension regards the visualization of the learning experience via immersive technologies. Aspects such as motion sickness, the duration of the experience, the choice of the 3D contents, the evaluation of the trade-off associated with AR/VR devices, and the effects of the VR/AR on the student, especially if he/she has special needs (e.g. autism syndrome, Specific Learning Disorders), should be identified and tackled. Finally, the third dimension is related to the interaction between DL systems and immersive technologies. Data that come from the student experience should be integrated into the smart systems to allow real-time feedback to the student, and thus improve his/her skills, as well as technical details should be taken into account to implement an enhanced experience.

4 Use cases

The framework is suitable to be applied in several educational contexts. The potentialities of AR/VR allow achieving advanced training experiences especially when the training could not be made physically because of the critical level of the process (e.g. surgical operations). We deeply describe a design of a use case according to the guidelines suggested by the framework in order to implement a learning experiences that focus on AI and AR/VR environment.

Acknowledgements Daniele Schicchi acknowledges funding from the European Union PON project Ricerca e Innovazione 2014-2020, DM 1062/2021.

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An innovative example of using Augmented Reality into behavioral lessons

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1 Introduction

Augmented Reality (AR) [1] is rapidly emerging as an increasingly useful technology in educational contexts, since it provides techniques and tools that facilitate students' engagement and facilitate the learning of new concepts. In the literature, recent studies ([2],[3],[4]) show that AR is suitable for enhancing student motivation through an attractive and functional learning environment and, in addition, it is able to make learning a more engaging activity. When AR is applied in the context of behavioral education, which is concerned with the study of how the environment influences changes in students' behavior, the expected behaviors to be performed in specific scenarios can be shown directly in a real context. In the ARETE[5] (Augmented Reality Interactive Educational System) H2020 project, consortium members designed and implemented an ecosystem aimed at supporting teachers with the construction of a collaborative learning environment through the use of AR in order to improve educational experiences. In particular, one of the designed pilots aims to introduce AR for the first time [5] into the behavioral lessons of schools by leveraging the PBIS (Positive Behaviour Intervention and Support) methodology[6]. In these schools, in fact, positive behavior is taught to the students in the same way as any other subject. According to PBIS, the combination of the designing, teaching, and reinforcing expected behavior phases constitutes a more effective way to guarantee that all students understand behavioral expectations. A positive environment is then created in which students are taught to be respectful, responsible, and safe.

2 The AR Ecosystem for PBIS lessons

The architecture proposed within the ARETE project, incorporates AR technology into the behavioral lesson learning process to support teaching, practice,

[5] https://www.areteproject.eu/

and reinforcement phases of expected behaviors, thus creating an augmented environment called AR Behavioural Learning Space (AR-BLS) enriched with AR Behavioural Learning Resources (AR-BLR). Within this learning space, teachers create their own behavioral learning resources that will be stored in the ARETE Moodle repository[6] and can be reused through an application designed for students. Teachers are provided with the MirageXR authoring system[7] that allows them to create AR-BLRs contextualized in a real-world environment. This environment gives students a more realistic learning experience concerning their learning context (i.e. classroom, corridor, hallway...). A set of 3D characters, specifically designed for PBIS, are available within MirageXR. These characters have been designed by taking into account the needs highlighted by PBIS teachers during focus groups and interviews. Once these AR-BLRs have been created, they can be stored on the ARETE 3D digital repository as their creation follows the ARLEM standard[8] to support the reuse of the learning content. In fact, ARLEM provides the description of AR content in terms of the interaction between the physical world, the user and the created information, the context for learning assisted by AR, and other parameters of the environment. Students are provided with a system, the PBIS-AR application, that allows them to visualize AR-BLRs created by teachers through MirageXR directly in real-world school contexts by using AR technology. In this case, the AR technology does not use markers but is based, instead, on environment mapping through, for example, plane and feature point tracking. Using such a system, students are able to access reflective games to practice and reinforce expected behavior through the use of AR markers required to activate the augmented content. The various markers will be placed within the school, and the students, by framing the markers can access AR-based learning activities that will allow them to earn points and badges according to a reward system provided by PBIS. In addition, the application provides a multi-user, interactive and collaborative learning section to practice some of the expected behaviors. To monitoring and recording learners' interaction with the PBIS-AR application and particularly with AR-BLRs, the ExperienceAPI (xAPI) standard is used [7], by integrating a cloud-based learning record storage repository and PBIS analysis tools. This will provide objective feedback on the learning process. The combination of these technologies and systems creates an example of a technological and innovative ecosystem designed for creating behavioral lessons in AR.

Acknowledgment

The following paper has been supported by European Union's Horizon 2020 research and innovation programme, ARETE project under grant agreement No 856533.

[6] https://arete.ucd.ie
[7] https://dev.xr4all.eu/product/mirage-xr/
[8] ARLEM Augmented Reality Learning Experience Model standard https://standards.ieee.org/ieee/1589/6073/

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On cooperative learning and peer tutoring. A decision support system for students' group formation.

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1 Introduction

Managing classrooms and implementing effective teaching activities is a though task, especially in Higher Education where classrooms with hundreds of students are the norm. Although universities try to acquire ever more students every year, such populated classrooms become ever harder to manage for teachers and instructors. This is more true when group activities – and team-based learning [1] strategies – are (strongly) recommended for an effective learning.

We know, from the literature, that active learning such as cooperative learning and peer tutoring are teaching approaches with a long history of use that have made powerful comebacks to the academic arena [2]. Both are based on social psychological theories, and both are considered successful strategies for promoting student social skills and increasing student academic achievement [3–6]. Both cooperative learning and peer tutoring are believed to facilitate learning through the powerful influence of peers not only sharing answers but also engaging in the process of finding those answers [7–9]. Further, cooperative groupings offer social advantages as students learn and exercise collaborative skills such as expressing appreciation and encouragement, learning to disagree constructively, decision making, communicating, and managing conflicts [2].

The main issue rising in Higher Education is how to form 'adequate' groups, in large classrooms, for such team-based learning [1].

In the light of the above, in this paper, we propose the prototype of a *decision support system* for *students' group formation*. It employs a *hybrid* approach involving *Non-Negative Matrix Factorization* (NMF) [10] and *clustering algorithms* (see Section 2), and is based on the analysis of *students' answers to closed-ended questionnaires*. Its *outcomes* unfold on different levels: *(i)* highlighting students *hidden skills*; *(ii)* highlighting students with *similar skills* (useful for implementing *ad-hoc* teaching approaches and measuring the effectiveness of teaching); *(iii)* finding *weaker students* which needs specific teaching support (useful for peer tutoring); *(iv)* identifying and forming *groups of students* with a diverse set of skills (useful for team-based learning).

2 Materials and methods

The main source material for this research are the evaluation questionnaires for the admission to the faculty of Economics at University of Foggia, Italy. These questionnaires contain 40 questions for the assessment of students' initial knowledge and are answered by around 400 students every year. In particular, the questions measure three main student's traits: logic, mathematics, reading and understanding. To analyze them and develop our decision support system for students' group formation, we resorted to a hybrid approach that involves Nonnegative Matrix Factorization (NMF) [11] and clustering algorithms [12].
NMF represents a useful method to approximate data with lower rank matrices. It has been shown that, if it is applied to students' data, the method extracts latent factors that are ascribable to the students' hidden skills [10]. The system we are going to introduce, represent the students in terms of the student's skills, then, leveraging the student's representation, suggests a way of grouping students for team-based learning activities (e.g. forming students' groups with mixed skills). The grouping procedure involves the usage of a range of clustering algorithms, e.g., K-means [13]. In Table 1, we show the best configurations obtained by applying our hybrid method. It comprises the representation of students questionnaires responses through NMF method applied with different initialization methods, optimizers and with two hidden factors, and k-means algorithm with k varying from 2 to 15. The parameters shown result from a tuning phase with a *Grid Search* method. For space reasons, we only offer the configurations leading to the higher *silhouette* score.

#Hidden Fact.	**Initialization**	**Factorization alg.**	k **(#clusters)**	**silhouette**
2	Random	Frobenius	2	0.435
2	Random	Sparse NMF	2	0.462
2	Random	NMF divergence	2	0.433
2	Nonnegative SVD	NMF divergence	15	0.4198
2	Nonnegative SVD	Frobenius	15	0.4198

Table 1. Best configurations of our decision support system.

In conclusion, the system offers a support tool for the teacher that will be able to forming groups according to the teaching strategies and activities, e.g. grouping students with similar or heterogeneous skills.

Acknowledgements This research was financially supported by University of Foggia within the project "TILD (Teaching and Learning Development)". Daniele Schicchi and Emiliano del Gobbo acknowledge funding from the European Union PON project Ricerca e Innovazione 2014-2020, DM 1062/2021.

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Special Track 2

Educational Approaches and Innovative Applications to Counteract Social Media Threats

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At cybersecurity school with Nabbovaldo: evaluation of a serious game

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1 Introduction

A recent survey by EUKids online (Smahel et al., 2020), conducted on 25101 children aged 9-16, from 19 European countries, reveals that 11% of participants reported data abuse. These results tell us that most children are unaware of cybersecurity problems. In recent years, interventions to raise awareness and promote cyber security behaviors have become widespread, but much still needs to be done to spread this knowledge on a large scale (Coenraad et al., 2020). While many intervention and prevention programs for risky online behaviors such as cyberbullying and online sexual exploitation have been developed, few frameworks have focused on issues such as online fraud, hacking, and identity theft (Finkelhor et al., 2021). Video games (i.e. serious games), can represent an effective mode of building digital skills because are effective in improving learning through active involvement and by motivating and inspiring emotional connections to content (Connolly et al., 2012; Clark et al., 2016: Ranieri, 2015). For this reason, the Ludoteca del Registro. it, a body of the *Institute of Informatics and Telematics (IIT) - CNR of Pisa* that has been working for years to promote safe behavior on the Internet, has conceived and developed a serious game called *"Nabbovaldo and blackmail from cyberspace".* The videogame has as its protagonist Nabbovaldo, a boy who is passionate about the online world but naive and has little awareness of the possible risks, who moves within the city of Internetopoli, helping the inhabitants to solve small IT problems and learning new terminologies and concepts of IT security. The game provides a hybrid structure between a fixed path and an open world: you can move freely on the Map, talk to the characters and solve the mini-games in the order you prefer, even if the game's plot develops in four main "chapters", plus an epilogue.

2 Aims and Methods

The aim of this work is twofold: first of all, to evaluate the video game in terms of satisfaction and usability by the students of the lower secondary schools, moreover, to understand to what extent the video game is effective to improving cyber security knowledge. The evaluation of an online training course is the starting point for monitoring the progress of the students' knowledge, assessing the effectiveness of the training courses proposed, and highlighting the strengths and potential gaps that may emerge. 270 students (mean age=12.66, SD=.70) of four schools of Tuscany participated in the project promoted by the Ludoteca del Registro. it, which included two meetings for the presentation and explanation of the video game conducted by the Staff: one aimed at teachers, and one aimed at the participating classes. The teachers then had the opportunity to organize training sessions using the video game and the material available by the Staff, moving within the topics addressed in the video game: computer security, Internet of Thing, Dark Web, etc. To evaluate the videogame, self-report questionnaires were prepared and administered at the beginning and at the end of the project. The questionnaires investigated the use of the Internet and videogames by the children (both in terms of frequency and type), knowledge relating to IT security aspects (both general, cybersecurity specific and technical-practical), and surfing habits on the Net. In addition, questions relating to the liking of the video game were included.

3 Results and Conclusion

The results were analyzed by comparing the level of incoming knowledge (ex-ante) with that of outgoing knowledge (ex-post). Any differences related to gender, age, and the average number of hours that children spend using video games were also checked. The average level of specific cybersecurity knowledge (es. “I know what ransomware is”) is lower than general knowledge (es. “I know what cybersecurity is”), already in the ex-ante survey. After playing the videogame the average level both in terms of general knowledge and specific cybersecurity knowledge increase (Figure 1 - $F_{(1, 204)} = 109.327; p=<.001; \eta p^2=.35; F_{(1, 204)} = 112.625; p=<.001; \eta p^2=.35$). Moreover, the improvement is greater in students who claim to have actually played the video game. The knowledge that improves the most concerns many technical aspects of the Net, i.e.: "I know what spyware is", "I know what ransomware is", "I know what a denial of service attack is". As for satisfaction and usability, the video game was rated by the children as useful, with mechanism and game operation easy to understand, and original graphics. The video game was being interesting, as well as the themes addressed, with an engaging story and quite fun mini-games.

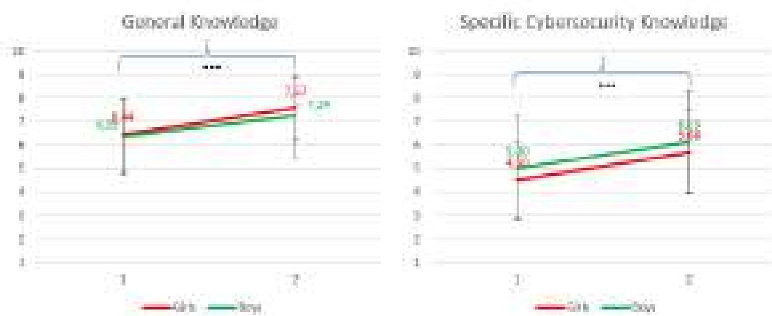

Fig. 1. Pre-post level of general knowledge and specific cybersecurity knowledge

This study represents a useful starting point for expanding knowledge on the subject. Video games represent an extremely important educational tool, to be exploited and integrated more and more within the training courses of our schools.

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Designing Educational Interventions to Increase Students' Social Media Awareness - Experience From the COURAGE Project

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1 Introduction

Social media, defined as "computer-mediated communication channels that allow users to engage in social interaction with broad and narrow audiences in real time or asynchronously" [1], are an integral part of our everyday lives offering new opportunities for communication and interaction way beyond what was possible only a few years ago. 98% of young people between 15 to 24 years use the Internet daily [2]. Most of them (96%) use social media, where they share experiences, opinions, and news on prominent platforms such as Facebook, Instagram, or Twitter. The ubiquity and usage intensity causes the situation that even children and adolescents are confronted with very heterogeneous, and sometimes harmful content. Algorithms, network, and content factors of social media may also represent threats for (young) users, ranging from digital addiction, discrimination, hate speech, misinformation, and polarization to manipulative influences of algorithms as well as body stereotyping or cyberbullying. Since users do not know how to protect themselves from harm transmitted through social media or how to help other users, educators are challenged to help students mitigate risks by developing critical skills. Teachers are being given an increasing responsibility in providing learning activities that stimulate reflection on the mechanisms behind the use of social media (e.g., toxic dynamics driven by other users or algorithms providing toxic content). However, educators are not adequately prepared to face these challenges, and, consequently, there is an increasing need to provide them with new methodologies and tools specifically designed for these purposes. Teachers as well as students would benefit from critical social media literacy since social media spaces are not neutral and students need strategies and tools to leverage the opportunities emerging in these spaces [3].

2 The COURAGE Project

In this perspective, the multinational and multidisciplinary team of the COURAGE project aims at providing educators with new tools and learning methodologies that can be adopted within higher education learning paths to train the educators in facing the social media threats and supporting their students accordingly. In particular, novel approaches leveraging most recent advances in the fields of artificial intelligence and in the educational domain paired with social and media psychological insights are proposed. One of the outcomes of the project COURAGE is a virtual learning companion (VLC) that can be applied by educators for empowering adolescents regarding the threats of social media by developing social media competences and self-protection skills. A particular emphasis was put on the role that experts and educators play in the management of the companion by driving and moderating the use of the companion in classroom-based educational activities as well as providing learning strategies, objectives and activities implemented in the companion [4][5][6]. Gamification strategies based on the concept of interactive counter-narrative Narrative Scripts, have been implemented to support learning scenarios in which students are immersed in social media stories that expose them to counter-narratives and conversations about counter-narratives, about biases, discrimination, or attitudes and behaviors in what (and how) is spread online [7]. These components drive content recommendations and educational interventions such as triggering specific validation tests that improve the accuracy of the system (e.g., user state estimation) as well as advancement in Narrative Scripts, which are gamified educational activities based on the concept of interactive counter-narrative. The efficiency of more advanced, multi-step and user specific, algorithmic interventions, e.g. content and connection recommendations, to counter network and algorithmic threats as well as support the achievement of educational targets and improve the collective well-being of the user community is currently supported by simulations based on collected data and validated user models [6]. Common AI algorithms of social media platforms do not directly counter threats for teenagers but may actually worsen them, because they rather aim at providing highly clicked content or advertisements in order to generate as much traffic as possible. In contrast, our companion is powered by an AI system that counters these threats and platform-specific algorithmic hazards. The companion AI system design comprises adaptive detectors of content and network threats, user models to support personalized interventions as well as content and educational activity recommendations. The current version of the COURAGE eco-system has been experimented in several studies with teachers and secondary school students. The aims of these studies were and still are: a) to investigate the effects of training activities about social media mechanisms (algorithms and social influence), b) to support understanding and dealing with different types of threats, c) to encourage a constructive use of social media, d) to assess procedures aimed at analyzing psychological characteristics of adolescents in correlation with social media use such as mental well-being, emotional intelligence, critical thinking, life satisfaction and resilience, and e) to implement scenarios of educational interventions through narrative scripts and minigames, educational content design. Overall, the technical environments and empirical studies demonstrate the feasibility and encouraging positive impact of the approach.

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A game-based educational experience to increase awareness about the threats of social media filter bubbles and echo chambers inspired by "wisdom of the crowd": preliminary results

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1 Introduction

Social media are a game changer in the communication arena in terms of quantity, quality and origin of information users are exposed to. Yet, it's not clear the outcome of multiple and continued interactions between users and information personalisation systems. These systems may skew the distribution of content and contacts presented to the users. If users are unaware of such mechanisms their perception of reality especially may be distorted [1–3].

Digital citizenship, intended as the proper and responsible use of digital technologies [4], and media literacy could enable users to critically approach social media and deal with its threats [5–9].

We propose that a preliminary training with respect to social media threats is needed for students and that merging educational activities with a guided, direct, and game-oriented experience of some social media threats [10–13] could be an effective method to raise students' awareness of the impact of complex phenomena, such as information personalisation, social influence, filter bubbles, and echo chambers [14, 15]. Our intuition is that through direct exposition of one of the most impacting echo-chamber and filter bubbles consequences, i.e. when biased sampling distorts users' unbiased opinions, and its explanation, the students will become more aware of these mechanisms and their effects.

2 Experiment description

The proposed experiment entails a game oriented social estimation task inspired by the "wisdom of the crowd" (WOC) [16] inside an educational activity aimed at rising awareness about social media influence and information personalization effects [16, 17]. The main components of the experiment are:

- **Questionnaires** participants answer multiple questionnaires before and after the experiment. They measure the impact of the WOC game through the change of participants' perception of social media influence using a 6-points Likert scale (2 items). The questionnaires also estimate if users believe that privacy is protected on social media, how much time they spend on it, and their 'Fear of missing out' [18].
- **Digital media literacy talk**: It covers the differences between traditional media and social media with their complexity and pervasivity, the impact of cognitive biases, and, finally, their interplay with information personalisation algorithms, highlighting the concepts of echo chambers and filter bubbles.
- **WOC educational game**: It reproduces an experience of social media-like influence by repeating the following steps: i. an image showing a number of red points are presented to participants who answer with an estimation of the number of points; ii. social information is introduced showing an aggregated metric of all the answers[16, 17]; iii. participants give then a second estimation. In half the trials the social input is biased and magnifies the participants error, similarly to the effect of an echo chamber. After both conditions, we show and explain the expected results: unbiased social information improves performance [16], biased information affects performance.
- **Baseline**: Where results are not shown or explained to single out the effects of the WOC game.

Baseline and full activities were performed with two different high school classes respectively of 32 and 19 students.

3 Results

In the baseline condition, students did not show increased perceived social media influence between initial and final survey responses. Instead, when the full experiment is performed, i.e. performance in biased and unbiased conditions are compared and explained, there was an increase in the perceived social media influence (see table below).

Perceived Social Media Influence (Number of Responders)				
Target	Self		Other	
Phase	Initial	Final	Initial	Final
Full	**2.89 (19)**	**3 (18)**	**3.74 (19)**	**3.89 (18)**
Baseline	3.08(32)	2.66 (32)	3.86 (32)	3.69 (32)

4 Limits and future work

Due to COVID restrictions the experiment were performed through remote connection, limiting engagement and number of trials. Predicted outcomes, consistent with the preliminary trials and established results [16], were used to deal with the noise affecting the WOC protocol with few participants [16].

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Enhancing Social Media Literacy Skills in Students: Empirically Investigating Virtual Learning Companions

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1 Introduction

In a digitally led society, where social media consumption is constantly increasing, users are confronted not only with positive, but also with toxic content and dynamics like cyberbullying, racism, hate speech, or fake news [1,2,3]. Oftentimes, users are not aware of the severity (e.g., racist or homophobic comments) or level of manipulation (e.g., ideal body image which can be linked to eating disorders, feeding disorders, vigorexia) of specific postings [4,5], or do not know how to protect themselves against cyberbullying, discrimination or hate speech. On occasions, victims of cyber aggression even become perpetrators themselves, as they do not find another way out. This is highly problematic as it can initiate a severe circle expanding the dissemination of toxic behavior and content. This emphasizes the need to design and develop social media literacy interventions to raise awareness of the dangers and threats that are hidden within. To this date, a variety of media literacy initiatives have taken place to promote digital literacy skills and raise awareness around social media use [6,7]. However, most current approaches are limited in enabling deep reflection as they provide detached learning situations, or tend to be centered on more traditional methods [7].

COURAGE [8] introduces a new perspective on social media literacy by proposing the integration of educational opportunities within a simulated social media platform (SMP) addressed to adolescents. To successfully achieve this, we propose the use of virtual learning companions (VLC) that can provide opportunities for users to learn (e.g., empathy training or information transfer) whilst they naturally explore social media. VLCs can support this notion as they transfer learning with the help of computer-simulated characters [9] through interactive chat interfaces. Incorporating this in an SMP has the potential to allow users to directly interact with social media scenarios and receive instant support instead of teaching them detached from hazardous situations.

Therefore, rather than using external censorship or restriction, we aim to strengthen learners' social media self-protection skills through practices targeting their critical and analytical as well as socio-emotional skills, such as empathy, self-awareness, social awareness, responsible decision-making, and the enhancement of emotional intelligence mediated by a VLC within a SMP.

2 VLC for Social Media Literacy

This contribution presents the empirical approaches that have been designed as part of the COURAGE project to investigate the use of a VLC to enhance learners' social media self-protection skills. In particular, six empirical studies with diverse methodologies have been designed and partially conducted in Spain, Italy, and Germany as international collaborations between interdisciplinary research groups. Each of these studies explored a distinct aspect of social media literacy and explored how a VLC can support it; (i) Fake News. This approach sees the implementation of a browser plugin to assist learners to find facts and credible content on social media faster. The aim of this work is to raise awareness of fake content and increase the learner's critical thinking skills, guided by a VLC [10]. (ii) With scientific literature [11] highlighting that adolescents with high levels of emotional intelligence are more likely to recognize fake news, a further study was designed to explore this aspect. Specifically, the research focused on the promotion of social media literacy through the enhancement of emotional intelligence levels in adolescents. (iii) Racist content. A similar approach sees the use of a VLC to inform users about racism in social media postings. This approach specifically aims to increase factual knowledge regarding everyday racism with the end goal to decrease the distribution of racist content. (iv) Social media self-protection skills. The use of narrative scripts [12] to empower the digital and self-protection skills of learners with computer-supported collaborative learning activities. In this approach, a virtual companion delivers learning materials and activities to learners through an educational platform and provides adaptive learning opportunities with the use of counter-narratives. (v) Cyberbullying. An extension of the narrative scripts to explore empathy training guided by a virtual companion with the aim of raising awareness of cyberbullying incidents. The empathy training will be conducted by presenting a self-created video on empathy (containing a definition of empathy along with a concrete example) as well as a conversation with the VLC, referring to a cyberbullying scenario presented via social media postings and triggering empathic reactions. (vi) Image Manipulation. The implementation of a VLC feature to enhance learners' critical thinking skills with the use of AI-generated image decorators. This work aims to first understand the learners' attitudes and trust in AI, determine the effectiveness of image decorators for raising awareness of image manipulation [13], and then propose the implementation of machine learning-based models to provide additional information (decorations) regarding manipulated images in an SMP.

With an immediate need for social media literacy initiatives to educate about social media dangers through innovative educational methods, the use of VLC could be proven an effective way to provide learning through interactive and implicit ways. This contribution presented five empirical studies that implemented VLCs in educational SMPs with the common goal of investigating the use of VLCs to promote social media literacies.

Acknowledgements

This work has been partially funded by the National Research Agency of the Spanish Ministry (PID2020-112584RB-C33/MICIN/AEI/10.13039/501100011033, MDM-2015-0502) and the Volkswagen Stiftung (Courage, ref. 95 566).

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The Courage Virtual Learning Companion: Learning Design and Technical Architecture

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Misinformation, toxic content, and cyber-bullying have become serious problems in current online media. It has been proposed to address these issues by filtering and blocking supposedly noxious information spread through these channels. In an ongoing project consortium, we develop an alternative approach that aims at empowering adolescents (from secondary school to higher education) to confidently interact and utilize information on the internet and especially in social media [1]. We take a multi-faceted and multi-disciplinary approach rooted in psychological and pedagogical theories combined with AI-driven techniques. Building on the tradition of Intelligent Tutoring Systems, we are developing a technical framework based on a "Virtual Learning Companion" (VLC) enabling educational and interaction support for raising awareness and resilience of the learners.

The companion implements playful adaptive educational strategies to engage and scaffold adolescents interacting with a social media environment under restrictions of pedagogical responsibility, e. g. via narrative scripts [2], such as the "Pyramid app" that implements a collaborative learning flow pattern combined with counter-narratives to raise learners' awareness through the externalization and sharing, empathy, and perspective-taking.

This paper illustrates how these goals are materialized in a web-based learning environment comprising a controlled social media platform and the VLC [3]. It is supported by an AI backbone using transformer-based models for robust classification of media content according to risks and considering related educational needs.

The basic version of the VLC environment provides an Instagram-like social media platform as a closed world with controlled content. We have chosen PixelFed as an open-source framework to simulate the social media environment. While PixelFed holds the content, the virtual learning companion (VLC) is implemented as a plugin for the Chrome browser. As depicted in Fig. 1, the learner can interact with both environments and get prompt feedback from VLC during the scripted chat dialogue. Learners are guided through tasks that require judgements and comments on the displayed information items typical of the image based social media format (images with short textual captions). A specific feature of the VLC is based on using "reverse image search" (RIS) engines, which retrieve the same or highly similar images published by different sources, to ask the learners to judge if a posted image and its caption are credible or fake information by comparing with corresponding content and keywords retrieved by RIS from different sources.

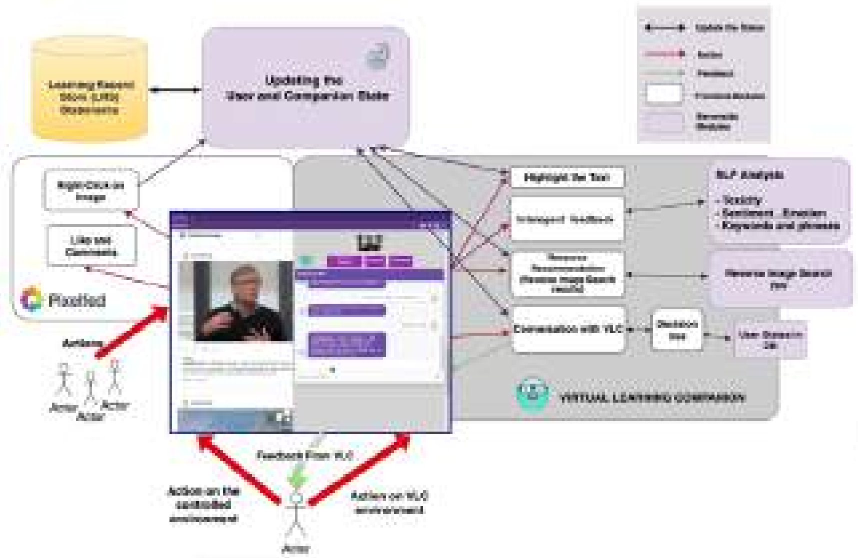

Fig. 1. Conceptual architecture of the Virtual Learning Companion system

To enable the analysis of learner activities, all user actions are captured in a learning record store (Learning Locker) based on the xAPI description format. This includes interactions with the VLC as well as certain actions in the PixelFed space (e.g., selecting images). This architecture allows for aggregating action logs from different sources. A dashboard allows for analyzing and visualizing the logged actions.

The current version of the VLC environment provides learner guidance through scripted interaction and contextual information prepared for the closed environment.

To create an "open" version of the VLC, which will enable interacting with real social media environments, we are currently adding intelligent components for detecting toxic content and for analyzing learner comments. To be of actual practical use it is paramount that any such classifiers perform well enough. To achieve this, we incorporate state-of-the-art approaches that we have developed as part of the project and which have been demonstrated to be robust and competitive across classification tasks (e.g., toxic comment and fake news detection) and languages (Italian, German, English), e.g., [4, 5]. We are also actively pursuing the possibility to use GCN based detectors which should allow us to flexibly integrate contextual information from different sources [6].

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Analyzing the intrinsic motivation in narrative scripts to enhance social media awareness

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1 Introduction

Motivation is described as an internal process that can help maintain goal-oriented behavior, making it an essential element in the learning process. The inclusion of motivational aspects in education is a stimulating factor to increase curiosity, reflection, and critical thinking [1][2]. Literature has addressed the study of motivation in learning from different perspectives and approaches [3][4]. Self-determination theory (SDT) is a motivation theory that provides a way to understand human motivation in people's learning [5]. Applying the SDT to educational activities has the potential to improve the experience of learners [6], by increasing the levels of satisfaction, attention, and interest.

The integration of such elements in motivational learning designs is not an easy task. Activities need to be engaging to get learners' attention and deliver all the important concepts. Researching the effectiveness of this implementation is therefore necessary.

The concept of narrative scripts (NS) [7] describes a novel approach in educational methodologies that aims to enhance social media awareness among youngsters within a simulated social media platform. The NSs consist of educational activities that combine mechanisms from computer-supported collaborative learning scripts and storytelling elements. The use of NSs has been described to provide students with motivating, engaging, and authentic scenarios to reflect on social media experiences. Their design takes into consideration several motivational facets; for instance, the storytelling element, the users' implication in the story, and the sense of collaboration to solve the prescripted problem. Likewise, NS immerses students in conversations with characters and exposes them to counter-narratives; allowing them to observe and analyze different/alternative scenarios (story development). By providing these elements NS supported a motivating pedagogical framework to teach about social media toxicity and inoculate both self-protection and self-regulation mechanisms.

This paper aims to analyze the motivational properties of the Narrative Scripts. Specifically, we will evaluate the students' intrinsic motivation components (Interest/Enjoyment, Perceived Competence, Perceived Choice, Pressure/Tension) inside the narrative scripts.

2 Methodology

This study utilizes data from a social media literacy workshop conducted in schools in Barcelona from early October 2021 to early May 2022. To test the motivation component of the narrative scripts we analyzed the data from 125 high school students. As part of the protocol, participants enrolled in the workshop (6 sessions) and learned about topics related to SM social phenomena such as the digital footprint, social media addiction, and manipulated images. The learning materials were presented to the students through different activities inside an educational social media platform. These activities included collaborative activities using the Pyramid, Jigsaw patterns, and missions assisted by a virtual companion (chatbot) [7]. To measure the motivation levels of the students, we applied the intrinsic motivation inventory (IMI) [8] at the end of the 5th session. A Likert scale questionnaire (1 = not at all true - 7 = very true) was designed to measure participants' interest/enjoyment, perceived competence, felt pressure and tension, and perceived choice while performing a given activity. As part of the data analysis, we conducted a descriptive statistical analysis. We computed the percentage, scores, and mean values for each of the measured variables. We also conducted a qualitative analysis of feedback responses. We coded the answers under eight contextual categories, added sub-coding, and analyzed results with the support of memos and network clusters in the software Atlas.ti.

3 Results

Results show that narrative scripts generate intrinsic motivation in the students, especially in the component of interest/enjoyment (4.4 over 7) and good scores in the components of perceived competence (4.06 over 7) and perceived choice (3.98 over 7) while at the same time present a low score in the component of pressure/tension (2.52 over 7) additionally we performed a qualitative analysis of the feedback provided by the students. Based on their comments, the participants reported having enjoyed the tasks assigned on the platform as a way of putting into practice what they had seen before or after the workshop sessions. For the most part, participants mentioned being satisfied with the format of the activities and would not change anything. The teaching instruction was well rated and qualified as "well developed" while the collaborative activity among classmates was of interest given the context of the subject matter. In general terms, the workshop was qualitatively valued by the participants as a comfortable space for sharing points of view, since it allowed the participants to freely express their opinions. Likewise, the participants felt motivated by the continuous evolution of the workshops; and they describe this evolution as the transition from "heavy and tedious" lectures to more dynamic and entertaining activities that generated greater interest and enjoyment. In summary, the participants describe the NS as a good educational tool. In terms of demotivating aspects, it was mentioned that the topic was not very novel. That there should be more freedom in responding to the virtual companion. Other participants felt that the activities should be more dynamic and less repetitive.

Acknowledgments

This work has been partially funded by the National Research Agency of the Spanish Ministry (PID2020-112584RB-C33/MICIN/AEI/10.13039/501100011033) and the Volkswagen Stiftung (Courage, ref. 95 566). D. Hernández-Leo acknowledges the support by ICREA under the ICREA Academia program.

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Special Track 3

Hybrid Learning and Accessibility in higher education

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Metaphors and representations of the experience lived in blended synchronous mode learning by students of a university course. A lesson learned for teaching act from a descriptive longitudinal study

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1 Introduction[1]

Both the documents produced by the main international organizations [1] [2] and the thematic scientific literature [3] [4] highlight the impact of distance learning and blended synchronous learning, introduced following the COVID-19 pandemic. Two years after the introduction of distance learning and blended synchronous learning, what seemed to be an exceptional initiative is turning into an educational opportunity for students and teachers provided that reflection on these impacts and results helps to inform some changes in the teaching-learning act as a “lesson learned”. The research question refers to which teaching-learning act claims can be provided in view of main results of a discourse analysis on students’ metaphors and representations on their biennial experience in distance learning and blended synchronous learning in a university course. We present the results of a descriptive longitudinal case study on metaphors and representations of the didactic experience lived in these two years by students of a university course. In line with the findings of similar studies, possible hints are given for improving learning-teaching relationship due to coexistence with distance and blended synchronous mode learning for the future as a challenging opportunity.

2 Background[1]

In the last two years, we have witnessed a vast production of both documents produced by international organizations and scientific literature on the topics "pandemic - distance learning - teaching learning relationship” [1] [2] [3] [4]. In this sense, some research works return, on a global scale, the fact that by virtue of the "way of doing school" experienced in the last two years, children expressed anxieties about their ability to partake in class activities producing large pockets of learning losses. In this regard, the data produced on an international level confirmed in the national trend, for the Italian case, highlighted: Learning losses and lack of motivation; Lack of participation; Feeling of tiredness, uncertainty, worry; Increase of explicit and implicit dispersion [5] [6] [7]. In any case, in the continuum of the teaching-learning relationship, from the point of view of the students, a problematic image has given back on the educational impacts of the COVID-19 pandemic. On the teachers' side, it is recorded: Most teachers teach in the same way as if they were in the classroom; Worsening of teaching quality; Prevalence of frontal video lesson. This synthetic outline from both international and national organizations and evidence-based research allows a reflection. Most of the weakness and difficulties occurred in the last two years were, in fact, already present in the educational systems and the pandemic has only intensified them by relegating the introduction of distance learning to a "missed opportunity". The abovementioned results agree on the need to rethink the teaching acting also improving research their reflexivity on classroom daily practices and on their representations about them [8].

3 Materials and methods[1]

This paper aims to answer the following research question: which teaching-learning act claims can be provided, as lessons learned, in view of main results of a discourse analysis on students' metaphors [9] [10] and representations on their biennial experience in distance and blended synchronous mode learning in a university course. The research design is based on a descriptive longitudinal case study that involved 26 university students attending the academic year 2020-2021 (T0) and 2021-2022 (T1) two courses of pedagogical disciplines in UNINT. The guiding question is: *With which metaphor would you represent your didactic experience in the university courses of this academic year? What motivation is behind the choice of your metaphor?* Self-report with its textual corpus analysis of representations and metaphor was analyzed through a qualitative methodology with exploratory research strategy and inductive analysis strategy [11]. In order to develop an inter-rater agreement for data reliability, all data has been analyzed by 2 blind coders as follows: Coder1: Analysis technique: "Thematic Coding", MAXQDA; Coder2: Analysis technique: "Content analysis" T-Lab [12].

4 Results[2]

Main results highlight how the students' metaphors and motivations have qualitatively changed with respect to the way they experienced distance learning.

5 Discussion and conclusion[3]

In line with similar studies, possible hints for improving learning-teaching relationship regard the coexistence with distance learning as a challenging opportunity [12].

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Online synchronous communication in a blended learning course: an analysis of Webinars

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1 Introduction

In this contribution, we intend to investigate synchronous online communication within a blended master's degree course activated since the academic year 2016/17. Specifically, we want to highlight how the functionalities of the online video conferencing systems (OVS) have been adopted in order to promote active learning.

We refer to a specific definition of blended learning, according to which the introduction of technologies in teaching allows a differentiation of supports to offer information and contents, teaching strategies, online and face-to-face moments which must be wisely harmonized [1].

To overcome the emergency and the mendacious dichotomy between distance learning and face-to-face teaching, in the following academic year, blended learning was extensively adopted as a functional way to support the teaching and learning processes. As Limone argues, the balance of hybridization between face-to-face and distance teaching is the fundamental issue [2].

As formerly highlighted [3], in an online and blended environment one of the key-factors is the design activity, especially in its architectural dimension [4] that refers to the planning of the teaching actions, the choice of methods, tools, student's activities and e-tivities [5].

The macro-design, generally made visible in the syllabus [6], allows the students to have a significant orientation on the activities to be performed and the opportunity of situating oneself with respect to the overall path.

The importance of designing the microstructure of the courses in higher education has been recognized as one of the crucial factors that impacts on student achievement [7]. Moreover, the micro-design of an online session, reified in the lesson plan [8], responds to the need to clarify learning goals, teaching phases, strategies, tools in order to consider the cognitive load and the fluctuations in attention due to the online situation.

2 Webinars in a blended learning course

The research context is the blended master's degree in *Business management and consulting* of the Faculty of Economics at the Catholic University of the Sacred Heart of

Milan, launched in the academic year 2016/17 to better support working students. There are some distinctive features characterizing the designed blended model [9]:

- 6 modules per semester, spread over 13 weeks;
- balance between classroom and online activities (50%-50%):
  - intensive classroom activities (biweekly), with lectures, case studies, testimonials, simulations, group works;
  - webinar sessions, in the evening hours, for insights and troubleshooting;
  - video lessons;
  - forums;
- individual and group assessment and frequent feedback, in the logic of assessment for learning and as learning [10];
- e-tutors and e-teachers, which support guidance in the course and the learning process [11].

In a blended learning course, a strategic element to punctuate the progress of learning is synchronous communication, made possible by increasingly efficient and user-friendly online video conferencing systems (OVS). Researchers have founded that students generally perceive synchronous interactions positively, because of instantaneous feedback and because they feel more engaged in the online experience [12].

The main objective of the research is to focus the online synchronous teaching practices and students' activation: as provided by the blended model, synchronous interactions have been made possible within webinars, "a nearly face-to-face environment that increases participants' social presence and facilitates multi-level interaction" [13].

3 Method

Between the 2016/17 and 2019/20 academic years, synchronous online sessions delivered by Blackboard Collaborate Ultra were monitored by e-teachers and e-tutors.

About 700 online synchronous sessions of 27 courses of the master's degree carried out in four academic years were analyzed in order to focus on the teaching practices. The analysis was conducted on the data collected through an observation grid that includes a brief description of the session, technical quality of the video and audio transmission, adopted functionalities of the online video conferencing system, teaching formats, interaction [14].

A descriptive analysis will be carried out on the different items, supported by the framework outlined by Lieser et alii. to promote the 4Es Learning Cycle (engagement, exploration, explanation, and extension) through webinars, highlighting which OVS functionalities can support the learning experience dimensions [15].

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Designing for Student-Centered Hybrid Learning Environments: A Framework for Programming Languages Course Design

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1 Introduction

Hybrid learning environments are a means of delivering instructional content in that online educational materials and opportunities for interaction were combined with traditional classroom methods. Hybrid learning environments give students the opportunity to work in an environment enriched with digital learning tools, and to support student-based learning approach. Student-based learning approach promotes engagement to make students active learners via various ways such as interactivity, feedback, etc. Researchers identified feedback as an activity for promoting effective online learning and more so creating the environment for teacher-student teaching and learning interaction [1]. Besides, some instructional strategies, like gamification and flipping the classroom, have an important role in supporting active learning. In well-designed gamified environments, students tend to dedicate more meaningful interactions with the learning process, as their efforts are promptly and effectively recognized [2]. Students, in flipped classrooms, are transformed from passive listeners into active learners [3].

In this study, we aim to propose a useful course design framework for undergraduate programming languages in hybrid learning environments.

2 Methods and Processes

We followed the Kemp Instructional Design Model [4] to design the course, as explained in the following. First, we defined the instructional problems. Second, we worked on the learning styles and needs of both students and teachers by utilizing questionnaires. The study used a questionnaire to elicit information from Bachelor level engineering students and from teachers. In all, 372 students sampled from 19 European countries participated in the data collection; whereas, 47 teachers from five European countries participated. Results from the questionnaire analysis showcased the major benefit of online programming language classes was the variety of learning materials, for both teachers and students. Whereas, the major challenge was providing not enough feedback. They preferred simulations, video tutorials, and external resources as the educational elements that support lessons. Furthermore, teachers also stated they would mostly like to employ gamification, flipped classroom, and project-based learning activities in their classes. We also analyzed the existing course plans from five European countries. According to the course plan analysis, we have identified the weekly topics, learning objectives, and the related pedagogical approaches.

Third, based on the data from the questionnaires and the course plan analysis, we made content analysis to determine the instructional objectives. Then, we sequenced the content, determined the instructional strategies, and designed the messages, by utilizing the content analysis. As a result of these steps, we developed a course plan template (see Fig. 1).

Fig. 1. The course plan template.

The template has features especially in terms of instructional strategy issues which are closely related to student-based learning approach such as feedback, gamification, and flipping the classroom. In this framework, conscious efforts are made to put the teacher as a facilitator and active student learning. This framework clusters the dimensions of the pedagogical competence of the teacher into three main dimensions:

- **Pre-Instructional Activities**: Topic and/or subtopics, specific objectives, the environment for the learning, and resources/material for the lesson.
- **Instructional Sessions**: The lesson delivery, specific teacher roles, formative assessment, motivation techniques, and lesson conclusion.
- **Post-Instructional Activities**: Summative assessment, remedial plan for students, and preparing students for the next lesson.

The other subsequent steps of the Kemp Model have not been completed yet. Therefore, the future works for us to deliver the course using this course template and evaluate it.

3 Results and Conclusion

As a result, we developed a course plan template and a course design. The course design was developed for undergraduate programming languages in hybrid learning environments. The template has features especially in terms of instructional strategy issues which are closely related to student-based learning approach such as feedback, gamification, and flipping the classroom. Based on the insights throughout the design and development process of the course plan template, we discussed implications in terms of hybrid learning environments and programming languages courses.

Acknowledgement: The study has been conducted with the support of the Erasmus+ Programme of the European Union, Project ID 2020-1-TR01-KA226-HE-098258.

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Accessibility in Blended Learning and Hybrid Solutions at Higher Education Level: A Word from the Students

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1 Introduction and literature background

Hybrid instructional solutions redefine the ways of teaching, educational time-space boundaries, the ways of relating to knowledge and the ways in which students and teachers interact [1];[2]. It does so by combining technology with face-to-face instruction in a fluid dynamic [3], integrating multiple instructional methods, tools and formats (e.g. blended learning) [1];[4]. The educational quality of hybrid solutions relies upon their capabilities to foster meaningful learning and support collaborative and learner-centred instruction [5];[7]. As a hybrid instructional format, blended learning refers to a variety of different approaches to course organization, ranging from adding online activities to a traditional face-to-face course to building a blended learning course from scratch [8]. Higher education has long embraced blended learning as it can well realize flexible and personalized curricula [6];[9];[10]; address student diversity by using differentiated instruction [11]; and improve students' engagement with learning materials [12]. However, teachers' and institutions' preparedness for delivering hybrid/blended instruction is crucial and it has not always passed the test for quality education in the past few years, especially when the Covid-19 pandemic forced the online transition [13];[15];[16]. Worrisome issues arose on a global scale: sub-optimal quality of the educational offer and inequality in access to education caused by infrastructural, personal, and contextual factors [14];[16]. In order to maximize the benefits of hybrid/blended learning solutions (HBLS), four main challenges must be addressed [17]: embedding flexibility and access, facilitating interaction, fostering autonomous/collaborative learning processes, and creating an affective learning environment [6]. This study focuses on the educational quality and accessibility provided by hybrid/blended learning solutions (HBLS) at the university level, as perceived by the primary protagonists of education: the students.

2 The present study

This study investigates a HBLS initiative in a master's degree course for teacher education, involving 680 student-teachers who participated to a total of 21 HBLS courses and 112 HBLS group-based workshops (10% of total academic hours was online – [18]), over the past 6 months (2021-2022). The research questions are: *How do higher education students perceive HBLS to foster accessibility in education? How do they perceive HBLS to foster quality in education?* An online survey was administered to the student-teachers, gathering 294 responses. The respondents were mostly female (95%), 26 years old on average and at their 2nd year at university (32%).

2.1 Methodology

The survey comprised four sections: demographics; ICT integration at university (13 Likert scale items); HBLS courses/lectures (12 Likert scale items and 2 open ended questions); HBLS workshops (11 Likert scale items and 2 open ended questions). The sections were tested for reliability and were found excellent (Chronbach's alpha >.91). Exploratory factor analysis was carried out on the questionnaire to observe possible underpinnings for perceived quality and accessibility of HBLS in higher education. Three factors were identified: *quality in HBLS workshops* (10 items, alpha = .95); *quality in HBLS courses/lectures* (11 items, alpha = .94); *accessibility of HBLS in Higher ed.* (14 items, alpha = .94). First, descriptive statistics were run on the three constructs for the whole population (Table 1). Then, a two-step cluster analysis was performed in SPSS to explore patterns of responses among the participants. Further details will be provided in the longer paper.

3 Findings

Overall, participants appreciated the *quality of HBLS in workshops*, with a mean of 3.70 on the 5-point Likert scale. The most appreciated aspect relates to the coherence between face-to-face and digital activities (item 33, mean 3.88, st.d. 1.03). Moreover, participants fairly valued the *quality of HBLS in lectures/courses*, with a mean of 3.49. The most appreciated aspect concerned the use of HBLS to foster collaboration (item 5, mean 3.73, st.d. 1.14). *Access to HBLS in higher ed.* scored quite high on the scale, with a mean at 3.83. The highest scoring item within this factor was number 14, on the flexibility of study time (mean 3.90, st.d. 1.18). A cluster analysis on the participants revealed three patterns of response across the sections of the questionnaire. A first pattern related to those who expressed an enthusiastic appreciation of the quality and accessibility of HBLS in HE, grouping 82 of the respondents. Another 125 demonstrated a good appreciation of HBLS in HE, while 77 were dismissive of the quality and accessibility experienced. Variables such as gender, age, year of attendance, or degree of participation in HBLS activities did not determine the cluster affiliation ($p< .05$). In contrast, the highest title held and being a student or a working student influenced cluster membership ($p<.05$).

4 Discussion and conclusions

This study investigated higher education students' perceptions of HBLS quality and accessibility. Overall, HBLS activities were appreciated in terms of both quality and accessibility (as in other studies, such as [15]). In a deeper analysis, three profiles of students were identified, who evaluated HBLS quality and accessibility differently based on their education and role as students or student workers rather than gender, age or participation. Universities can utilize these findings to gain insights into how to improve their educational offers to benefit and support diverse students [10]. Understanding the specific needs and evaluation criteria of their students, universities might set clear expectations for the courses, developing guidelines on how to support teachers and students through HBLS practices [15].

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Now it's your turn: training the engineer of the future

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In today's society, in which access to information is practically unlimited, a change in the student's attitude towards the classic master class can be observed [1]. This teaching-learning methodology is being increasingly rejected by students who consider it to be obsolete because it does not really connect to their current needs. This attitude is accentuated in the case of engineering students who favor practical over theoretical knowledge. Engineering students consider they can acquire information in a much more entertaining and dynamic way through the different resources that are available to them due to the Information and Communication Technologies (ICT): attending classes and listening to the teacher, therefore, is not necessary.

In this presentation, we address the problem of the reluctant attitude of engineering students towards humanities subjects, proposing a new teaching-learning methodology that we have called Now it's your turn, and that have been developed in the subjects of "Humanities: History of Biomedical Engineering" (Degree on Biomedical Engineering) and "Evolution and Future of Robotics" (Degree on Robotics) at the Rey Juan Carlos University. The goal of this methodology is twofold, on the one hand, to reduce the negative attitude of the engineering students to humanity subjects, showing them that there can be a synergic interaction between humanities and engineering. And, on the other, to show the students that humanities refer to something more than the mere acquisition of information regarding historical facts. There are a series of skills, such as critical thinking, that are necessary today and that need to be learned. The humanities subject is the ideal place to transmit this type of skills: given its contents, it is easier for the students to be able to intervene and participate in it while obtaining knowledge and developing skills such as creativity, group work capacity, dialogue, reasoning, communication…

Talking about critical thinking is a constant in different disciplines such as philosophy and psychology [2] and education [3,4]. This type of thinking is developed through a series of activities such as: analysis, synthesis, dialectical vision, inferences (inductive, deductive, or abductive), or development of value judgments, among others [3]. There are, precisely, all these activities that must be taught to the students. The key to all these activities is that they teach the student how to reflect and justify their ideas in an accurate and better way, allowing them to: (1) make decisions in his day-to-day life; (2) be a good citizen, adapted to the current society in which he lives; and (3) be a good scientist, able to listen, express their ideas correctly and justify their positions.

Regarding critical thinking, there are authors who consider that this is an innate ability that only a few people have. This consideration, however, is changing. Thus, it is currently recognized that, although developing critical thinking is a complex task that requires effort, persistence, and motivation [2, 5, 6], it is also a human disposition, which implies that everyone has this ability and that it can be taught and developed. This is precisely the position that is sustained in this presentation. To encourage the development of critical thinking and the acquisition of knowledge, we propose a methodology in which it is intended that the student knows the necessary and relevant information of his discipline, while turning it into knowledge through the continuous use and application of it in a critical and rational way. This methodology does not refer to a single activity or method that the teacher can use in the classroom, but to a set of activities that, although oriented towards specific goals, contribute to the promotion of the critical thought of the future engineer.

Thus, it is intended that the student knows, understands, and critically reflects on the different periods that mark the evolution of their discipline, while guiding and helping her to form a useful historical and conceptual framework applicable to the main problems, advances, debates... that occur in it. The proposal Now it's your turn is made up of a series of activities such as (1) the formation of team's work; (2) conducting discussion seminars; (3) collaboration with upper classmates; (4) the analysis of current news; (5) conducting guided visits to places of interest; and (6) the preparation of a research paper. Each activity has a specific dynamic and methodology. Yet, they are all related to each other, since they all prioritize the active role of students in the teaching-learning process, and therefore contribute to the holistic and comprehensive training of students.

In this presentation, we will develop each of the activities that are part of the proposal *Now it's your turn.* The aim is to illustrate how these activities have been applied to in the classroom, the way in which the students have carried them out and the advantages that engineering students have obtained given the skills and knowledge acquired through these activities. The structure of the presentation is as follows: first, we address the change that the introduction and development of ICT has generated in the teaching-learning process, clarifying that there is a distinction between the transmission of information and the obtaining of knowledge, something that is key to understand teaching as something more than the mere transmission of information. Next, we present the methodological proposal Now it's your turn, focusing on the different activities that comprise it and showing their relevance for the training of the engineer of the future. Finally, conclusions and a general discussion are presented.

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The inclusive design of a learning path with Integrated Digital Teaching in the Education Science Degree Course at the University of Genoa

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1 Introduction

Following the provisions on the methods of delivery of university courses issued at the Ministerial level to gradually restore a return in the presence of lectures, the University of Genoa, like many other universities, has established, up to the persistence of the state of emergency linked to the pandemic, the activation of Integrated digital teaching. The application of the integrated digital teaching has offered teachers the opportunity to experiment whit the potential of technologies by favoring, during the delivery of their course, the active participation of all students, the development of theirself-regulatory capacity, the use of diversified methodologies of active didactic and innovative forms with which to propose self-assessment courses to students from a training perspective.These aspects are fundamental in an inclusive perspective that focuses on the importance of structuring personalized learning paths aimed at self-regulation, in order to ensure easy access to knowledge content even for students with a special educational need (SEN). In fact, in inclusive training courses, personalization is fundamental because it allows each student to choose the path of acquiring knowledge starting from their own set of skills. The use of tools and technological applications amplifies the perception in students of a greater possibility of choosing the learning path to follow, a fundamental element for starting the self-regulation process [1] [2] understood asa metacognitive dimension in which the student independently manages his / her own learning path from a motivational and behavioral point of view [3] [4] [5]. Also, in this case, the use of technological devices and applications solicits the dimensions connected to self-regulation [6] [2] and offers students the possibility to control these dimensions by adapting their skills and abilities to the learning environment and to experiment success in performance [6] [2]. However, to increase the processes of personalization and self-regulation in learning, it is not enough to introduce technology or use a technological learning environment, but an effective didactic design is essential. The teacher must know how to combine the technology (tools, applications, and environments); the methodologies and strategies (cooperative learning, problem-based learning, flipped lessons); the critical reflection (sharing of points of view, comparison of ideas); the content and evaluation (feedback, self-evaluation) [7]. Furthermore, to ensure a quality training experience, it is essential to constantly issue adequate feedback from teachers and learning companions [8] [9] [7] which refers to the formative dimension of evaluation**.**

2 Methodology, Data Analysis, Tools and Results

Starting from these observations, the paper presents the results of an exploratory survey conducted with 135 students attending the courses of Special Education (92 students) and Inclusive Didactics (43 students) in the Degree Course in Educational Sciences of the University of Genoa in the academic year 2021-2022. The objective of the survey was to detect how the inclusive design of the learning paths of the two courses, through the application of digital teaching, has influenced (a) the personalization of the students' learning path and (b) it has increased the process of self-regulation and self-efficacy in student allowing for better reworking of learning content. Three types of integrated learning environments were used: (1) Environments in presence (ie the physical environment); (2) Interactive and synchronous environment (i.e. the Teams platform), connected with the presence environment thanks to the use of applications such as Wooclap for the management of formative assessment processes, the brainstorming and shared analysis (of videos, for example) and Kahoot in which the anonymity of the answers motivated the extended participation of the students [10] [7]; (3) Asynchronous interactive environment (i.e. the Moodle platform) a Learning Management System (LMS) necessary to insert the lesson modules, propose activities, request the resolution of authentic tasks even in asynchronous collaborative mode (for example through the use of wiki); manage formative evaluation paths (through the provision of feedback, for example through forums); connect to virtual message boards such as Padlet (for the collaborative construction of knowledge, the personalization of learning, the braistorming and online tutoring). Regarding the organization of the course contents, the partition of the course in modules and not by a single lesson [7] was chosen, to ensure greater personalization and self-regulation of learning. Each module has been implemented in the Moodle platform and organized internally with the indication of the expected objectives, the contents, and the activities to be carried out (in Moodle), the required prerequisites, necessary to support the understanding of what the student could expect from each module allowing him a correct attribution of any successes or failures he would have obtained [2] [3]. Each module has provided the same time frame and different materials within it, such as preliminary documents for the meeting with the teacher, "task sections" with diversified activities chosen by the student, links to videos, links to Padlet to structure personalized paths, wiki for collaborative writing, audio of the lessons downloaded from the Teams plat- form, interaction forum between classmates and teacher.

At the end of each module, two questionnaires were administered: (a) the Self-regulated Knowledge Scale (SRKS-U) [11] [12] in order to measure the frequency with which students have implemented different cognitive strategies in relation to different tasks and technological applications; (b) the perceived school self-efficacy scale [13] to analyze the students' beliefs about their ability to regulate their motivation to study according to the different requests.

The data analysis highlighted the positions expressed by the students (also students with SEN) in relation to the experience undertaken which demonstrate a positive opinion regarding the usability and accessibility of the organization of the courses presented.

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Perspectives on TLC development and technology enhanced teaching and learning at the University of Trento

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1 Introduction and theoretical framework

Teaching and learning centres (TLCs) are called to scaffold academics' professional development to enhance their teaching practices using innovative approaches, methodologies, and technologies. The contribution describes the development of University of Trento TLC (FormID – Centro di competenza per la FORmazione e l'Innovazione Didattica) and the role played by technologies, intended both as an aim in terms of enhancement of teachers' digital competences as well as a powerful means for academic development initiatives. The Centre FormID was born in 2018 and implemented a series of initiatives to help professors improving their teaching practices, before and during the pandemic. The paper presents the reflections developed by FormID Scientific Committee members and Coordinator regarding the Centre's directions of growth with specific reference to the role played by technologies for learning, to the problems and opportunities and, more importantly, to strategies to scaffold pedagogical skills referred to hybrid learning settings. In fact, digital technologies in our social-cultural context are modifying the knowledge building processes and the professional practices; therefore, a rethinking of university education is required [1]. One of the Centre's missions is to promote transformative reflection to innovate teaching practices and to understand how the teachers' role could influence the context and students' outcomes [2]. In connection with this aim, information and communication technologies cover an important role on the creation of teaching settings for active learning, but this highlights the need to go beyond linear-sequential teaching design logics and, instead, set up challenging learning environments that foster an integrated approach to knowledge and forms of collaboration among peers in the discovery of knowledge [3]. Literature demonstrated that in the use of (synchronous and asynchronous) technology in the classroom, tools are not directly connected to positive or negative results; to guarantee positive results, it is necessary for teachers to understand technology and integrate them in a consistent teaching and learning design [4]. Thanks to the rich pedagogical reflection in recent decades [5, 6, 4], it is possible to identify models and strategies to make the best use of the media in learning and teaching. Two years of pandemic raised awareness about the new opportunities to develop and support active learning through digital resources, but it is now necessary to make these lessons learnt more structured in a new integrated framework for technology-enhanced learning.

2 Methods

Employing collaborative ethnography [7], FormID Scientific Committee members engaged in a collaborative reflection about TLC perspectives, sharing objectives and priorities connected to the use of quality digital resources and strategies. Individual autobiographical narratives (chronological and critical events) were collected and then analysed through content analysis using the software Atlas.Ti 22. For each theme, results offer a picture of main elements mentioned by respondents. The coding was followed by a collective reflection on codes emerged in order to collegially interpret emerging themes, develop identity, strategies and perspectives.

3 Results

The initial results show strengths and weaknesses and the need to develop a full integration of current resources and structures. Coded emerged are interpreted using the "8P" model: purpose, practice, people, place, profile, politics, professional development and publications [8]. The purpose of FormID was identified in developing teaching excellence as well as individual and collegial professional development of academics to promote students' learning and success. Practices emerged and planned for the near future are: disciplinary and interdisciplinary communities of practices [9]; online resources for self-directed learning; support and help in implementing and monitoring technology-enhanced teaching innovation in class; scholarship and digital scholarship actions [10]; internationalisation of university teaching and learning; students' engagement in planning educational development and training actions for life skills development. People involved are FormID Scientific Committe members, but also representatives from each department that can connect the Centre with the needs of local units as well as pedagogical and technological experts/developers. The Centre operates in strong connection with the e-learning centre [11] to value all the technology-enhanced teaching and learning practices already in place within a common framework. As for place emerged the need of a physical one (with rooms for meetings, activities, seminars, workshops) as well as virtual environments such as Moodle and the TLC website which will be integrated with new resources aimed at sharing the Centre's activities but also scaffolding self—directed learning through videos, guidelines, glossary, articles. Regarding politics, all the narratives highlight the importance of having a permanent center for teaching and learning, not only based on casual projects but as a structure to enhance teaching and digital competences. As for the profile, staff development programs are in place both for new faculty and for all academics, with specific modules aimed at enhancing teachers' digital competences. However, the TLC is not only a training center, but also a research center, which aims to invests in educational research as well as scholarship on teaching and learning innovation in face-to-face, blended and hybrid contexts. The last two Ps, professional development and publications are really connected to the last point and to the aim to increase networking opportunities, scholarship and scientific outputs of the academic development activities.

4 Conclusions

The collective ethnography guided FormID Scientific Committee members towards a growing process: from awareness of the past to empowerment, motivation, perception as a group, to identification of the identity of our TLC, to finally new perspectives and trajectories to scaffold a culture of excellence in a new hybrid and digital world. The presenters will engage the audience in sharing and discussing together strategies identified, problems emerged and challenges for the future.

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Quality online learning: new perspectives of the Teaching and Learning Center

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1 Theoretical background

The last two years have been characterized by important and rapid changes in teaching models and strategies, given the repercussions of Covid-19 pandemic on international societies. The effects of the pandemic have visibly translated into an almost total paralysis of educational institutions all around the world, involving every level and every subject in the system. It is estimated that this phenomenon has affected more than 1.5 billion students worldwide [1], corresponding to 91% of the entire student population. In such a scenario, according to the research needs that have emerged, EDUCAUSE has developed a specific survey concerning the new challenges of higher education. EDUCAUSE is a global non-profit organization whose members include international higher education organizations, companies and K-12 institutions [2]. Last year, its research team drafted and presented the Horizon report, adding, as subheading, *Teaching and Learning Edition*. It includes quality online learning among its various topics, since one of the emerging challenges that higher education has to face is involving all stakeholders of academic institutions in the quality assurance processes. In order for us to assess the quality that effects and perspectives of the new teaching practices have, it is necessary to define the very idea that is conjoined with this paradigm. The term "quality" refers to a multidimensional concept involving different aspects. Within the academia, in particular, it can refer to the different, fundamental elements that define processes and outcomes. We refer to "quality" in different situations: teaching and learning activities, delivery and evaluation processes, etc.. The concept "quality" is a real process that is controlled and monitored taking into account specific standards and performance parameters. The purpose of quality assurance is to make it known, both internally and externally, that the academic organization, through its services and structures, takes care of every single member: students, teachers, technicians and administrative staff [3]. In order to be effective, this system must ensure that the educational environment is characterized by participation and transparency in teaching and learning processes. The quality perceived by users during online teaching is a critical factor in assessing the quality of distance learning. The same mechanism for supplying and assessing quality has, like the entire education body, undergone a series of sudden changes, taking on the consequences of the emergency period and the difficulties of a forced digitization of work.

2 Purpose of the study

The present study therefore develops an exploratory survey for the identification and comparison of good practices and development models of Teaching and Learning Centers (TLCs) [4], with particular reference to online learning environments and teachers' digital skills. It has been noted indeed that among the projects recently triggered with respect to quality online learning, many of these have concerned the setting up of TLCs online. Consequently, in the second part of the article, some reference models about TLCs will be presented, developing a critical description of them, highlighting strategies, tools and services involved.

3 Main Results

Essential assumptions were considered, collecting significant study experiences - see, for example, Coman [5] - in order to draw as clear a picture as possible of quality online learning. In general, the lack of digital skills with online teaching was found to have a negative impact on the overall qualitative perception of teaching experiences. Teachers' competences in the use of technology turns out to be fundamental for high quality teaching [6, 7]. These considerations appear useful in reconfiguring and redesigning the training of teachers of the future, considering the increasingly substantial weight that technology will hold in everyone's daily life.Some reflections are proposed on the role that TLCs can play in the future of training, based on previous experiences and sensitive data collected on the subject. The contribution aims to provide research ideas and possible study and improvement paths, for the benefit of the quality assurance systems, teachers, students and anyone else who participates in the cultural and administrative life of higher education institutions, with a particular focus on achieving the collective well-being of the learning community.

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Creating Interactive Courses for a Modular Information System

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1 Introduction

Today, online courses are a prevalent way to acquire new skills, knowledge, and information, and their popularity continues to grow. Compared to ordinary education, they have many advantages, such as price, comfort, interactivity, or proceed according to one's possibilities and pace. More and more mainstream schools also provide their curricula online to enable distance learning, mainly due to the situation in recent years, when full-time teaching has been severely limited, and schools have had to adapt to these conditions. In addition, online courses are a great way to provide students with more materials to deepen and practice their knowledge beyond the curriculum or beyond.
Today, many online services provide online courses, their creation, and sharing. It can also share its knowledge in various forms on several web applications, either with a particular group of students or random Internet users. Coursera is one of the world's most popular sites focused on online education. The most popular course categories here include information and data technology and business or personal development [1], [2]. Another well-known site for online learning is Udemy. The service is especially suitable for students who want to acquire specific practical skills but are not looking for a university degree. Udemy also issues various certificates, but unlike Courser, these certificates are not officially recognized by universities [3], [4]. The Moodle educational platform is a simple, integrated and adaptable solution for online education for administrators, teachers, and students, often used in Slovak universities. At present, it is the most used system of education management, the so-called LMS, which are generally teaching administration and administration applications that provide communication between students and tutors [5], [6], [7]. After examining possible platforms for publishing training courses, we agreed that none of the existing solutions for creating interactive courses from our university curricula is suitable for adapting to its system.

2 Solution design

In this paper, we present the design of a module for creating interactive courses as one of the micro-services of a modular information system. This module will be divided into administrative and user parts. In addition, it will serve as a place for students to gather study materials and enable teachers to create and publish online courses with these relevant materials easily. It should be focused mainly on the needs of informatics subjects, but our intention is also to make it universal to use in general for the entire faculty.

The module for creating interactive courses is designed as a part of a modular information system, which contains several functions, and therefore it is not a simple monolithic model. Monolithic architecture unifies all its components, business logic, and modules. It is easy to develop, debug, and deploy, but it is only suitable for non-demanding applications due to its firm consistency. Only a tiny change causes significant adjustments throughout the project, and one problem can cause the whole system to crash [8].

Therefore, such more complex module systems use a micro-service architecture, where each module or service can operate independently of the others as a stand-alone application. If a problem occurs in one of the services, it is elementary to find the problem, and the other parts of the system can continue to work without problems [8].

The separate modules will be grouped using a single interface, representing another independent module. Through this system interface, the user will be able to access the requested service (Fig. 1).

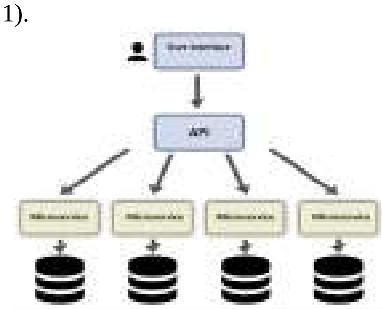

Fig. 1. Microservice architecture diagram

In this article, we propose and implement a module for creating interactive courses as part of a modular information system [9] that increases the entire system's reliability with the use of microservices [10], [11]. The work results in a module with defined functionalities for three types of end users: administrator, teacher, and student. A course assigned to a specific subject consists of lessons and chapters, and all parts of the system can be edited or deleted, published, or hidden from students. In the future, we can expand the module to include the creation of various educational activities, such as quizzes, assignments, or an online compiler.

Acknowledgement

This work was supported by the Ministry of Education, Science, Research, and Sport of the Slovak Republic under grant "Creation of methodological and learning materials for Biomedical Informatics – a new engineering program at the UNIZA" (reg.no. KEGA 009ŽU-4/2020) and the Slovak Research and Development Agency (APVV) under grant ‘‘Risk assessment of environmental disturbance using Earth observation data’’ (reg.no. SK-UA-21-0037).

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Special Track 4

E-learning for providing "augmented" mathematics education at University level

Organizers:
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Do 5W+H commute in Communication of Science?

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1 The commutative property

We have been taught two non-trivial things since primary school: the commutative property of addition in math and the **5W + H** rule in telling.

The commutative property of addition depends on the meaning we attribute to the noun "addition". Implicitly, we immediately focus our attention on numbers whose addition is commutative **5 + 3 = 8 = 3 + 5**. Yet, moving beyond the implicit reference to numbers, non-commutative relations become frequent. The classic example comes with the use of letters where their addition means arranging the letters one after the other. It immediately pops up that **o + n = on** is different from **n + o = no**. This beautiful example is often proposed to primary school students to emphasize the commutative property of the addition between numbers and that nothing must be implicitly assumed. The example is taken from the book written by Giorgio Parisi to popularize his studies that led him to the Nobel Prize in 2021 [1]. The commutative property is trivial also for the multiplication among numbers, but it is violated by the multiplication among matrices and operators in general. How rich is the non-commutativity of operators in quantum mechanics? The Heisenberg uncertainty principle itself depends on this failure. Here, starting from Pietro Greco's intuition of extending the Heisenberg uncertainty principle to the communication realm [2]. Let **r**=rigour and **c=**communicability one has $\Delta r \Delta c \geqslant k>0$. Hence popularization of science cannot reach the maximum of the rigor ($\Delta r = 0$) or the maximum of the communicability ($\Delta c = 0$) without losing the complementary quality. Greater communicability means less rigor and, conversely, greater rigor leads to loss of communicability. The **5W + H** narrative structure is very easy to explain and, nonetheless, very profound. Note that the 5W + H structure also contains the arithmetic operation of addition and, hence, attention should be paid to its commutative property. Every time we use this narrative structure, we should ask ourselves what it is best to start with. Should we begin with **What** or should **Where** come first? Or is **When**? **Who**? Perhaps **Why** or **How**? What comes next? Which one should play the role of the third in the row, and last, even if not the least. This narrative is used also to structure the programs of many teaching courses. In a history teaching course where and when are swapped the result changes from synchronicity to diachronicity. Similarly, the order is relevant in an starting Mathematics course if the set theory (what) is taught ahead of the algebraic inequality (how) or the opposite.

2 Science communication at the University of Bari

In 2020, after the outbreak of Covid-19 pandemic, the University of Bari "Aldo Moro" launched its first course **Science Communication** that now reached its third edition enrolling roughly 100 students. Following the analysis of the first [3] and the second [4] editions, we here present the analysis of the online course structure that has been adapted over the years, comparing the three editions against the order chosen in the **5W + H** structure. In Table 1, "**Why**" is the motivation that leads to communicate the scientific results and knowledge; "**What**" corresponds to the contents of the science communication; "**Who**" means to have in mind public and communicator, especially in public speaking contests; "**Where**" identifies the different communication channels, social media, blogs, newspapers, scientific journals; "**When**" refers to the different timing of the communication and also to the editorial plan; "**How**" considers the communication strategies (visual identity, brand protection, marketing) and also the technical skills of image creation and video making.

Table 1. Ordering of the program sections identified by the 5W and H in the three editions of the Science Communication course

2020	2021	2022
Why	**Why**	**Why**
Where	**When**	**How**
What	**Where**	**Where**
Who	**Who**	**When**
When	**How**	**Who**
How	**What**	**What**

Measurable qualitive parameters and subjective experiences will be used to assess the three science communication courses. Qualitive parameters include student satisfaction, teaching and studying payload, and acquired technical skills while the personal experiences account for the level of confidence among the participants, the empathy felt during the courses, and the involvement during class discussions.

3 Conclusions

The analysis will bring to yet another, possibly more effective, organization of the 5W + H for the program of future editions. Nevertheless, back to Pietro Greco's uncertainty principle, we are gaining awareness that the optimal balance between communicability and rigor is quite a thin red line.

The project Pandora - Polymath Agora and New Dimensional Observatory on Research in Aerospace - Università di Bari is acknowledged for financial support.

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ASYMPTOTE: A tool for teaching and learning mathematics online

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1 Extended Abstract

Due to Corona pandemic in March 2020, the need to develop new learning environments that also guide the learner remotely was evident [1, 2]. In this context, the Erasmus+ ASYMPTOTE project was developed. ASYMPTOTE is an acronym for *Adaptive Synchronous Mathematics Learning Paths for Online Teaching in Europe*. This project is carried out by seven institutions from five European countries (Germany, Greece, Italy, Portugal and Spain). The project aims to develop an adaptive, synchronous and mobile system for online mathematics education in Europe.

ASYMPTOTE therefore intends to provide a system for the teaching and learning of mathematics from lower secondary school to university, i.e. a system that is not limited to a specific topic, but provides learning tasks and learning graphs (LG) for a wide range of mathematical topics. A LG is defined as a directed graph, where each vertex represents a learning task, based on a learning trajectory as the intended and expected way of learning [3]. ASYMPTOTE's LG includes further tasks to deepen students' understanding of the mathematical topic (challenge tasks) or support tasks on a more basic level. Therefore, it is possible to define three general states of tasks that constitute a LG:

- Main tasks are compulsory tasks. Thus, a student who has solved all the main tasks has met and learnt the minimum requirements of the topic on which the LG was constructed. This implies that students should solve as many main tasks as possible.
- Supporting tasks are linked on the right side to the corresponding main task. They are related to the same topic but in a lower level and they are provided in order to help on the solution of the main task. This may be a simpler version of the task or the repetition of a topic needed to solve the main task. Several supporting tasks can be linked to the same main task.
- Challenge tasks are linked on the left side to the corresponding main task. They are designed to be more difficult, challenging students who finish faster or who are willing to go deeper into the topic. The challenge tasks are unlocked after solving the respective main task or previous challenge tasks, as several challenge tasks can be associated with one main task.

Through the combination of compulsory main tasks, optional challenge tasks and individually selected support tasks, the architecture of such a LG guarantees two fundamental concepts. Firstly, the main tasks aim to cover the most important concepts of the mathematical topic that, for example, were taught in the previous lesson at school. In this way, by solving as many main tasks as possible and using support tasks if necessary, students can practise the basic topic and achieve a deeper understanding of it. Secondly, the entire learning process is self-guided and autonomous according to Deci & Ryan's self-determination theory [4]. Therefore, each learner can choose a personal path through their LG, having the opportunity to work autonomously on tasks that meet their own level of performance.

ASYMPTOTE is a system consisting of two components, taking into account the teacher's and the student's side. On the one hand, students are provided with a smartphone application that can support them in completing the assigned mathematical tasks. On the other hand, teachers can create tasks and LGs through the system's web portal. In the web portal, teachers can share the tasks they create adding them to the already existing repository of tasks and more importantly, they can assign LGs to their students while monitoring their learning process through the digital classroom functions.

These possibilities allow teachers to provide individualized learning and support to their students. Within the Digital Classroom, teachers can monitor student's individual working progress, track student's engagement and directly contact students via chat. Simultaneously, the "Teamwork" mode involves setting up a group chat for synchronous and text-based interactions to support collaborative task processing, discussion, and reflection [3]. Meanwhile, the reward-based system applied, facilitates students' engagement, and puts the app in the gamification spectrum of education.

All said places the system into the general framework of Garrison's Community of Inquiry [5], designed for e-learning. This model envisages a number of collaborative interactions that contribute to generating a remote presence that fosters the development of such a community. The teacher plays the role of mediator and facilitator in the creation of such as community [5]. Indeed, teachers are called upon to create the organisational and didactical conditions for quality collaboration between learners to take place. Therefore, especially in an online learning environment where learners can be easily distracted, become passive or feel isolated and disconnected from their peers and the teacher, it is important to establish connections that are able to create and maintain an active, interactive, collaborative and engaging online learning environment.

A beta version of the ASYMPTOTE system was delivered in May 2022. Both the web portal and the app are free of charge and GDPR-compliant. The ASYMPTOTE app is compatible with both Android and iOS devices.

During this presentation, the potential of the new system and any results that will be collected in the meantime will be highlighted.

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The role of feedback in a formative assessment path for pre-service Mathematics teachers: the case of rational numbers

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1 Introduction

The workshop concerns a formative assessment activity that has been implemented in the Primary Education Sciences and Mathematics Degree Courses, specifically in Mathematics Education subjects for Mathematics pre-service teachers, of which the authors are lecturers of the courses. The workshop activities follow a structure divided into various phases in which the students worked in small groups: solving a problem concerning rational numbers, peer assessment of the course participants' solutions and sending an improvement feedback, subsequent modification of the solution proposal to the problem after the feedback received from peers and finally a feedback from the course teachers on the solutions' evolution. The role of technology is fundamental, as the workshop is online. It plays an important role in peer assessment, ensuring the random distribution of the tasks to be reviewed and the monitoring and sharing of feedback from teachers. One of the difficulties that the student, future mathematics' teacher, manifests in solving a problem is taking for granted and obvious the reasons behind the choices of problem-solving strategies.

The aim of the work is to analyze how the communicative aspect related to solving processes of a mathematics problem by students, improves through the assessment of problem's solution produced by peers.

2 Theoretical framework

The formative assessment processes allow students to verify their learning levels and plan and implement the necessary strategies to achieve the pre-established learning objectives [1]. This occurs through interactions with the teacher and classmates. These activities also support the professional training of teachers allowing collaboration between them [2]. In the Formative Assessment practices, the feedback referred to, concerns the information that each student provides on the activity produced by other students and receives on his own activity and, according to Ramaprasad [3], becomes formative only if it allows the student to evolve his own performance. Therefore, it is necessary that the feedback highlights errors, inaccuracies and possible deficiencies. Hattie and Timperley [4] identify four types of feedback: feedback on the task, feedback on the execution of the task, feedback for self-regulation, feedback on the individual as a person. The feedback must follow some specific criteria [5][6] defined by the teacher:

correctness, completeness and clarity. Technology also plays a major role [2], as it allows to support the formative assessment processes in its three main functions: sending and viewing; processing and analysis of the data collected during the lessons; provide an interactive environment, where students can interact to work individually or in groups on a task or to explore mathematical / scientific content.

In this paper we focus on two types of feedback: feedback on the execution of the task and feedback for self-regulation. The research questions we try to answer are: 1. How does providing and receiving feedback on problem solving help improve communication and problem-solving strategies? 2. How does feedback make the future teacher more aware of their knowledge?"

3 Research methodology: the workshop

The designed workshop was developed in the following four phases with the relative requests to the students:

Phase I: resolution of the arithmetic problem concerning rational numbers

Phase II: review of the solutions provided by peers, answering the following questions relating to the criteria of correctness, completeness and clarity [6]: Are there any mistakes in the result or in the resolution process? Are all the answers given? Is the theoretical reference, if any, correct? Are the mathematical symbols used correctly? Are there parts or leaps of reasoning missing? Or unwarranted conclusions? Can you find all the necessary steps in the reasoning? Is the reasoning expressed clearly and unambiguously? Are the sentences understandable?

Phase III: request to eventually modify their solutions based on the feedback made and received.

Phase IV: Feedback from the lecturers of the course on the evolution of solutions.

All the phases were carried out through a technological platform that allowed interactions among students in the working group, the immediate sending of feedback and the processing and analysis of the data collected during the lessons and of the protocols delivered by the students after the three phases.

4 Discussion and results

The review carried out by the students was revealed to be an adequate tool for the workshop. The feedback's analysis sent by each group of peer students and the analysis of the changes made after receiving the feedback highlighted that this type of activity has favored an improvement in communication and in problem solving strategies. It is interesting to observe how the revision had a double value: on the one hand receiving the feedback improve the solution of the problem, on the other hand the revision phase itself allowed to have a greater awareness of the mathematical concepts involved and to improve own proposal both from a communicative point of view and for the mathematical contents. This work has allowed future teachers to gain greater awareness of their mathematical knowledge and the importance of communication.

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Online asynchronous interactions on mathematics and mathematics teaching

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Borba and Llinares (2012) report “Interest in online distance education has grown exponentially in the mathematics education community and specifically in mathematics teacher education” (p.697). Indeed, the most recent developments in technology have offered new communication interfaces, such as learning management systems and e-learning platforms used both for hybrid training courses and for totally online courses, such as MOOCs. The potential of online environments, such as the use of e-learning platforms, is especially evident also in helping students counteract the mathematical difficulties they encounter in the transition from secondary school to university. In such a contest, the technology can play a key role in affecting the relationship between students and mathematics, although the literature in this direction is not very exhaustive.

Gueudet (2008), indeed, underlines the need for more research on the role of technology in the secondary-tertiary transition: “The question of the effective and possible uses of technology in the secondary–tertiary transition has not been researched yet (…) Could technology be helpful to foster novice students’ autonomy, for example by using appropriate online resources?” (p. 252). Also Llinares and Olivero (2008) underline that the use of new communication tools (forums, chats, …) plays a central role in the generation of communities of learning, which are formed by people who engage in a process of collective learning. These studies were taken up by Bardelle and Di Martino (2012) whose conducted a theoretical exploration of the potential of online environments in helping students to overcome the mathematical difficulties in the transition from secondary school to university.

With the aim of trying to further investigate how the use of online resources could improve university students’ learning, the authors of this abstract have designed online resources that provided for asynchronous interaction between students (Albano et al., 2020, Pierri, 2020). Students thus have the opportunity to check their learning levels, plan and implement, in interaction with the teacher and classmates, the strategies necessary to achieve the given learning objectives. Just as an example, we have submitted a simple mathematical task related to calculating the inverse of a matrix. The teacher, through the forum, shows two different resolutions of the exercise and asks students "what is the difference between the two ways of working?"

S1: […*To reduce to reduced steps in the first method we first normalized the pivots by making them 1, then canceled the elements above them. In the second method we first canceled the elements above the pivots and then normalized them. The result remains unchanged*…]

S2: […*With reference to the second resolution, there are calculation errors*…]

We can thus see how student S1 refers to appropriate theoretical recalls, S2's observation is purely computational.

One of the authors of this abstract (Taranto, 2020) has been involved since 2015 in the design, development, and conduction of both national and international MOOCs for mathematics teacher training. Two qualities emerged in this context. On the one hand, we have what Taranto et al. (2017) define as plasticity, that is, the desire to establish interactions transpires in the online community of the MOOC, even if it is neither simple nor immediate for these to take shape in a broad and articulated way. The sharing processes (of materials, thoughts, ideas, experiences) then take place using various technologies (from web 1.0 onwards) that coexist and complement each other and are used by the teachers in training. This aspect is interesting and little highlighted in the literature. It is something similar to the multimodal interactions that occur in the classroom thanks to the activation of different registers. Taranto et al. (2017) called this a technological multimodality.

In this paper, we are interested in investigating whether such qualities also emerge when students interact online using digital resources. Therefore, the research question guiding the study is the following: to what extent and how is it possible to delineate the presence of plasticity and technological multi-modality in asynchronous learning by university students?

In the seminar, we will explore online asynchronous interaction realized by using specific resources of a Moodle e-learning platform, such as Forum and the Workshop modules, highlighting if and how the two qualities have emerged.

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Empowerment of in-service teachers through the use of technology at different levels

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1 Introduction

The paper describes a project concerning the design and implementation of an educational path devoted to in-service lower secondary school teachers (ISTs). The aim of the project is to increase the teachers' technological skills as well as their awareness, by involving them in designing digital educational resources for their students.

The educational program, funded by the Regional School Office of Marche (Italy) and promoted by Università Politecnica delle Marche (Ancona, Italy), has been fully carried out in remote learning.

Recent studies in mathematics education have been focused on the teachers' engagement in digital resource design and the effectiveness of the designed instructional materials [1], [2]. This paper sets in that stream and should contribute to investigate the perceived effects of the design resource process for the teachers' professional development in terms of metacognitive practices [3]. In particular, the educational path aimed at improving the participants' *awareness in counsel* (i.e. the awareness needed to be a "real teacher" [4], p. 243) about the potentialities of the integration of technological tools in their teaching to foster students' learning.

In the laboratory part of the program, the ISTs worked in groups, according to the idea that the methodological aspects and the benefits of cooperative learning are better understood by direct experience and demonstration [5].

2 The project

The educational program involved 114 ISTs of lower secondary school and was carried out through the conference platform Zoom. The participants were exposed to:

- 4 sessions of two hours and half plenary lectures concerning the following themes: difficulties in Mathematics; the potential of the software GeoGebra and its community; Euclidean geometry of plane and space with GeoGebra;
- 4 two-hours laboratory sessions, during which they worked in breakout rooms to design and implement GeoGebra applets.

The educational path also envisaged 12 hours of groups' autonomous practice devoted to the elaboration of a final project work.

The plenary lectures aimed to show the opportunities offered by the software GeoGebra and its functionalities (drag and drop, check boxes, input fields, …) to support the students' overcoming of common difficulties and misconceptions in Mathematics. During the laboratory sessions, the ISTs remotely worked in groups of 4-5 people and were asked: to construct their first GeoGebra applet by following some accurate guiding instructions, so that they become familiar with the software; then to discuss the students' typical difficulties concerning a specific mathematical topic; and, finally, to design and implement digital resources aiming to foster the overcoming of these hardships. The ISTs jointly wrote a design sheet and, after the implementation of the applets, a sheet containing a metacognitive analysis about the resources they created, guided by stimulus questions. The tutors, among them there were all the authors of this paper, were available to support the ISTs during and between the sessions.

In the first laboratory meetings, the ISTs' activity has been scaffolded by worksheets guiding the participants to the implementation of GeoGebra applets focused on different mathematical topics and with different educational goals (visualization, exploration, remediation, self-assessment,...). In the subsequent meetings the scaffolding gradually faded [6, 7], so that the teachers were involved both in decision-making processes and in metacognitive reflections.

In this study, within the research framework concerning the different levels of awareness needed to be a "real teacher" [4], we address the following explicit research questions: (1) Does the designed educational path improve the participants' awareness in counsel? (2) What is the ISTs' perception of the educational path for their professional development?

3 Results

To give an answer to our research questions, we used a case study methodology [8] and collected different kinds of data: the design sheet written by the groups of ISTs; the GeoGebra applet created by the groups of ISTs as a final project work; the sheet containing the metacognitive analysis of that GeoGebra applet and its educational potentialities; the individual answers of the ISTs to a final questionnaire.

The three researchers separately carried out the analysis of the productions of each group. They compared the design and the metacognitive reflection with the produced applet, identified and coded the excerpts of the ISTs' individual answers to the questionnaire referred to the perceived impact of the educational path. Finally, the main emerging themes have been discussed to reach an agreement.

The analysis allowed us to highlight a change of perspective of most the ISTs. They shifted from an occasional use of simple GeoGebra files (mainly created by others) to show some basic geometrical properties to the potential plan to autonomously producing GeoGebra applets with different and more complex educational goals, including inducing *shifts of attention* [5] in the students. This suggested that the ISTs' awareness in counsel about the potentiality of a careful use of technology increased.
Moreover, most ISTs perceived an improvement of their professional development in terms of technological and didactical skills, mainly fostered by their engagement and communication within the cooperative activities carried out in remote learning.

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Pre-service primary teachers' professional development through an educational path in remote learning designed with an interdisciplinary perspective

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1 Introduction

Recently interdisciplinarity and teachers' professional development have been indicated as two of the major challenges for Mathematics Education [1]. Moreover, the need of deepening affordances and limitations of remote teacher education has been highlighted and more experimental studies on this approach should be carried out [2].

In this paper we present an experimental study carried out within an interdisciplinary perspective [3] and fully conducted in remote learning by three researchers in Mathematics Education and a researcher in Teacher Education. The research involved pre-service primary teachers (PTs) from two different Italian universities who were asked to collaboratively work online to solve an arithmetic-algebraic task.

The study pursues two intertwined goals: from an educational point of view, it aims at fostering PTs' professional development through a pedagogical device [4] involving a careful use of communication technology fostering the peer-discussion; from the research point of view, we are interested in investigating to what extent the use of a pedagogical concept like the Core Concept (CC) could support the achievement of a key mathematical goal, such as the generalization of the concept of relation [5].

The CCs are essential concepts recurring along a disciplinary curriculum and having an organizing value for the construction of knowledge; they mirror the structure of a discipline, encompassing epistemological and pedagogical aspects [6]. Some examples of CCs in Mathematics are "spaces and figures", "measurement", "number", "proof", "relations and functions" [7].

2 The project and the structure of the educational path

The project involved 330 PTs from the Italian universities of Macerata and Bari. The PTs of the university of Macerata attended the course of Teacher Education in their third year of study, while the PTs of the university of Bari attended the course of Mathematics Education, in their fourth year. Along the educational path, the PTs were parted in small groups of people of the same university and required to solve an arithmetic-algebraic task working online. Then, they were exposed to two one-hour lectures on the CC in general terms and on the CC in Mathematics and, after having worked together with a group of the other univesity, they have had the possibility to rework their first solution. In the next phase, the PTs were required to reflect metacognitively on the whole experience. Finally, the teachers of the courses taught an online lecture, in order to analyze the PTs' productions and give a joint feedback. The PTs provided their solutions and metacognitive reflections through three online open-ended questionnaires.

Each component of the pedagogical device [4] had a specific function within the educational path: 1) the arithmetic-algebraic task, designed according to the Radford's model on the level of generalizations [8], should have brought out a cognitive conflict and induced the generalization of the concept of relation; 2) the peer discussion, completely carried out at distance through different communication channels, should have fostered the comparison of different viewpoints and supported either the improvement of communication skills and the evolution of the collective solutions and metacognitive reflections; 3) the CC as underlying theoretical element, should have favored an easier access to the mathematical content by the PTs, supporting the overcoming of the cognitive conflict, and fostered the PTs' transition from the student-perspective to the teacher-perspective.

3 Results

To investigate the research goal, we collected and analyzed the answers to the open-ended online questionnaires, where the PTs shared their solutions to the arithmetic-algebraic tasks, their reworked solutions and their metacognitive reflections.

The PTs' solutions to the task have been analyzed according to Radford's model on levels of generalization [8]. Our analysis allowed us to highlight a significant transition of PTs from the lower level of generalization, namely the factual level, to higher ones, namely the contextual and symbolic levels [8], which testifies the evolution of their cognitive processes towards the generalization of the concept of relation. Moreover, the PTs' reflections highlighted that the CC played a crucial role in this evolution. The CC revealed its value as a structuring and structured element, in a mutual interplay with the mathematical goal. It gave structure to the educational path, promoting the PTs professional development and favouring their access to the mathematical content; conversely, it turned out to be structured by its instrumental use within the mathematical task, which favoured the PTs' understanding of the value of the CC for the design for learning. Further, the metacognitive reflections shared by the PTs allowed us to highlight the key role of the peer discussion, fully carried out at distance by different communication technology channels. Indeed, the PTs declared that the peer discussion fostered the comparison between different viewpoints (students from different universities, attending different courses), and their progressive assumption of the teacher-perspective.

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Exploring Affective Outcomes in a Structured Online Problem-solving Learning Experience at University Level

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1 Theoretical Background and research context

Problem solving has a central role in mathematics education as it provides experience of those key processes that are involved in exploring, conjecturing, proving, representing, monitoring [1], [2]. A problem-solving process develops at different synergistic levels each related to multifaceted competencies: metacognitive [3], cognitive, affective. In this context, inspired by a national research project [4], the key idea of personifying by cognitive roles the problem-solving process [5] represents the engine of an ongoing research on the construction of problem-solving undergraduate student's competencies, begun with an analysis of some metacognitive aspects that students experienced by playing the roles [6]. Each role corresponds to a cognitive function coming into play when a mathematician faces a problem: Boss, Promoter, Critical mind, Blogger. On this strand, we proceed the study with a magnifying lens on the affective level, based on beliefs, emotions, attitudes, values, motivations, and all other emotional aspects influencing student's decisions and actions, all dealing with affective competencies. According to Goldin's idea, affective competencies "*refer to the capabilities of an individual to make effective use of affect*" [7]. We focus on the analysis of student's perception of affective outcomes at the end of a problem-solving online experience.

2 Methodology

The experience, designed in four problem-solving activities, involved fifty Mathematics undergraduate students, attending a Topology course [8], working in three groups of 16-20, each divided into 4 subgroups engaged at different levels. One, the *Solver group*, devoted to collectively solve the problem, while the remaining three, the *Onlooker groups*, critically observing the first one. Each student also acted according to one of the cognitive roles, so she has been associated with a role-pair, varying along the activities. Groups had at their disposal a digital environment, consisting of various tools: a) TEAMS Microsoft platform to communicate online; b) a collaborative board MIRO [9], enabling to collectively brainstorm, by adding post-it, importing images, drawing and connecting ideas, exchanging comments by chat, according to [10]; c) two Word Google-doc, one personal and the other one shared with the subgroup, to report the reflections concerning the individual role played and the collective mathematical process and product, respectively. At the end of all the activities students were also required to answer a questionnaire related to the personal experiences they lived. In this paper we focus on a qualitative analysis of the first affective outcomes, looking at the students' answers in: - the personal Logbook: *Describe how you played your role and what your contribution was. Do you think that the interventions related to your role were useful to achieve the goal? Why? Would you have done something differently? Why?* - the questionnaire: *What sensations did you feel during the activities? Have they changed over time? How? Beyond the exam, what do you have left of this experience? Would you recommend a friend of yours to have a similar experience? Why? Tell us.*

3 Preliminary findings

To shed light on the affect impact of the problem-solving activities, we analyzed the Logbook and the questionnaires of 24 students. The experience's meta-affective potentialities came out. The activities helped students to overcome some affective obstacles.

As an example, concerning the passage from fear to satisfaction, and from stuck to *fluidity* the students St.1 and St.12 say, respectively:

St.1: Initially I admit that I found a bit of difficulty. Fortunately, however, I am not a person who gives up easily, so I rolled up my sleeves and tried my best to understand and apply all the concepts. In the end, I think I succeeded, and fear has given way to *satisfaction and a sense of fulfillment* for all the work done.

St.12: ..when I tried to solve the proposed problems I found it difficult and tended *to get stuck* in some phases of the resolution. During the activities this problem has improved a lot, I have learned to think about alternative solutions and to reflect thoroughly on the concepts studied without stopping on the surface.

The following excerpt seems to highlight the experience's meta-affective potentialities say. Student transforms positively the fear to make mistakes.

St.17: Before starting *I was very anxious* I didn't know what to expect. I didn't know any of the guys enrolled in the course, and the idea to have this kind of experience with strangers scared me a bit. During the first activity we were all very silent, we did not interact much, I think that in these circumstances there is always the *fear of making mistakes* and being "unable" and this slows down a bit. Afterwards all this has changed, we already knew what awaited us, we compared each other, we realized that *we necessarily had to make mistakes to get the solution,* and this also allowed us to create a more serene environment, making the work more *enjoyable and fun*.

4 Conclusions

Our preliminary analysis seems to confirm that the structured cooperative problem-solving online experience, according to Albano et al.' model [5], joined with Thinking Classroom model [10], fosters the development of processes oriented to achieve affective and meta-affective competencies [7], in addition to those already outlined in our research path [6]. We hypothesize that this practice could also allow students to implement self-strategies oriented to achieve well-being goals and fostering performance goals and learning goals, in their self-regulated learning [11] [12] [13] [14] [15] [16].

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Special Track 5

STEAM Education old and new challenges in distance teaching/learning approaches in Higher Education

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Accessible websites as tools for approaching STEM education: a still open challenge

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1 The role of scientific societies in higher education

Associations, councils, scientific national and international societies (hereinafter "scientific societies") are dedicated to the dissemination and advancement of studies within their relevant topics. Scientific societies play a fundamental role in the representation of the discipline, with the aim of promoting research, training, definition of professional standards and verification of the quality of services. They are elements of value for the whole of society because they are able to offer an intellectual contribution regardless by governments, research committees, universities, industry, and they are capable of identifying the objectives and means of maximum effectiveness and added value [1].

The main aim of this research is to investigate the possibility of access to these tools by people with disabilities, in particular with visual impairments, through the choice of a case study that highlights a wide spectrum of access problems.

2 Web accessibility as fundamental human right

The first contact between users and the scientific societies are their websites which also represent the showcase of their activities. From this point of view, web accessibility is a current issue and not to be underestimated. It is becoming increasingly easy to reach thanks to new technologies and the implementation of the UN Convention on the Rights of Persons with Disabilities (CRPD) which establish the access to information and communication technologies as a fundamental human right [2].

People with disabilities can greatly benefit from interacting with digital technologies and the Internet. For example, if up to thirty years ago a blind person who wanted to consult a book had to have recourse to a Braille printer or a cassette tape recording made by a voice donor, today the same person is faced with the potential possibility of finding it directly in digital format from an online library and read it immediately using the computer on his desk, equipped with the appropriate assistive technologies, speech synthesis or braille display. But this immense potential does not come about automatically. Software, websites, digital materials must be able to communicate with assistive technologies and adapt to the specific needs of people with disabilities.

The World Wide Web Consortium (W3C) defines the standards for the web. Since its inception, it has been involved with establishing technical standards and virtuous processes that can be referred to create content that results accessible even to people with disabilities. The Web Accessibility Initiative (WAI) of the W3C [3] is aimed at both Information and Communication Technology (ICT) operators and content producers. It provides indications and tools to open the web to an audience of potential users including people blind, partially sighted, with hearing, cognitive and motor disabilities. The W3C directives have constituted the fundamental technical reference for international [4] and national legislation [e.g. 5, 6] aimed at achieving the digital inclusion of people with disabilities.

3 The "Società Lichenologica Italiana" as case study

Although there is a social sensitivity, a technical possibility, and a political will, we have the impression that people with disabilities still find many obstacles to participating in STEM training and education initiatives even if they have also been developed online. In the last years, for example, the Italian Lichenological Society (Società Lichenologica Italiana, hereafter S.L.I.) has organized courses attended by dozens of people [7], but none of them with visual disabilities. We therefore thought as a first step to check the accessibility of the first contact tool with potential users, the website.

S.L.I. is a scientific association founded in Italy in 1987 and devoted to the dissemination and progress of lichenological studies [8]. The society organizes an annual congress, introductory and advanced courses, educational events, and field excursions. Members are also organized into voluntary working groups dedicated to specific interests. The choice of this specific scientific society lies in the fact that an extremely specialized discipline such as lichenology, in Italy in recent years has encountered an ever-increasing interest, both from institutions (especially for conservation purposes, i.e. in the application of the Habitats Directive) and from amateurs of any age. Despite this, its website is quite dated, so supposed to be representative of most of the access problems encountered in similar sites.

A technical analysis was carried out in order to verify the adherence of the S.L.I. web pages to the Web Content Accessibility Guidelines of the WAI project of the W3C [9]. A first report was automatically generated with the tool Multiguideline Accessibility and Usability Validation Environment (MAUVE) [10] which highlighted the critical issues. Afterwards, we deepened and refined the analysis by letting navigate the site by blind and visually impaired people who give us their feedback. From this process, a series of suggestions have emerged. Solutions and implementation strategies, to make the website accessible to blind or visually impaired people (such as visually impaired or color blind) will also be indicated and made available both to create the contents of the site (e.g. structure of documents, adaptability of contents to special needs) and to provide for its technical integration (e.g. adherence to standards, separation of content from presentation).

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Differences in the comprehension of the limit concept and desired "connected knowing" in calculus between prospective mathematics teachers and managerial mathematicians

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1 Introduction

Calculus (at least on the basic level) is intertwined through all STEM-oriented university studies. It is a critical milestone in various transition processes from secondary school to university mathematics. For many students it is "the necessary evil" to pass through, and many of them struggle in their courses. One reason of this struggling could be the huge difficulty of linking between the knowledge of mathematics learned at university and the knowledge acquired in secondary school. This gap between mathematical levels and institutional cultures can lead to several study problems of freshmen. As Pinkernell [1] summarizes, students meet different level of rigour in communication or reasoning, and institutional differences, e.g. concerning the didactic of teaching and learning mathematics. The other problem could be that situation at some study programmes is almost the same as one of the interviewees said in research made by Bosch et al [2], "…the exercises is a list that comes from father to son. It's the same list that has been there for the past 10 years. […] the key for 60% or 70 % of the students to pass is to do an exam that is not essentially different from previous one". Critical reason could be also that many students are only passive listener and users of calculus. The algorithmic characteristic of the tasks solved in the lessons and tests can lead to passing through exams without deeper understanding on subject matter. In terminology of Boaler and Andrew-Larson [3], most of our students have "received knowing", which means, they believe that doing mathematics means to memorize and quickly recall information needed.

2 Methods and chosen tasks

We observed the lessons and tested two groups of students at Faculty of Mathematics, Physics and Informatics, Comenius University in Bratislava (Slovakia) on comprehension of the definition of sequence limit (how can small changes, e.g., order in quantifiers, in definition of specific concept influence the meaning of the definition). The first group comprised 24 pre-service mathematics teachers (PMTs), the second group comprised 28 managerial mathematics students (MNGs). Based on our previous research, [4], freshmen are struggling with basic properties of functions (mostly goniometric and logarithmic), have no experiences with formal mathematical notation and therefore are not able to follow the lectures. Moreover, they have problems with logical structure of statements containing several quantifiers and lack experience with rigor in reasoning. Due to COVID-19 we had to shift into online environment. We were looking for the answer for our research question: *How the ways of reasoning in the groups of PMTs and MNGs differ when teaching/learning in online environment?*

In students' solutions, we looked at the type of argument elicited (in terms of Bieda et al [5]). The test asked students to provide an argument in any form (empirical argument, provide counterexample, formal proof, etc.) using different representations (e.g. graphical, symbolical, verbal, etc.).

The tasks we gave them were similar to the examples below:

1. Let real number L be the limit of sequence $\{a_n\}_{n=1}^{\infty}$. Can the number L be one of the terms of this sequence?
2. Considering the following statements decide how is the correct definition of limit of sequence violated. For every provided statement show an example of a sequence types, which will be convergent within it.
   a. Real number L is called the limit of a sequence $\{a_n\}_{n=1}^{\infty}$ if for every $\varepsilon > 0$ there exist an $n_0 \in \mathbb{N}$ such that $|a_n - L| < \varepsilon$ for infinitely many $n > n_0$.
   b. Real number L is called the limit of a sequence $\{a_n\}_{n=1}^{\infty}$ if for every $n_0 \in \mathbb{N}$ there exist an $\varepsilon > 0$ such that $|a_n - L| < \varepsilon$ for all $n > n_0$.

We discussed our results with relevant literature concerning teaching and purposes of calculus at universities (like [6, 7]).

3 Results

Even though two studied groups of students had different backgrounds and mathematical training at the university, there are no significant qualitative differences between these groups when answering our questions. On the other hand, we observed higher effort to reason and prove the answers in the group of MNGs.

The most common argument in both groups was by providing a counterexample. Even though students during the semester encountered several different representations of sequences and their limit (graphical, algebraical, numerical, topological), the most popular way of solving the tasks was graphical, by using epsilon stripes.

Several misconceptions were identified. The most common were epistemological obstacles, when students applied properties of finite sets to the infinite ones (as described in [8]), problems caused by fundamental linguistic flaws in the standard presentation of limit (as identified in [9]) and misunderstanding of the quantifier logic in mathematical statements.

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STEM education and digital instruments of the scientific museums and botanical gardens.

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1. Abstract

Some observations, as well as first data of an analysis inspired by personal experience of the authors during the online teaching of "Botany for primary and infant school" and "Museology and management of museum assets” in the courses of Science of the primary education and Tourism Science of the University of Palermo, are below reported.

As is well known, in general in the teaching of any discipline communicative skills are also required by the teacher, including syntactic and methodological skills (relating for example to semantics), as well as those of "empathic" type, thus contributing to make effective the transmission of knowledge and the teaching/learning relationship.

In online teaching, the risk of a loss of the emotional component is very high, as well as that linked to interpersonal interactions, including those between teacher and learner. In addition to this aspect, for disciplines such as botany and museology, which also provide for direct observation of plant specimens or parts of them and artefacts, as well as various types of museum spaces, distance learning can be decidedly penalized with respect to the traditional one. To reduce this gap, digital content provided online by museums, scientific but not only, and botanical gardens, such as virtual tours, videos and educational resources of various kinds, could be useful [1-3]. These are highly effective communication tools which some museums have been using for some time and which have seen a strong diffusion during the pandemic. For example, the digital cataloge of collections is one of the most popular systems for disseminating museum contents through institutional sites. This tool allows not only to know the consistency and type of the collections host in the museum, but also to carry out targeted research based on specific needs and educational objectives. In this way, for example, a virtual visitor of the National Museum of Science and Technology Leonardo da Vinci can choose to carry out advanced searches, even of an interdisciplinary feature, using the various search fields of the museum database (for example search by collection or period). As for the botanical gardens, for example the site of the Botanical garden of Pisa, offers the possibility to obtaining information on plant collections through the "U-plant discover”, a database that includes botanical families of plants cultivated in museum as well as other research fields such as the floristic kingdom or, of course, the location

in the various museum sectors. Thanks to this database it is therefore possible to carry out “transversal” searches which, for example, allow to extrapolate all the plants natives of a specific geographical region cultivated in this Botanical garden. In this way, the virtual visitor is given the opportunity to acquire general knowledge on some plants species and not only related to the museum site.

The didactic strength of these tools, which certainly make the exploration of museum sites fascinating, thanks also to very detailed images, lies in the possibility of personalizing and "building" the visit based on the specific educational needs, obviously set by the teacher, or the simple curiosities of individual visitors.

Virtual tours of the exhibition rooms, as well as those of the various sectors of a botanical garden, are also quite common and allow remote visitors to wander around the digital reconstructions of the museum spaces, often using sensitive maps that also give access to insights as well as allowing them to identify the location of the collections or plants [4].

For dissemination of educational programs based on the use of informal languages via video, platforms such as Youtube or social networks such as Facebook and Instagram are preferred. These are projects that have had a significant increase during the Pandemic, have as protagonists the curators and specialists who illustrate specific topics related to the collections, are characterized by short duration, musical accompaniment, recognizable formats, simple language and in some cases by translation LIS [5]. There are also educational tutorials that explain how to replicate scientific experiments with commonly used materials and objects [6]. Sometimes the educational contents produced by museums are disseminated through podcasts, audio files specially designed for different types of public [7]. In this case the interactivity is not yet very developed, essentially limited to projects that involve the user only in the selection of content to be explored in the form of written or audio text. A separate consideration must be reserved for didactic games and quizzes. Generally, these are rather simple applications that repropose models known as Memory® or the puzzle [8], but which in perspective present themselves as the area in which there will certainly be great development. In fact, based on the principles of edutainment, these projects effectively exploit the familiarity that the public, not just the little ones, has with videogames [9].

Overall, the difference between the various museums, Italian or even foreign, is still quite marked, with reference to the quantity and diversification of the digital contents offered. It must be clear that these tools are auxiliary and a completion or a preparation, and therefore not an alternative, to a site visit but they certainly represent a valid support tool in online teaching of scientific disciplines, making it possible to actively involve the student Certainly they requires by scientific museums synergistic work between different figures and skills, as well as specific economic investments.

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Understanding STEM students' difficulties with mathematics

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Among the thousands of freshmen enrolled at STEM university courses all over the world at the beginning of the semester, around 40% of them would dropout in a few weeks. The phenomenon of STEM-related dropout has received increasing attention in literature. Tinto (2010) has proposed a theory of academic persistence that is of inspiration for subsequent studies, since students' persistence is affected by a number of factors, as skills, abilities, and prior schooling, as well as by experiences at university. Interestingly, it seems possible to predict students' academic success by looking at their first days at university. To this respect, Larose et al. (2019) stress that students should adjust to a new context, a new program, new teaching practices, and a new institution, and they list a number of variables that should be considered to understand students' adjustment in the school-university transition. Among them, gender, students' expectations, coping strategies and school of provenience are the most relevant. University mathematics, specifically, causes difficulties to students with STEM majors in general and to Engineering students in particular (Gomez-Chacon et al., 2015).

The main goal of our research is, thus, to investigate whether different approaches to mathematics at school are related to different performances in mathematics. To that end, we measure success at first impact with university with high scores in math tests and we collect data about students' views about mathematics to identify different communities of students. Our presentation focuses on a Bridge Course (i.e., a course offered to freshmen to recap the essential mathematics), held at Polytechnic of Milan in 2017. The Bridge Course is hybrid: in the online part, the students recap essential mathematics using the Massive Open Online Course (MOOC), produced by Polytechnic of Milan and hosted on www.pok.polimi.it; in the in-presence part, students are involved in group activities focused on problem solving. Students are invited to attend the MOOC before the in-presence course. The data for this study come from a questionnaire (administered on the first day), which investigates personal-level features such as gender and high school provenience, attitude towards the use of digital resources, and affective dimensions, such as the mathematical views. Moreover, four close-end tests were administered (during the in-presence part), which measure cognitive factors, assessing students' mathematical knowledge.

The heterogeneous data were analysed resorting to nonparametric methods that do not rely on strong assumptions on the structure of data, nor on linearity of connections. To understand the interplay of personal-level features and test performance, and to identify how students clusterize according to their views of mathematics, we resort to the community detection, as described by Kock et al. (2020), combined with the classification trees to investigate the interplay between personal-level features, the belonging to a community and the mathematical test performances.

Community analysis identifies 3 clusters. The first cluster is populated by students (majority of males) with a strong mathematical curriculum in high school, and who have a rather procedural view of mathematics. Their math performance in tests is good, but they declare to seek for the teacher's help when facing difficult problems, instead of employing more self-directed modalities. We expect that these students will face difficulties in the first semester, as also observed in Andrà et al. (2011). A second cluster is as well populated by students with a strong curriculum in mathematics, but they are used to a more conceptual approach. These students have partly attended the MOOC. Our interpretation is that they selected the contents they actually felt useful, being able to not lose time and showing self-regulation. Finally, students in the third cluster are aware that their mathematical knowledge is not enough to attend the first year, and they start to work hard to bridge the gap: thus, they attend both the MOOC and the in-presence course. According to Andrà et al. (2011), these students have a probability of getting the degree on time that is comparable to the one of the students in the second community. The results confirm that the mathematical background plays a key role in determining the success of a student in mathematics, and a strong mathematical curriculum predicts success (Andrà et al., 2011; Roesken et al., 2011). However, also students' beliefs are worth of consideration (Daskalogianni and Simpson, 2001). Moreover, our findings have two elements of novelty: the first consists in taking into account students' attitudes towards online learning, the second is the idea of clustering students with respect to both personal-level characteristics and their views of mathematics, to explain their performances. To conclude, we have a first indication that mathematical knowledge is important, but students' awareness about their weaknesses is also crucial for success in undergraduate STEM studies. We are further planning, in the next future, to analyze the interplay between personal level features, performance in mathematics and mathematical views using more advanced machine learning techniques.

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Are you a collaborative e-learning platform?

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1 Introduction

Collaborative online learning is an essential aspect of higher and STEAM education which has gained more attention in the last years. Collaboration brings main benefits to collaborators; it can increase the social skills of the participants of the group [1], develop trust and support among them [2], gain greater confidence in themselves and their skills [3], and learn how to distribute tasks [4] and gain new information from each other [2]. Collaborative e-learning platforms, such as Learnweb [5], are platforms which are designed by nature to support online collaboration in an e-learning environment. However, there are multiple non-classical collaborative e-learning platforms, which can promote collaboration, but their potential remains unrevealed as the required elements for a platform to support online collaborative learning are unexplored.

2 Methodology

Although the an increased interest in online collaborative learning, based on our knowledge, there is no technical description of the requirements which an online platform should fulfil to promote collaborative learning in higher education. We explore this gap by investigating the required features in online collaborative learning platforms and proposing a framework to classify a platform as a collaborative e-learning platform.

Our methodology consists of the examination of state-of-the-art related to e-learning and collaborative learning frameworks, their adaptation in online settings, the analysis of collaborative learning platforms and their technical features. Finally, after the creation of the framework, we gather collaborative e-learning platforms via keyword search in Google Scholar and social media pages, which we then compare against non-classical collaborative platforms.

Our related work is formulated around research and technical reports regarding e-learning and collaborative e-learning platforms and frameworks. By investigating the literature, we found various types and descriptions of e-learning and collaborative e-learning frameworks.

3 The Framework

From the subsequent analysis of existing collaborative e-learning platforms and the state-of-the-art findings [6–8], we identified the crucial elements for online collaboration in our framework (Fig. 1). We aim to help in further analysis of collaborative elements in e-learning platforms and assist in developing new features to support collaborative e-learning platforms in higher education.

We identify three main elements that are essential for collaborative online learning: 1. Learning, 2. Communication, and 3. Collaboration. The learning element happens in a platform in different ways, such as by providing active learning processes via MOOCs, such as edX [9], or learning via question-answering like Stack Overflow [10]. The communication element occurs if users on the collaborative platform can communicate with each other on one to one basis or in a group. The collaboration or social element is divided into the sub-categories of user's actions, environment, community and feedback characteristics.

We analyse the categories and sub-categories into sub-items, which are the technical features a platform can offer. Each item then can assist group work, either fully or partially. For example, the item "messaging" can support collaboration fully if a person can send a group message or partially if it can only text individuals. We identify a total of 12 technical feature items.

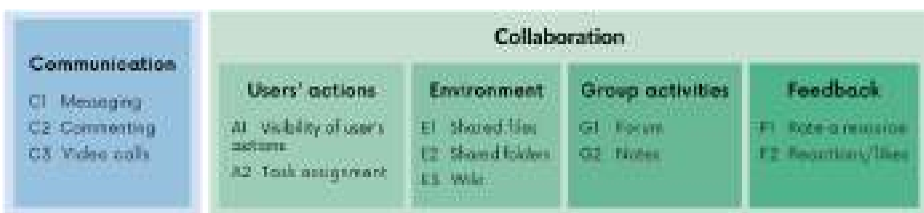

Fig. 1. The presented framework.

4 Discussion and Future Work

Our contributions lay on two factors. At first, this paper serves as a technical guide that reveals the necessary characteristics of collaborative e-learning platforms. This guide proposes a framework which identifies three main categories and their sub-items. We argue that an e-learning platform needs at least one feature in each category to assist even partially online collaborative learning. Further, based on our framework, we provide a comparison of well-known collaborative e-learning platforms. We show that non-classical collaborative e-learning platforms can support online collaboration as well.

In the future work of collaborative e-learning platforms features, we identify some potential directions for improving current available features, like enhancing communication with messaging reactions, and additionally towards the exploration of new features, such as graph summary visualisations [11].

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Digital tools to support interdisciplinary approaches to mathematics in high school

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1 Introduction

STEM education plays a crucial part in preparing the workforce for the future global economy. As the economic development relies further on science and technology, there will be an increasing need for STEM professionals. Sarı et al. (2018) suggest that problem-based STEM has significantly increased students' interest in STEM disciplines and careers. In addition, STEM education also equips students with the knowledge and skills needed not only in STEM-related jobs but also for working in other fields (e.g., Committee on STEM Education 2018).

Mathematics is a gateway to many scientific and technological fields. It is important to prepare students for the continuously increasing demand for quantitative and computational literacy over the twenty-first century. Students can acquire an understanding of concepts, methods, and tools of the different scientific disciplines in a more meaningful way through a teaching aimed at favouring the connection of these with real life. In order to interconnect disciplinary knowledge, guaranteeing balance in curricular learning, it is desirable to promote integrated digital teaching practices.

For example, Mathematics and Physics are disciplines that with their own specificities and without distorting them converge on common educational objectives as they favour interconnections of knowledge that normally lead to a deeper understanding. Failure to recognize this link within the classroom is the root of some learning difficulties, so much so that students consider mathematics and physics to be two very difficult, boring and disconnected subjects. Current teaching struggles to counter this trend, also because it continues to use registers and communication styles that are very distant from those of the students.

The result of this contributes to the shattering of that world and reality that the developing mind intends to know, understand, interpret in its entirety (Marra Barone, 2006). A paradigm shift in teaching practice - which exploits the educational value of the subjects in the operational form of learning environments deriving from the real world - constitutes a good starting point for overcoming the focus on individual disciplinary contents in function of the development of learning for skills.

Integrated digital teaching (IDT), adapted to contextual conditions and characteristics even in pandemic times, favours a synergy between disciplines by virtue of the fact that it integrates physical and virtual realitie. This allows students to build competencies through experiences based on conceptual themes in which mathematical and scientific thinking take place.

1.1 Research question

Alongside the importance of disciplinary knowledge, attention to interdisciplinary relationships is constantly reiterated.

According to Morin (2000), interdisciplinarity plays a pivotal role in the educational process. In fact, for Morin (1994) interdisciplinarity is part of a broader concept that goes by the name of complexity: a complete vision of reality, and of knowledge, is possible only by connecting all the parts that make it up.

Teachers can improve their teaching practice by seeking connections both within a single discipline and between other disciplines on various levels of knowledge. In the educational process, interdisciplinary connections support a thorough comprehension of concepts and their meaning just because understanding is rooted in those associations and, thus, 'closed compartments' (Brooks, 1999) can be avoided. Among the connections and integrations required for the creation of integrated teaching practices between Mathematics and Physics, it is important to highlight the role of the construction model as the representation of a given phenomenon as a true knowledge experience.

The purpose of this work is to show a format of interdisciplinary teaching practice - which integrates Mathematics and Physics - aimed at recognizing the unity of the cognitive processes underlying the understanding of some concepts and 'related' structures of the two disciplines with the use of digital tools.

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Active Learning Methods in Higher Education in Presence and at a Distance: Theoretical Foundations and Examples from Physics Education Research

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1 Abstract

Over the last several decades, active learning methods have received attention from the educational research community. Today, they are credited with improving student conceptual understanding in many fields, including physics [e.g., 1-2], improving student self-confidence and self-reliance [e.g., 3] and helping them to develop attitudes toward scientific inquiry and higher-order thinking skills [e.g., 4-6].

The scientific literature commonly presents active learning methods as credible solutions to the reported lack of efficacy of traditional educative approaches [7], often based on lecture formats, based on mono-directional transmission from the teacher to the learner of facts, laws, and concepts. A possible cause of the lack of efficacy of traditional education can be identified in its decontextualized and abstract nature, which often underestimate the interdependence of situation and cognition. Conversely, the strongly contextualized nature of active learning situations can help students to see knowledge as a tool to face and dynamically solve problems, rather than seeing it as the final product of education [8].

The general idea of active learning is deeply rooted on the constructivist models of human learning, that led to the development of the theory of cognitive apprenticeship [9]. Cognitive apprenticeships are designed, among other things, to bring the implicit processes involved in carrying out complex skills into the open, where students can observe, enact, build representations of the world and practice them solving problems with help from the teacher. Part of the effectiveness of the cognitive apprenticeship model comes from learning in context and is based on theories of situated cognition [10]. Cognitive researchers argue that cognitive apprenticeships are more effective when skills and concepts are taught in strict connection to their real-world context and situation. Learning and cognition are fundamentally situated.

As we noted, active learning methods are credited with improving students' confidence in self-directed knowledge acquisition from their experiences. This means students can be fostered in developing a Growth Mindset (e.g., Dweck [11]). According to Dweck's idea, Growth Mindset students are generally aware of how their learning

may happen, and they believe that extra focused effort and motivation may improve their capabilities [12], acquiring expert skills from experience. So, the Growth Mindset prepares the students to assume responsibility for knowledge acquisition. Deliberate Practice is the process found by Ericsson [13] as the most effective in acquiring expert skills from experience. This is a particular type of practice that is purposeful, systematic, and performed at progressively more challenging levels [14]. While regular practice might include mindless repetitions, deliberate practice requires focused attention and is conducted with the specific goal of improving performance. A fundamental aspect of this process is that the student can develop self-awareness of his/her points of strength and weakness. This also allows the teacher to help focus practice that can be repeated at different levels of difficulty to improve a skill that is found as weak by both him/her and the student him/herself. Emphasis on self-awareness in Deliberate Practice is likely to play a role in the effectiveness of the Growth Mindset, and, more generally, in the effectiveness of active learning methods.

While the adoption and use of active learning methods are becoming more and more common in primary and secondary education, their acceptance in higher education is still limited. Some remain skeptical about its real efficacy at an education level where theoretical deepening is strongly required and see it as one more in a long line of educational fads [8]. Many also express doubts about what active learning actually is and how it can be considered different from traditional education. Especially, they claim that their teaching methods can already be considered "active", as classroom exercises, homework assignments and laboratories are part of them. Adding to the confusion, many faculties do not always understand how the most common forms of active learning differ from each other, and in some cases, they are not inclined to comb through the educational literature for answers. The difficulty in effectively implementing active learning strategies in distance teaching makes the acceptance of these methodologies even more difficult.

In this talk, I will introduce and distinguish some different types of active learning strategies that can be profitably used in the field of science education, with particular relevance to strategies more or less fitted to presence or distance teaching. Then, I will discuss some of the pedagogical and psychological foundations of these strategies and some results of researches on the effectiveness of active learning in actually improving student knowledge, conceptual understanding, and self-confidence. Considerations on possible moderators of the effect of active learning at both teacher and student levels will conclude the talk.

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A distance learning approach to surface phenomena based on Smoothed-particle hydrodynamics computational method

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1 Introduction

Foundations and applications of fluid mechanics are relevant in many scientific and technical fields, like physics, engineering, medicine, and environmental sciences. Particularly, surface phenomena, like capillarity, are fascinating topics since their understanding involves thermodynamics, statistical mechanics, fluid mechanics, and other science subjects.

In many textbooks aiming at introducing surface tension, there are often unclear points and sometimes errors. This one is perhaps the main reason why this topic often does not enjoy great popularity in teaching, even at universities [1,2,3].

The origin of surface tension lies in molecular interactions and thermal effects.

This microscopic model is in principle satisfactory from a didactic point of view. However, it cannot be easily used when one wants to develop computer-based simulations for a distance learning approach to surface phenomena especially when large portions of liquid are to be simulated. This model would require huge computing resources.

In the literature, it is possible to find models called "mesoscopic", in which the liquid is made of particles with a radius equal to a tenth or hundredth of a millimeter [4-6]. The size of these particles depends on the spatial resolution and the calculation efficiency.

The interaction forces between these particles are similar to those present at the microscopic level. This model has the advantages of the microscopic one and also allows the user to simulate large portions of liquids even with low-cost computers, readily available, for instance, in schools.

In the literature are described several simulation results based on mesoscopic models and Smoothed-Particle Hydrodynamics (SPH) computational methods in often complex experimental situations and the engineering field [4-6]. However, very few examples exist of basic phenomena such as the formation of a liquid drop or the formation of menisci [7].

Models and modelling can be taken into account to foster an integrated and authentic STEM education and STEM literacy. Models and modelling processes can bridge the gap between STEM disciplines through authentic practices [8].

The study here described aims to fill this gap by introducing new ways to didactically approach the surface phenomena by using a mesoscopic model of liquids. We implemented this model through numerical simulations to make this approach more efficient in a distance learning context. We show and discuss some simulation results for basic behaviors of surface phenomena.

2 Model and simulation results

We consider a liquid made of mesoscopic particles. The equations of motion (Navier Stokes equation) of the discretized liquid are solved through the well-known computational method called Smoothed Particles Hydrodynamics (SPH) [6].

On a qualitative level, our approach allows teachers/students to investigate various basic phenomena. The formation of a liquid drop with and without gravity and the formation of menisci. The sessile drop and a solid resting on a liquid.

The simulation can allow students/teachers to observe the physical system at the equilibrium and also its evolution over time through the creation of short movies. For instance, when the solid-liquid force is slightly bigger than the liquid-liquid one we observe a convex meniscus and the rise of the liquid inside the capillary. It is also possible to investigate the behavior of the principal forces applied to the mesoscopic particles of liquid.

Quantitatively, the approach presented here consists of the possibility of simulating the behavior of different liquids by setting those fundamental quantities on which the behavior itself depends (for instance, the density, the viscosity, the intensity of the interaction forces). As an output of the simulation, it is possible to obtain the value of the surface tension in a given configuration or the verification of a law.

The simulated value of the surface tension is obtained in the context of capillarity phenomena. We consider a liquid contained in a tray with a capillary tube inside. At the equilibrium, we observe the formation of the menisci as a function of the liquid-liquid and solid-liquid interaction intensity and calculate the value of the surface tension.

A possible way to verify the Young-Laplace law is obtained through the simulation of a two-dimensional liquid droplet in mechanical equilibrium without the action of gravity. The pressure inside the droplet is calculated as a function of its radius by using the virial theorem [9].

3 Discussion and conclusions

The approach here described can allow teachers and students to highlight some relevant properties of liquids related to surface tension.

We think that this method could prove to be a very useful tool for both high school and undergraduate students in physics and many other scientific fields. It allows teachers and students to build/use computer simulations that allow them to easily control relevant parameters for understanding the mechanism of functioning at the basis of the surface phenomena. Further studies are necessary to better correlate the typical quantities of the model with the macroscopic one.

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Non-covalent interactions: an opportunity for AR use in chemistry education

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1 Spatial skills and molecular models

1.1 The domains of chemistry education

In a seminal paper of 1991, Johnstone argued that the difficulties that many students of scientific subjects encounter are connected to what he called 'multilevel thought' [1]. Chemistry students are required to move incessantly between the macroscopic domain (macrophenomena such as solubility, equilibrium, etc.), the sub-microscopic domain (atomic and molecular structures and interactions) and the symbolic domain (chemical formulas, equations, etc.).

Translating ideas and representations between symbolic and sub-microscopic may be particularly challenging. Many students lack sufficient spatial and visual skills that play a crucial role due to the molecules' tridimensional nature and the importance of graphic imagery in understanding molecular interactions [2]. However, it has been shown that spatial abilities are essential for problem-solving tasks in chemistry and are intrinsic to the acquisition of representational competence [3].

1.2 Molecular models

One way to improve representational competence is using "concrete" (plastic or metal) models for the molecules. Computer-generated 3D models have improved students' visual and spatial skills like "ball and stick" models [4,5]. At the same time, they allow overcoming some of the limits that physical models present, i.e., the versatility of representation, ease of access and use, and the possibility to build extensive and complex models (such as proteins, nucleic acid, polysaccharides, etc.) that would be very time consuming or even unattainable with physical models.

1.3 Models in augmented reality

Conventional computer-generated models exist in virtual reality (VR) "inside" the screen resulting in a 2D projection (non-immersive VR). Manipulation of such models is typically performed via mouse-driven operations that often result in an unintuitive interaction that can severely limit the development of the visual and spatial skills required. On the other hand, interactions with concrete models are more fluid and immediate. Comparison between different structures is also easier because the user can independently rotate two different molecules, one with each hand.

Technologies that use augmented reality, AR (or extended reality, XR) may help overcome the limitations of both the physical and virtual models. Their purpose is to blend the physical space around the users with the simulated molecules. The main advantage of AR tools is the complete control of the visualization allowing the user to keep in view their hands while interacting with the simulated objects, effectively facilitating interaction, compared to VR [6] and promoting engagement [7]. They have been demonstrated to be very effective in higher education in understanding structural aspects of the sub-microscopic domain, such as VSEPR and stereochemistry [8,9]. The same approach could be beneficial also in many other areas of chemical education.

2 Teaching non-covalent interactions

2.1 importance of non-covalent interactions

Non-covalent interactions are a significant portion of any higher education introductory chemistry course. They vary significantly in nature and effects, influencing to a large extent many properties of matter from the sub-microscopic to the macroscopic domain, such as phase behaviour or self-assembly and adducts formation. They also play a crucial role in living systems, determining molecular recognition, catalysis, signal transduction, information storage, plasticity, etc.

Causes and effects of non-covalent interaction present many spatial and symmetry-related characteristics that involve orientation in the space of the units participating in the interaction, structure of the resulting entity, etc. Therefore, visual and spatial skills are essential in understanding their nature and predicting their outcomes.

2.2 Aim and scope of the learning module

We present a development of a learning module about non-covalent interactions that uses MoleculARweb [10, 11], a platform for interactive AR-based molecular visualization running in web browsers. The platform is open source and freely available without registration. Users can load any .pdb file and show it superimposed to an external environment, interacting with any digital object using printed visualization markers or using mouse or touch gestures on a screen

The learning module aims to cover all the different types and effects of non-covalent interactions, taking the student from elementary examples from inorganic chemistry, such as ionic compound lattices or solvation, to complex and articulated ones from biochemistry, such as protein/ligand interactions, lipid bilayers, nucleic acids structures and so on.

All the units in the module are designed to be easily used in the distance and/or asynchronous learning settings where the students may autonomously experiment with the provided model using an inquired based learning and flipped classroom approaches. In addition, all the units are sufficiently independent of each other so that the module can be easily adapted to specific courses.

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Towards Integrated Digital Learning: prospective challenges in STEM education

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1 Introduction and motivations

This paper is in line with the authors' research on innovative teaching methodologies in STEM courses in Mathematics and Physics. Previous works highlighted the importance of using information technologies in the educational dialogue to prevent dropout by improving students' engagement, motivation, and participation linked to the Situation Awareness (SA) model. In particular, in 2016/17, a blended teaching model was tested with half-flipped teaching in the SCALE-UP learning environment [1]. In 2017/18, blended teaching was tested using the Just in Time Teaching and Peer-Led Team Learning methodologies integrated with a social platform [2],[3]. In the academic year 2018/19, the experimentation used Augmented Reality to address some crucial topics of the mathematics course and evaluate student interaction and participation with Fuzzy Cognitive Maps [4] as a systemic structure model for analyzing critical success factors of the learning system [5]. Augmented Reality has overcome some students' difficulties with various calculus topics. Moreover, some technological tools (3D glasses, computers, tablets) and innovative methodologies have experimented. In the same year, studies were conducted on how the situation-aware e-learning platform and its feedback generation system influenced students' Situation Awareness.
We wonder if engagement, motivation, and participation in mathematics class change with fully distance learning extended for a second year in an emergency; if the updates made to the e-learning platform help maintain an adequate level of SA for the students in a long-term emergency. Moreover, we wonder what elements of full distance education can be useful for effective teaching of mathematics and physics in STEM courses and can be integrated with more traditional teaching.

2 Conceptual Framework

The teacher's educational activities and the students' reactions are analyzed in the light of the theory of transformative pedagogy [6], trying to understand if the transformations in didactic can give rise to new teaching-learning methods able to survive the duration of the crisis, or if they are only transient manifestations dictated by contingent needs and destined to decline.
Many research findings can be read through the lens of Vygotsky's Zone of Proximal Development (ZPD) theory. Vygotsky [7] defined ZPD as "the distance between the actual developmental level determined by independent problem solving and the level of potential development determined through problem-solving under adult guidance or

in collaboration with more capable peers." This seems to be linked to the student's motivation, participation, and engagement.

Situation Awareness [8] helps us analyze how the students' perception, comprehension, and status projection have been affected in this emergency period.

Finally, the Fuzzy Cognitive Map theory has been used as a tool to describe and model complex systems/environments symbolically, highlighting events, processes, and states.

3 Teaching experiment

The study was conducted with first-year engineering students attending the calculus II course and physics II on 2018/19, 19/20, and 20/21. It involved two tutors in addition to the course lecturer. This work uses a mixed-methods methodology to integrate high-level extension studies (typical of the quantitative paradigm) and specific, in-depth studies (typical of the qualitative paradigm). The quantitative data include the students' interactions on the e-learning platform, the results of the tests, and a semi-structured questionnaire according to the Likert scale. In addition, the questionnaire anonymously proposed to students also included open-ended questions from which to infer the student's motivational state through qualitative analysis. Finally, a Fuzzy Cognitive Map (FCM) was built from the qualitative and quantitative data to derive the students' engagement, motivation, and participation parameters. The quantitative approach suggests the instructional, educational, and training strategies that might work under conditions. The qualitative approach provides information regarding why specific systems work, i.e., under what dynamics and how. To sum up, the main findings of this research are that, in the long run, distance learning and other social factors harm students' motivation, engagement, and participation, despite the countless teaching strategies implemented and a situation-aware e-learning platform. This has also had negative consequences on the level of mathematical competence and Situation Awareness of the students and has accentuated the drop-out phenomenon; the authors' efforts to model the didactics according to the students' status in an emergency, together with the use of the updated platform able to follow the students in their needs, were useful to limit the negative results achieving an acceptable level of Situation Awareness and success in the results obtained; some positive aspects of distance learning highly appreciated by the students can be integrated with traditional teaching and enhance a blended modality of didactic action. Technologies are a tool to support teaching action but cannot completely replace the social action of face-to-face teaching. Although teaching activities have been remodeled and technologies have been used adaptively to optimize education, cognitive processes have been influenced by external factors that have partly compromised the effectiveness of the educational activity. The authors hope that some aspects the students appreciate can be integrated with traditional face-to-face teaching. We will highlight how some aspects of distance education can be integrated with more traditional teaching. For example, include lecture recording, an adaptive e-learning platform to track students' skills constantly, and software to understand certain topics better. We will also show the differences between distance education in a physics course and a mathematics course for undergraduate students.

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A phenomenological study about the effect of Covid-19 pandemic on teachers' use of teaching resources about reasoning & proving in mathematics

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1 Introduction

If we study the history of societies, we can find several pandemic events such as smallpox, cholera, plague, and SARS [1, 2]. Each one of these pandemics events affected human life in many aspects from health to the economic sphere [3], education is one of these aspects. The SARS-CoV-2 pandemic (Covid-19) has had a massive impact on Education: many students of different countries have been affected by school and university closures due to the Covid-19. Italy was the first Western country to suffer a coronavirus emergency. On March 4, 2020, the Italian Prime Minister announced a strict lockdown and the immediate closure of all schools and universities to contain the spread of the virus. This phenomenon then extends to other countries as well all over the world. In response to school closures, UNESCO recommended the use of distance learning programs and opened educational applications and platforms that schools and teachers can use to reach learners remotely and limit the disruption of Education. These proposed "solutions" had involved all levels of Education [4, 5]. According to [6] the Covid-19 has shown different everyday situations and different related emerging problems around the world; new pedagogical and didactic perspectives about competencies are needed [7, 8].

2 The *MaTeK* research framework

In the last two years several researchers investigated teaching practice and their own response to the crisis [7, 8]. Steed and Leech [9], discussed the US teachers' difficulties in personal interactions with students and their inadequate resources. Hu et al. [10], painting the Hong Kong Covid teaching scenario, provided evidence of barriers including difficulty engaging students in online activities and highlighted inadequate support from several parents for learning activities. Nikolopoulou [11] highlighted teachers' negative feelings in particular, at the beginning of online education in Greece. Brunetto et al. [12] proposed a new teaching model for describing and analysing a new teaching system in Covid 19 Time. Several Researchers in [5] put in evidence as pandemic was for many teachers and students an opportunity to re-examine their teaching/learning. Very few of these works look to the effect of Covid-19 pandemic on teachers' use of resources. Since January 2021, the MaTeK (*Enhancement of Research Excellence in Mathematics Teacher Knowledge*) Horizon 2020 project Consortium is investigating these phenomena. The Consortium is, in fact, conducting an international research focused into the use of resources by 8^{th} grade mathematics teachers from different countries to prepare and implement their lessons and conceptions, particularly about Reasoning & Proving in Mathematics. With the aim to study the "repercussions" of the Covid-19 about these themes a pilot study defined by an open-ended questionnaire was deigned. The research was carried out during the 2020-21 academic year, and it involved 110 voluntary teachers from several different school institutions of all five MaTek countries. The questionnaire is made up of Twenty-three items aimed to focus on some key aspects in studying teachers use of resources in mathematics, for refreshing or improving their personal knowledge in mathematics, for inspiration or ideas for teaching mathematics, for preparing assessments, for finding materials to be used with your students in class. Six more question were dedicated to particularly analyse teacher's conceptions about Reasoning & Proving and the related of teaching resources. The last part of the questionnaire was dedicated to collect demographic data such as age, experience, etc. The survey was quantitatively (e.g. by cluster analysis [13, 14]) and qualitatively analysed. In this paper we refer only to the data interpretation by the K-means clustering.

3 First conclusion

According to our results not all teacher seemed to be aware about the important of the use of teaching resources in Reasoning & Proving. Interesting correlation was found between their culture, their teaching experience and the declared school teaching grades. We think that these data can be useful to highlight in Higher education (such as in in-service and pre-service teacher training programs) interesting international comparison on some potentialities, critical aspects and challenges about future research on educational methodologies, use of teaching resources and assessment activities in digital learning environments.

Acknowledgment

This abstract was supported by the H2020 project no. 951822, MaTeK. https://www.projectmatek.eu/. We would like to express our special thanks to our colleagues in the project: Işıl İşler Baykal, Erdinç Çakıroğlu, Iveta Kohanová and Jakub Michal

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Use of mathematics and physics teachers' resources during and post Covid-19 pandemic

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1 Introduction

During the global pandemic an approach to teaching, lesson planning and classroom preparation had to be adjusted. On one hand online teaching made it impossible to use conventional methods teachers were used to employ in their math and physics classes. On the other hand, the online environment offered several new and exciting opportunities to explore. Lots of previously not that frequently used online, or offline applications and websites started to get recognized and used. Many new materials of all kinds were created by teachers and shared online (e.g. in teacher groups on Facebook, online libraries, websites for teachers, etc.). The amount of online videos (YouTube, Khan Academy, etc.) surged and views of instructional or educational videos for all grades increased as well.

This unexpected and sudden appearance of new resources caught our attention. We were interested in ways in which mathematics and physics teachers' use of resources has changed due to the Covid-19 outbreak. In accordance with Winter et al. (2021) we expected increase in the use of technology and new software environments during the pandemic. However, we were also interested if teachers still use some of these resources post Covid-19 as several studies (such as Chinnathambi et al. (2021)) suggest positive impact of online resources on learning and recommend using these practices even post Covid-19.

2 Methodology

We conducted a research among primary, lower and upper secondary school mathematics teachers from different countries participating in the Horizon 2020 project MaTeK. In a research one of the questions asked the teachers if there are any changes in their use of resources caused by Covid-19. Countries involved in that project are as follows: Slovakia, Czech Republic, Italy, Norway, and Turkey. We have also conducted several interviews with participating teachers. Most teachers agreed that their usage of resources was greatly influenced by lockdown and offered several examples. These preliminary results served us as a basis for a new questionnaire we developed as we wanted to deeper analyse impacts of Covid-19 on the use of resources in both – math and physics classes. This new questionnaire was developed with specifics of Slovak and Czech school systems in mind. We decided to focus on these two countries as our school systems are close to each other as we share common history and the results might be compatible (see Slavíčková and Novotná, 2022). Purpose of this questionnaire is to find answers to the following research questions:

- RQ1: Which methods did teachers find useful and working for pupils during the lockdown?
- RQ2: What changed in teachers' use of resources during and after the lockdown?
- RQ3: Do teachers still use new methods or approaches from RQ1 now? If so when, why and for what?

Questionnaire comprised two parts: First, teachers indicated what subjects they teach and based on that they answered questions about mathematics, physics, or both. These questions were either open, semi-open or closed. Teachers were asked about their use of resources pre-, during and post-lockdown. They were to select which resources they used when and state what for and why. Second part consisted of demographic questions.

3 Results and conclusions

From the preliminary results of questionnaires and the interviews with several teachers of mathematics or physics we observed many similar trends among teachers of the same country and some differences among teachers from different countries.

For instance, the most used resources before lockdown in both countries and subjects were *textbooks*, *discussions with colleagues* and *other books about the subject*. On the other hand, teachers did not usually use *online resources* or *journals.* During the lockdown all the teachers frequently used *digital applications (such as GeoGebra, WolframAlpha, etc.).* The greatest surge in comparison to pre-lockdown situation was present in *online video resources (such as YouTube).* There was also increase in the use of *general information websites* and *professional online platforms / libraries for teachers* as expected. Other use of resources remained similar to pre-lockdown situation. Several teachers responded that they only tried these online resources but did not use them frequently during the lockdown. We were also interested in resources that teachers discovered during the lockdown and do still use them nowadays. Results suggest that teachers still use *digital applications*, *online video resources* and *website where teachers can share their materials with others.*

Interviews with teachers should help us to better understand their preferences in the resources used and reasons why they either do or do not use given resources after the lockdown ended. Results of this study are to be shared and discussed with pre-service teachers of mathematics and physics as part of their university preparation.

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Active blended learning in an undergraduate laboratory of analytical chemistry during pandemic

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Theoretical framework. Conductometry appears increasingly neglected in undergraduate textbooks. A rapid survey of the literature points out this fact. For example, both of two well-known textbooks of the eighties of the past century ([1] and [2]) have a complete chapter dedicated to conductimetry with an extended discussion of both theoretical and practical aspects, even if mainly acid-base titrations are fully described. In a more recent book [3] there are only eight pages discussing conductometry citing only acid base titration, while in [4] and [5] one can find only short notes on the argument. Quite surprisingly, in some of the most popular textbooks ([6], [7], [8]) the technique is not even mentioned.

In our opinion, conductimetry is an inexpensive instrumental technique, unproblematic from a practical point of view and remarkably versatile in its applications. In fact, in addition to the classic determination of the salinity of an aqueous solution, it allows to carry out several common types of volumetric titrations (acid-base, complexation and precipitation). It is also effective in some special applications ([9] [10]).

Pandemic and teaching approach. Considering such features, conductometric titrations have for years been an integral part of the techniques offered in the teaching of Instrumental Analytical Chemistry in the BSc Industrial Chemistry course at the University of Bologna. The laboratory activities related to this technique, like all the others, have been always organized with a first design phase conducted by the students in working groups (typically in the classroom) followed by the practical realization of student's projects and a subsequent revision phase (again in the classroom).

The pandemic emergency prompted us to revise and reformulate the educational approach followed in the past exploiting the technique as a tool for a better understanding of the nature of electrolyte solutions and for predicting and interpreting trends in titration curves, even those of a certain complexity.

Pandemic and course organization. The pandemic has made it necessary to reshape the entire cycle of teaching activities, mainly due to the limited access to the laboratories (a maximum of 20 people per shift) which would have resulted in an unacceptable reduction in teaching hours for each student. It was therefore decided to divide the students into four macro-groups (MG A to D) each made up of 4/5 working groups of 5 people each. In each group there was also one person who would only follow remotely (Figure 1).

The teaching sequence. The planning and execution of the experiments was carried out individually by each working group of one of the four MGs (a total of 16 to 20 students at a time), working remotely using the Microsoft Team® channel mode.

During this phase, the teacher was able to visit the discussion rooms, also at the request of the students. At regular intervals, the plenary was then reconstituted, where one member of each group (in turn) reported to everyone on the progress of his group project. During the didactic break that each MG had, the groups had the task of processing

	LESSON	PROJECT ACTIVITY	LAB ACTIVITY	HOME ACTIVITY
week 1	Conductometry theoretical basis MG: A, B, C, D			
week 2		(MG_A e MG_B) strong acid, MIX of two bases		
week 3		(MG_C e MG_D) strong base, MIX of two acids	Work in lab (MG_A)	
week 4		(MG_C e MG_D) New problem…	Work in lab (MG_B)	Elaboration / reporting (MG_A)
week 5			Work in lab (MG_C)	Elaboration / reporting (MG_B)
week 6			Work in lab (MG_D)	Elaboration / reporting (MG_C) …

Fig. 1. Scheme of working group organisation

the data collected and drafting a short report on the work done. The laboratory activities of each group were followed by the student remotely, but sometimes it was possible to "virtually enter" into the laboratory even for the teacher involved in the design activity.
The problems to be solved. As shown in Figure 1, the outline of the didactic intervention scheme involved a first exposition by the teacher of the basic principles of conductimetry. In the planning phase, the MG were presented with two problems, the first quite binding (*A method must be developed to determine hydrochloric acid (for MG A) and sodium hydroxide (for MG B) in an unknown solution at a concentration ranging between 0.1 and 0.01 mol* L^{-1}) and the second quite open (*Develop a method to determine the quantitative composition of a mixture of a strong and a weak base*). Groups were free to choose the mixture to analyze. Finally, one of the goals was to make an estimate of the conductivity at the ending points and during the titration to assess the goodness of the prediction on the basis of the experimental work.
Results. The reports presented by the groups got an average score (we used an evaluation grid) of 70/100. Three groups out of 14 got an insufficient score <50. More than half of the groups elaborated a theoretical prediction (using a spreadsheet) of their titration and compared it with their own experimental results (elaborations were reported in the final reports and in the attached spreadsheet). This goal was achieved for the relative facility to treat conductivity data and to produce reliable plot with easy calculation. Despite the difficulties of distance teaching, a positive aspect to report is that such a modality has helped the students with some impair in relating in public to speak in the plenary sessions. At the end of the course all the students had at least once exposed the results of the group. Such think has never happened in traditional teaching mode. It was also observed by some students that the project and numerical exercise part of the teaching was more profitable on-line essentially for logistical reasons: inadequate classrooms, noise, distractions. This last point should be taken in account also in a non-pandemic situation.

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Special Track 6

Online Faculty Development: Next Steps for Practice and Future Research

Organizers:
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Autoethnography and faculty development: reflections from a co-teaching experience

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1 Introduction

Autoethnography is a widely used approach in qualitative educational research that focuses on the process of teacher professional identity formation and development [1] [2] [3]. Authoetnography extends beyond self study, but it applies to "the space between the self and practice" [2, p.2]; besides it is not limited to self-narrative in terms of data gathering and analysis techniques giving the right value to the self (e.g. to the teacher reflections) and others (e.g. to any other actors within the situatedness of the teacher in relation to them). Austin and Hickey [4] see autoethnography as "a very powerful 'method' of provoking the type of *conscientisation* necessary for authentic community engagement and commitment espoused by critical pedagogues" [4, p.371] which reveals of paramount importance to allow "the social transformative potential of teachers to actuality" (ivi).

Actuality, in nowadays teaching, cannot ignore the changes which affected the context and the actors of the teaching/learning process due to the emergency period experienced in the last two years where the "climate of layered and complex diversity" [2, p.2], which normally characterize students and the group class, has become even more demanding in terms of class management and learning needs. The present contribution explores how a co-teaching workshop took advantage of autoethnography as a reflective method to enrich the interdisciplinary relationship between the two involved professors and their mutual growing nurturing in terms of instructional design and teaching practices.

2 Co/autoethnography in a blended context

A co/autoetnography enables an enhanced reflection process due to the needed active negotiation of design models and teaching practices that allow the enaction of a "cultural" experience which clearly expresses in the generation of discourses between the different actors: the two professors and the students in the educational/didactical relationship they develop in a blended setting (partly online and in face-to-face contexts).

In the last two academic years a joint workshop was organized within the courses of "Educational Technology" and "Intercultural Pedagogy", run in the first semester of the third year of the degree course in the professional socio-pedagogical educator curriculum (University of Macerata, Italy) [5]. The project-based workshop had a hands-on approach and is to be meant as a “cluster” within the two different parallel courses [6]. It was developed with the objective to engage students (both online and in the face-to-face teaching context) in an interdisciplinary group-work whose core tasks and performance required a reflection on both subject-matters and the connotation of their entanglement on a theoretical and practical dimension.

Even though the workshop was integral part of the course was not mandatory and students had the chance to shift from online and face-to-face environments and interaction modalities.

Source (table 1) were teachers, students (2020/2021: no.36; 2021/2022: no.38) and pedagogic data (e.g. students’ artefacts) [7] and were analysed with the aim of disclosing trajectories of faculty development triggered in the different outcomes of the reflective practice. Among the final results there is a specific focus on the importance of teaching as a way of activating possibilities for students and teachers to exist as subjects [8] in the framework of a critical pedagogical practice [9].

Table 1. Overview of data types and collection.

Timing	Type	Description
Data collected during the first and second co-teaching workshop (November-December 2020 and November-December 2021)	Students’ artefacts	Teaching plan Grid of analysis presentation
	Field notes	Teachers’ observations during the workshop and the final student presentations;
	Trace data	Students’ requests via email and online written interactions in collaborative environments as part of the workshop activity; Students’ comments and peer assessment during the final presentation (audio and/or video recorded).
Data collected after the first co-teaching workshop (March-April 2021)	Academic writing	Published academic paper about the co-teaching experience in terms of methods applied.
Data collected after the second co-teaching workshop (April-May 2022)	Academic writing	In-progress academic writing about the co-teaching experience in terms of faculty development.
	Semi-structured interviews	Video recorded interviews with a sample of students.
	Faculty reflections	Written notes and comments on the interviews.

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Promoting a new Age of the Faculty Development through on-line initiatives

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1 From the past, to the future

Mary Deane Sorcinelli (2006, 2020) presented an evolution of the concept of Faculty Development (FD) organized for "Ages" according to which it starts in the Sixties with "The Age of Scholar" in which the focus was on the faculty members and their academic skills within their disciplines to arrive to the years between 2010 and 2020, called "The Age of Evidence," in which universities addressed the problem of the effectiveness of their interventions, also in connection with stakeholders' needs (Beach et al., 2016, Sorcinelli, 2006, 2020).

And what about the next Age? The one that now stands before us and that has presented itself to us with the business card of a pandemic that has upset the entire globe's life and habits? What will it be? Some scholars (Baker & Lutz, 2021) believe that it will be "the Age of Global Community" (p.62), interpreting as a distinctive element of the new decade the possibility for universities to share their FD actions beyond the local dimension, thanks to the massive spread of the digital tools.

This is a refreshing perspective, but perhaps it is possible to take a step further, considering digitization something able to support not only an "international" comparison but also an essential element in the development of an internal process of "positive reinforcement." Indeed, I think that starting from the suggestions offered by the holistic approach (Sutherland, 2018), in the next decade FD actions should follow a systemic and multifocal logic. Starting from this premise, I think that FD should promote not "single actions", organized in a "sectionalized way", but initiatives connected according to a principle of mutual reinforcement. In this way, acting at different levels but consistently, it is possible to promote a" flexible "development, capable of rethinking itself even in unforeseen solicitations. In a perspective of this type, digital tools can represent an essential resource because they allow you to emphasize its multi-perspective soul, both by creating opportunities for exchange and comparison and by allowing modular and integrated management of initiatives.

2 Section

A concrete example of what I mean is represented by two FD actions promoted by the University Teaching and Learning Center (TaLC) of the Verona University, one

dedicated to teachers ("Formarsi per Formare") and one dedicated to students ("Competenze Trasversali").
The "Formarsi per Formare" program is an initiative aimed at developing faculty members teaching skills. It is structured into six thematic workshops. Each workshop is composed of three meetings and it is focused on a specific theme linked to one of the three main topics (teaching planning, learning tools, and evaluation strategies). The workshops can be attended independently, but the timetable is designed to allow (those who desire) to participate in all six workshops. The trainers present a brief theoretical background of the theme and then describe an experience connected to it, involving the faculty members in a shared reflection. All the meetings are online and synchronously conducted, but they are also registered and available to the staff through the intranet.
The "Competenze Trasersali" program promotes training courses open to all Verona University's students, aimed to support their development from a personal, professional, and civic point of view. Starting from the framework "Life skills for Europe", the courses are organized into nine areas (numeracy; literacy; problem-solving; civic; digital; environmental; personal and interpersonal; health; financial) and they propose skill-based courses connected with issues relevant to the daily life of students (i.e., "Positive conflict management"), sometimes related to topical issues (i.e. "Intercultural communication"). The courses are held in digital mode (mainly in synchronous) and use a e-learning platform (Moodle) for the management of the moments of comparison or assessment activities required for the certification of the acquired skills.
Although they are two separate programs, they have essential elements of continuity within them. Firstly, they are two connected axes of the "UNIVR per l'innovazione didattica - 2021-2023" project (valid for the University Triennial Programming), promoting a vision of FD in which the enrichment of teachers and the enrichment of students represent two sides of the same coin, both essential to support the growth of the University. Secondly, "Formarsi per Formare" is both a formative moment and the starting point for a stronger relationship between the teachers of the University and the staff of the TaLC. Indeed, in many cases, teachers who attended "Formarsi per Formare" decided to be actively committed to promoting teaching innovation, choosing to dedicate part of their time to design and implement a course belonging to the program "Competenze Trasversali": they put into action what they have learned about teaching innovation at the service of all students of the University, taking advantage of this opportunity as a professional challenge. Finally, for both experiences, are foreseen the certification of the achieved skill through micro-credentials (Open Badges): for the "Transversal Skills" project, this certification is already activated, while the "Formarsi per Formare" project will be activated from 2022 / 2023.

Hence, these two projects, even if they have a "their own life", are part of a wider framework that, thanks to their mutual positive interactions, is promoting a systemic vision of FD at the University of Verona, according to which the growth of the institution is the result of the growth of individuals, within a harmonious and articulated environment.

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Capability approach and sustainability, a survey for the faculty development

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1 Theoretical framework

Higher Education must cope complex intertwining of challenges that places university teachers in a condition of continuous updating. With this in mind, we intend to deepen the theme of Faculty Development (FD) with specific reference to the fascinating intertwining of the Capability Approach (CA) and the objectives of the 2030 agenda.

What connects the boost provided by studies on FD and the CA is the invitation for teachers to train active, responsible citizens capable of critical reasoning and problem-solving skills.

The horizon of meaning outlined by the capability approach defines a primary and preliminary social responsibility: outlining the characteristics of the context to define the possibilities of acting, imagining, promoting, predicting. Therefore, the CA expresses a competence to act, in all contexts of life, from school to professional, defining the objectives that the person him- self is preparing to achieve. It therefore becomes an essential right for the full flowering of the human being, for the expression of citizenship and democratic participation. Through the CA perspective, human capital incorporates another aspect: the dimension of lifelong learning and learning by doing, stimulating learning in formal and non-formal contexts, and aiming at the acquisition of cognitive opportunities and the development of capabilities.

As a matter of fact, Nussbaum's capabilities approach is a constant reassessment of the answer to the question: Of what does the prosperity of a nation or region of the work and the quality of life of its inhabitants consist of? (Nussbaum, 1993).

The CA also meets the issue of sustainability in the educational-didactic field, directing the focus of research on the figure of the teacher and on the didactic planning that is implemented daily in professional practice.

The 2030 Agenda for Sustainable Development in this sense is a crucial document; it carries out an action program for people, the planet, and prosperity. The 2030 Agenda incorporates 17 Sustainable Development Goals, SDGs - into a large action program that reveals a total of 169 targets or milestones.

The sustainability philosophy encompasses three interrelated dimensions (Alessanrini, 2019): human development, social justice, care for the environment. The paradigm of sustainability and the perspective of the CA find a point of possible convergence for pedagogical reflection also around the theme of the community (Alessandrini et al., 2021). The purpose of global development, like that of any good national development policy, consists of promoting the growth of the capabilities of everyone (Ponce et al., 2018).

In this perspective, it is the 2030 Agenda itself that identifies community cohesion as one of the key elements for building an enabling environment for the full realization of rights and the putting into practice of the abilities of children and young people (UN, 2015, 7).

The agency represents the effective opportunity of the subject to exercise his freedom in terms of skills, or ways of acting, doing and being that guarantee his full development as a human being, respect for dignity and the promotion of individual well-being and collective (Alessandrini et al, 2021).

2 Second Section

The challenge argued should see everyone trying to find unprecedented answers to extremely complex questions. For this reason, at the University of Palermo, an investigation is being carried out for the in-depth study of the topics exposed. The research group envisaged in the first instance the involvement of the students of the CdS in Pedagogical Sciences attending the following subjects: Methodology of Re- search in the Educational Field (189 students) and Docimology and laboratory (200 students) - a.y. 2021/2022.

The research process activated sees both students and the research team as protagonists, as it allows to activate a reflective action on teaching practice to be able to constantly im- prove it and raise its quality. The survey aims at understanding how much future pedagogues know and know how to apply the 17 objectives promoted by the 2030 Agenda. According to what has been said, it is therefore a pre- liminary reflection step that precedes an experimental intervention, expected for the next academic year, that will be based on the implementation of activities workshops designed and implemented using the CA and which focus on the objectives of the 2030 Agenda. The tool used is the "Capability Approach and Sustainability" questionnaire created and built by the research group and the data analysis is quantitative.

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Co-design and Co-teaching in Higher Education: a research experience

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1 Introduction

This paper describes the advancement of a previous design-based research [1] [2] [3] [4] [5] on a blended model of teaching conducted at University of Siena during the uncertain period of the Covid Pandemic. Analysis in that research brought authors to conclude that the disorienting dilemma produced by the epidemiological emergency transformed a period of high uncertainty in an opportunity for didactic innovation. Moreover, authors suggested that to facilitate this opportunity academic governance could have supported the emergence of micro communities of faculty members that would have fostered professional development [6]. Following that research experience authors started to work jointly in a micro community codesigning and coteaching academic courses.

In this paper authors have two main objectives: a) describe more in deep how the micro community designed learning resources and activities and b) analyze their interactions and those had with students during the lessons. The general aim is to highlights how novices had the opportunity to share skills and knowledge necessary to support senior colleagues in providing examples and points of view, underlining new actions to design and conduct technology enhanced courses. note that the first paragraph of a section or subsection is not indented. The first paragraphs that follows a table, figure, equation etc. does not have an indent, either.

2 Method

The authors worked together in six courses of the Bachelor and Master's degrees in Educational Sciences at University of Siena during the 2020/2021 and 2021/2022 academic years. The micro community meet daily in presence or on-line to design learning resources and activities to be adopted during synchronous and asynchronous lessons, like cases, forums, webinars, and formative assessments. The Moodle Learning Content Management System (LCMS), Google meet system for video conferences, and the Panopto software to record lessons were the institutional technological support. To these, micro community adopted other web-based software like Canva or Thinglink. Students enrolled in the courses were for the most female (94%) attending lessons on-line and in presence.

To describe how the micro community designed courses, authors highlight the following aspects: a) number and types of learning resources or activities developed; b) description of the learning resources and of the assigned activities; c) number of students' interventions in online discussions and during the lessons; d) quality of students' interventions in online discussions and activities carried out on-line and in presence. Data have been collected through logs in the LMCS and through content analysis of the task carried out by the students [7] [8] [9].

To analyze interactions between micro community members and with students during the lessons, videos have been analyzed. Authors conducted video analysis following three different phases: a) creation of a register for video recordings that included the annotation of minutes and seconds, a summary description of the scenes, and comments related to a specific scene; b) transcription of the videos including dialogues, non-verbal language, and details of the scenes to refine the data archiving and annotation process; c) creation of meaning categories to examining social interactions starting from the transcription of the videos [10] [11].

3 First results and emerging themes

In this paper authors describe the joint work of codesign and coteach six academic courses. Even if data analysis described before is still ongoing first results and themes emerge. Resources and activities designed show an extreme variability, from the most traditional as forum discussions and assessment tests to photo based self-reflection exercises with Thinglink. Generally, the LCMS logs show a good level of participation in traditional reflection tasks (i.e., writing reflections on the read resource) but those level improves when students' creativity and problem solve skills are called upon in performance-based activities or in project-based learning. Interactions among micro community and students during lessons grow when the expertise of the senior colleague in proposing more professional contents meet novices' knowledge and was applied to on-line team works. Finally, interactions among members of the micro community allow for teaching skills development in terms of class management, use of different media to propose contents and to allow students' expression, design of assessment and evaluation.

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How To Cultivate Transformative Learning in Faculty Development: Towards the Framework of the 4s Model.

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1 Transforming Teaching and Learning in Higher Education

1.1 Overview

The contribution presents the first results of an exploratory study on faculty perspective transformations [1] due to the massive shift to online and blended learning in the time of the pandemic of Covid-19 [2; 3; 4]. The study was carried out in 2021 at the Teaching & Learning Center of the University of Siena and involves 50 faculty members, coming from a variety of disciplines and subjects. The conceptual framework included the methodological international literature on faculty development [5; 6; 7],on faculty community of learning [8; 9; 10], on methods for learning from experience in organizational and Higher Education contexts [11; 12; 13] and on collaborative and transformative research in Higher Education [1; 14; 15; 16].

The research questions were:

1. How and to what extent has the massive shift to emergency remote teaching changed faculty perspectives on teaching and learning?
2. What are the teaching methods that will be most promising in the integrated digital teaching post-Covid19?
3. How and to what extent can faculty be accompanied in a revolutionary process of reconfiguring their professional identity and epistemology towards the new digitalbased scenarios?

Starting from those questions, the Authors developed an exploratory study with colleagues from several subjects belonging to 14 different University departments.

40 faculty from University of Siena took part: they were all enrolled in a training course for active learning methodology for blended learning. Furthermore, 10 faculty and director of Center for Teaching and Learning of foreign universities (USA, Canada, Greece) were interviewed.

2 Towards the framework of the 4S Model for faculty development

The research design implied 8 focus-group and 35 in-depth interviews to gather deep and rich data. Focus group and interviews were videorecorded and transcribed ad verbatim. The data analysis process was iterative: a thematic content analysis was carried out, using the N-Vivo12 software to support researchers handling the coding

[17], and implied several coding steps in which three researchers worked first independently and then combining the results.

Findings suggest that institutions could benefit from the course and initiatives created during the pandemic for updating and re-adapting teaching practices carried out in the classroom. The results also show significant changes in epistemological perspectives about their professional epistemology for 30 participants: only for part of them this shift in epistemological premises about themselves as faculty resulted in teaching changes. For most of them, a polarized thinking about a dichotomy between online/in presence teaching still prevails. In addition, the analysis of participants' responses allowed to formalize a model to respond the new challenges of the post-Covid 19 university: the 4S model to faculty development, where the 4S is the acronym for Sociocracy, Space, Sustainability and Share dimensions of faculty development. The 4S model organizes into four dimensions the material and immaterial conditions, factors, and contextual elements that *moderate* and influence the different competencies developed by faculty and the changes in their traditional teaching practices.

Future research in the field might apply and test the 4S model to faculty development to enhance faculty self-efficacy and teaching effectiveness. To facilitate a large-scale evaluation of the framework with other institutions, the Teaching & Learning Center of the University of Siena is currently working on a dashboard for the dissemination of the 4S Model.

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Technology enhanced assessment and feedback practices: findings from a syllabi analysis to inform academic development

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1 Theoretical framework

Nowadays there is a growing attention to teachers' and students' digital competencies in a now developed and digital world. The analysis of the European Framework for the Digital Competence of Educators [1] describes the educators' competencies and divides them into six main areas and in related 22 sub-competencies. In the context of these six competency areas (1 Professional Engagement; 2 Digital Resources; 3 Teaching and Learning; 4 Assessment; 5 Empowering Learners; 6 Facilitating Learners' Digital Competence), this study explores the area of assessment to understand how university lecturers implement the use of technologies within their assessment practices. As the framework suggests, the use of digital technologies in the assessment process can contribute to monitor learners' progress, to facilitate feedback and to allow educators to assess and adapt their teaching strategies. This research focuses on integration of technologies in assessment and, more specifically, on the use of semi-automated assessment systems, intended as "systems characterised by the fundamental features of an online submission process by students and distribution of assessed material back to the students in a coordinated fashion" [2]. A specific emphasis is given to semi-automated feedback systems, in order to understand whether academics use these practices in their assessment and feedback processes. Why have we decided to investigate this specific topic? The Digital Scholar Framework [3] identifies the main features of the modern university teacher as a digital scholar, intended as "someone who employs digital, networked and open approaches to demonstrate specialism in a field" [4, 5].

The development and growth of a digital scholar "not only refers to linearly growing and developing digital competencies, but also to exploring, hopping around and jumping back and forth, sometimes failing, sometimes succeeding, but always and steadily acquiring new competencies in a more complex, sophisticated way" [3, p.30]. Academic development initiatives are therefore called to equip professors with such digital competencies, to use technologies and data in their teaching, learning and assessment practices. [6] Raffaghelli (2019) highlights the importance of the development of data literacy for educators, to be applied in designing and implementing their assessment strategies. More specifically the author refers to: integration of data produced in the learning process for summative and formative assessment; generation, selection and analysis of data as evidence of learners' activity to inform teaching and learning; use data collected to offer targeted and timely feedback. The literature highlights the power of (semi)automated feedback provided by the technological system for formative assessment [7-10]: in fact, this type of timely feedback involves students in continuous processes of reflection on their own work and development of deeper learning processes. Automated feedback has also an impact on teachers, who play the role of learning facilitators [7, 9] and can continuously improve their teaching practice.

2 Aims

The research intends to investigate, in a national context, teachers' use of technology-enhanced assessment and feedback assessment practices using syllabi analysis. Therefore, the research questions are the following: 1. What technology-enhanced practices do university teachers implement in their assessment processes? 2. Are semi-automated feedback practices included in Italian academic assessment processes?

3 Methods

In order to answer the research questions a sample of 1145 university teachers belonging to the Italian state "Mega Universities", as defined by Censis in the classification of 2021/2022 edition, was identified through a simple random sampling with proportional allocation. The sample to be analysed in the present study was selected from a larger, statistically representative sample, consisting of 5% of the comprehensive population and constituted by a subpopulation (n=3008 teachers), extracted by stratifying the entire population of Italian lecturers of all state and private universities (n=60158).

The found subpopulation represents the 5% of the overall population of the Mega Universities (22968 lecturers). It was decided to refer to the lecturers affiliated to the Mega Universities, assuming that they present the widest variability in terms of teaching characteristics, thus ensuring the possibility of obtaining a sample with the highest variability possible. Beginning with the identified sample we randomly selected, for each lecturer, the Syllabus referred to a single teaching unit. However, it wasn't possible to find the totality of the documents because they weren't available on the Universities' website.

4 Results and conclusions

The preliminary analysis shows that there is a lack of use of assessment or feedback practices implemented through the use of technology among the university Italian syllabi. The analysis is still ongoing, but it already appears that only a minority of teachers declare to use technology-enhanced assessment practices. Among the limitations of the research, we highlight that the academics may not have declared the use of technology applied in their assessment and feedback approaches as it was not required by the syllabus format. In fact, the research shows the need for a shared syllabus format to make the syllabus design homogeneous across universities, hence a syllabus model that would include the introduction of accurate information on the use of technology in teaching and assessment practices, as a pact for clarity, transparency and student involvement. Despite the pandemic, it seems that academics still need training and guidance to integrate technologies in formative and summative assessment and even more in feedback practices. Theoretical, practical, and policy implications are discussed along with avenues for further research. The results of the research will inform faculty development processes aimed at fostering the development of new assessment skills for university lecturers to become digital scholars.

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Hybrid mediation to faculty developers: didactic and organisational intersections in the TLC Uniba

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1 Changes in Higher Education: qualification of teaching and hybrid learning environments

The Recommendations of the Ministers of the European Higher Education Area [1] highlighted how university teaching qualification processes are related to a student-centered vision of learning, the continuous improvement of teaching practices and the ability of universities to support improvement of teaching-learning processes. The implementation of organisational-didactic changes, already envisaged by the Bologna reform [2] and aimed at promoting students' skills, appeared even more necessary due to the Covid-19 emergency. It has been a push towards an organisational rethinking of universities and greater flexibility and hybridization of learning environments [3, 4]. The growing use of technologies in university teaching represents a strong factor of change in the context of higher education [5] thanks to more flexible and accessible virtual spaces [6, 7]. This requires on the part of the teacher, an adaptation of their teaching strategies and the ability to act in different contexts, in presence and at a distance [8]; by universities, new training approaches to promote sophisticated knowledge not only of a disciplinary and / or pedagogical type, but also of a techno-logical-logical one [9]. Universities have been called upon to structure interventions in favor of hybrid teaching and the development of teaching skills through Faculty Development actions [10].

2 The faculty developer as a change agent in university teaching

In order to facilitate the actions of change and innovation in higher education, universities usually target one or more figures acting as manager of Faculty Development actions and programs [11]: these are the faculty developers, "agents of change" [12] and promoters of the improvement of didactics within the departments [13, 14]. They act within the Teacher and Learning Centers (TLC) and are involved in processes of negotiation, construction and tuning of knowledge, skills and identity with the organisational context [15]; their training activities should be oriented to facilitate an adaptive and situated use of knowledge, supporting the reflective capacity on practice. The University of Bari structured, in 2021/2022, a curricular training model for faculty developers, intentionally designed to encourage the creation of interdisciplinary networks at the departmental level. The aim is to activate, within the organisation chart of the Uniba TLC, a community able to facilitate an analysis of its practices [16] and to formulate proposals for innovation to fulfill the system level in the University.

2.1 What hybrid mediation for faculty developers?

The curricular model has a "drop down" [17] and provides for different target groups: at an institutional level (macro), the Quality Presidium; at the training level of the trainers (meso), the departmental representatives - faculty developers; at the level of groups of teachers (micro), the communities of practice. 22 departmental representatives (one for each department) were selected as faculty developers willing to engage in the hybrid mediation training course, to implement the knowledge acquired in teaching practice and to support the training of new hires and expert professionals, with different skills profiles. The course includes the involvement of experts at national and international level, in co-teaching. Also thanks to specific adaptations of the Moodle platform, tools for re-elaborating the experience will be used to support critical reflection on the practice. The results of a survey will be described which involved the administration of qualitative-quantitative data collection tools: a multiple and open-ended survey and probing interview questions. The survey is part of a mixed-methods research-training protocol (Fig. 1) structured to evaluate the impact of training actions in hybrid teaching, the learning actually achieved, the possible repercussions on teaching practice and the point of view of the participants in the training, starting from the explanation of their motivations, expectations, previous knowledge, training needs.

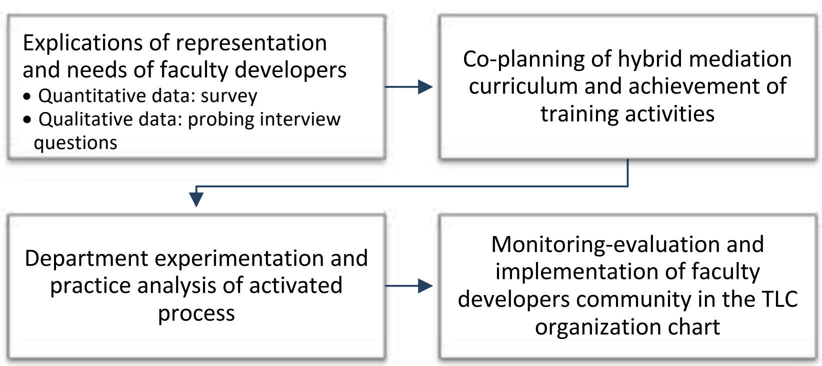

Fig. 1 – Research-training process on hybrid mediation to faculty developers

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Special Track 7

Artificial Intelligence and Multimodal Technologies in Education (AI&MTEd '22)

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Effects of a Collaborative Video-Learning-Tool on Flow Perception, Cognitive Load and Usability Evaluation

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1 Introduction

Educational research suggests that the use of videos for teaching, studying and learning can be meaningful and beneficial. E.g., Merkt et al. investigated the role of interactive features comparing print media with video learning [1]. They found that features that allow micro-level activities (e.g. pausing the videos) could actually show a benefit in learning success compared to using print media for learning. These results suggest that videos do have the potential to contribute to learning success, which is important for online learning environments, especially due to the changing learning structures triggered by COVID-19. However, social isolation is particularly observed in online teaching. According to Hiltz, this has the consequence that "one of the potential negative effects of online courses is a loss of social relationships and a loss of the sense of community that is usually present on a traditional campus" [2]. Therefore, she presupposes a type of collaborative learning for asynchronous teaching. Laal and Ghodsi examined collaborative learning as an educational approach and categorized the greatest benefits as social, psychological, academic, and assessment benefits [3]. They assume that learning in a learning group leads to higher success in the learning process and thus in examinations. The benefits and approaches of collaborative learning could mitigate the drawbacks of isolated learning at home and lead to more effective teaching.
To tackle this, we developed a collaborative framework called VGather2Learn (which in preliminary work was called Learnflix [4]), that supports students to watch and discuss teaching videos collaboratively in groups. By using this tool, students can collaborate on asynchronous teaching content and learn together through a chat and features to highlight specific video passages. VGather2Learn thus provides students with a form of communication and could be a useful tool against isolated learning.

2 Psychological Evaluation

To evaluate the VGather2Learn tool and its functionalities a psychological evaluation study got conducted. Overall, 17 students in 7 different groups participated and used the VGather2Learn tool for 2 learning sessions within 2 weeks (one week between each learning session). The average age of the sample was 22 years (*M* = 21.59, *SD* = 2.28). Unfortunately, the sample was not gender balanced, since 14 men and only 3 women participated. The evaluation was not embedded into an overall lecture or course program. Two independent science videos (Effects of glutamate (1) and blue light caused by digital devices (2) on the human body) that were not related to the students' course program were used to prevent confounding factors of participants' individual learning progresses. Students participated in self-organized pre-defined learning groups of 2-3 people. The whole evaluation study got conducted online and participants received course credits for their participation. After an online written instruction by the experimenter the participants used the tool on their own and were asked to watch the video collaboratively (using the given features of the tool) with the overall goal to learn about the videos content (like it would be a video-lecture used in regular courses). To test the usability and effectiveness of the tool no further adjustments were made by the experimenters. Thus, all participants gathered in their learning groups on their own using the VGather2Learn tool that was embedded via Moodle. After both collaborative video watching sessions participants filled in a questionnaire to assess the tools (psychological) effects. To test, whether the tool enhances the learning process or if it distracts from the actual learning goal, participants flow [5] and cognitive load [6] got measured. Moreover, different scales were used to measure the tools usability (SUS) [8], Enjoyment [7], Perceived Ease of Use [8]) and participants usage intention (self-constructed scale). Moreover, we checked for the social components and investigated how save participants felt in their group during the collaborative learning process (Perceived Saftey [9]). T-Tests were used to check if the sample's means significantly differ from the scale's center (indicating a low or high value). Results indicate that participants experienced a flow state (M = 5.37, SD = 0.94), that their extraneous cognitive load is low (M = 2.23, SD = 1.28), while the germane cognitive load is high (M = 5.00, SD = 0.89), when using the tool. This means that due to the low extraneous load participants are not distracted by the tool's functions and that due to the high germane load participants were engaged into the learning process. Moreover, learners felt save in their group (M = 3.49, SD = 1.21), and this positively correlates with the germane load (the engagement into the learning process) (r = .626, p =.002). In addition, the tools usability evaluation was good (M = 78.86, SD = 15.24), and participants indicated a high enjoyment (M = 3.92, SD = 0.90), ease of use (M = 4.13, SD = 0.77) and perceived usefulness (M = 3.15, SD = 1.13) of the tool. This enhances the overall usage intention.

3 Conclusion

To conclude, this work presents a psychological evaluation of a collaborative synchronous video based online learning tool that supports learners to jointly watch and discuss pre-recorded videos. As assumed, the evaluation demonstrated positive effects of the tool, since it enhances important psychological processes (like flow and cognitive load) within the learning process. Moreover, its usability was rated as good and participants showed a high usage intention for the tool. Nevertheless, further investigations in long-term learning courses are needed to finally confirm the tools effectiveness.

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Validation of the Relationship among Brain Waves, Heart Rates, and Facial Expressions during Programming Learning

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1 Introduction

Thus far, several studies on electroencephalogram (EEG) and research on applying EEG measurements to learning have been conducted[1][2]. The value of β/α was also evaluated [3]. We also conducted follow-up experiments [4][5]. However, it is unrealistic for learners to wear an EEG for learning.

In this study, we aim to discover biometric information that is an alternative to brain waves for estimating the learning state. We measure biometric information (brain waves, heart rates, and facial expressions) when performing programming tasks of different difficulty levels. Then, we try to explain the brain waves in terms of heart rates and facial expressions.

2 Explanation of brain waves by heart rates and facial expressions

2.1 Experiment

A total of nine fourth-year students of the Shonan Institute of Technology were included in the experiment. We measured brain waves, heart rates, and facial expressions (anger, contempt, disgust, fear, joy, sadness, surprise, neutral, engagement, and valence) while performing three types of tasks with different difficulty levels and obtained 27 experimental data.

2.2 Analysis

Although other types of brain waves are also considered in our research, we focus only on low α waves (α_l) and low β waves (β_l) in this article due to the page limitation. We seek a regression equation that describes the ratio β_l/α_l in terms of heart rate and facial expression. This time, for selecting explanatory variables, a multiple regression fraction is obtained by round robin (all combinations of 11 types of explanatory variables). Cross-validation is performed for the 27 experimental data with each combination of explanatory variables using the leave-one-out cross-validation. Particularly, one of the 27 data was used as test data, and the remaining 26 were used as training data. Multiple regression analysis was performed using 26 data to obtain a regression equation. We applied the test data to the regression equation to obtain the predicted value. We then found the difference between the predicted and measured values. These were repeated 27 times to obtain the root-mean-squared error (RMSE). These 27 iterations were performed for all combinations of explanatory variables to find the optimal combination of explanatory variables, i.e., the combination with the minimum RMSE.

2.3 Result

We performed the analysis according to the method in the previous section. The multiple regression equation using the combination of explanatory variables with the minimum RMSE value (0.0464) is as follows:

$$\begin{aligned}\hat{w}_1 = &-0.0072z_1 + 0.2409z_3 - 0.3228z_4 + 4.6063z_5 + 0.2140z_6 + 0.1784z_7 \\ &-0.8902z_8 + 0.1308z_9 - 0.0165z_{10} - 0.0455z_{11} - 0.0261 \qquad (1)\end{aligned}$$

where $\hat{w}_1$ denotes the predicted value of β_l/α_l, z_1 denotes heart rate, z_3 denotes contempt, z_4 denotes disgust, z_5 denotes fear, z_6 denotes joy, z_7 denotes sadness, z_8 denotes surprise, z_9 denotes neutral, z_{10} denotes engagement, and z_{11} denotes valence.

3 Conclusion and future work

In this study, we collected biological information during programming learning through experiments and obtained multiple regression equations that predict brain waves from heart rates and facial expressions. We used cross-validation to select explanatory variables and found the optimal combination of explanatory variables. Our study is at an early stage and used classical multiple regression analysis. In the future, we would like to use machine learning techniques to perform our analysis. In addition, we would like to perform further experiments to increase the sample data to improve the accuracy and clarify the relationship with the educational effect improvement.

Research ethics

The experiments were approved by the Research Ethics Committee of Shonan Institute of Technology. We also received signatures from examinees and parents of the examinees concerning experiment participation.

Acknowledgment

Part of this research result was carried out as a part of the research project "Research on e-learning for next-generation" of Waseda Research Institute for Science and Engineering, Waseda University. Part of this work was supported by JSPS KAKENHI Grant Numbers JP22H01055, JP21K18535, and JP20K03082. The research leading to this paper was partially supported by the grant as a research working group "ICT and Education" of JASMIN.

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Use of conversational agents in the university environment: First results

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1 Introduction

Conversational Agents have been identified as a tool that have gained popularity in the resent times, and it is a system than have been adapted and developed for many different domains [1]. Among other fields of application, the educational arena has a great potential for its application. There are many different scenarios of application, ranging from of information structuring and organization to facilitating the different processes such as student admission, support for educational processes, both in teaching and tutoring levels. Another relevant scenario, as described by Clarizia et al. [2] is the reinforcement of internal training procedures for the continuous improvement of all the roles that work in a university: administrative personnel and faculty members. According to [3], speech-based CA are closer to the human language than text-based ones. Thus, voice interaction is often used in customer support.
In this article we present a case study where an ALEXA-based Conversational Agent was used to deliver the course material to the students in a course. We have chosen ALEXA, which has been used in many cases reported in the literature [4], [5], [6], [7], [8]. In the presented case study, the students were able to ask the CA for new content, to ask for an evaluation test or ask for contents related to a given content. This CA was deployed during 15 weeks in two actual courses being taught at the hosting University.

2 Methodology

The methodology in use for the experiments is described as follows: first, we deployed a preliminary usability study. There, 6 volunteer students were observed while using the CA in a test case. As a result, we observed the need to split course contents (i.e. text with long paragraphs) in a set of short learning pills with no more than 20 words each. Also, we defined the type of actions more suitable for interacting with the CA: listening the pills in a sequential way, asking for specific parts of the content, or asking for the contents that explains specific concepts. With the lessons learned from this usability study, the conversational flow was designed. The designed flow allowed the students to maintain a fluid conversation with the CA without the need of previous training, and had the required adaptivity to fit the needs of different student profiles, depending on their experience on the use of Cas, and also depending on the previous user interactions with the system. The conversational flow was also designed to contain evaluation procedures, so that the students could ask for a test that challenges their acquired knowledge. This evaluation procedure is based on multiple choice questions. After that, the conversational flow was filled with the actual course content, which was correspondingly adapted to the case of use as described above (i.e. short pills instead of long paragraphs), and also with a collection of multiple choice questions.

Two courses were chosen to deploy the CA: “Entrepreneurship, innovation and digital creativity” in a Master’s Degree in Educational Technology and Digital Competences taught at the Faculty of Education where students have a not-technical profile; and “Human-Computer Interaction” in a Computer Science Degree, where the students had a technical profile. In both courses, the students were divided into control and experimental groups, where the CA was offered only to the experimental group. The students were randomly assigned to the groups. The CA was offered to the students with no award nor extra score in the course.

The analysis will follow a mixed model, considering these information sources: surveys launched for all the participants, interviews with a reduced number of participants, usage data for both the chatbot and the virtual campus and, finally, the obtained grade. Surveys and interviews will focus on measuring the TAM model for this system, also for understanding how the chatbot influenced the interaction with the course.

3 Result

A total of 800 students were enrolled in those courses, with 550 students in the experimental group and 250 in the control group. The evaluation of the impact of the CA in the course was based on understanding how, and how much, was the CA used, what was the students’ satisfaction and perceived usefulness. The evaluation also includes the comparative analysis of the final course results and interaction patterns of those students who made intensive use of the CA and those who did not. Table 1 presents preliminary usage statistics, with the course still on-going.

Table 1. Usage data from 2/23/22 To 5/10/2022.

Data	Sessions	Unique Customers	Utterances
Sessions	**585**	**103**	**2.613**
Unique Customers	**28** (03/01/2022)	**11** (02/23/2022)	**148** (03/01/2022)
Average per day	**7,46**	**2,94**	**34,37**

Future research lines include the qualitative and quantitative analysis of the students satisfaction and perceived usefulness, and also an analysis of the course results with and without using the CA. In a preliminary analysis, it has been observed that:

The case study reveals low level of participation. The identified cause for such low level is the lack of reward in the final grade for those students who uses the CA. That is, the CA was offered as a complementary tool, and the students recognized that, given the course workload, they are more prone to use the already known interface rather than experimental ones. Future experiments will reward the users to encourage CA usage.

Many students reported usage problems caused by their lack of experience with CA interfaces. Thus, the students did not know how to ask for course content. This reveals the need to introduce guidance systems for novice users. TAM surveys were launched in July that will allow us to obtain qualitative data. As of July 24, we have 55 completed surveys. Finally, multiple students acknowledged their use of text-to-speech tools, so that they listen the course content. This fact reveals a great potential of CA for interaction with course content, where a CA is by far more interactive that text-to-speech tools.

As conclusion, the presented case study for the delivery of course material in two authentic courses at a university level, where the preliminary results reveal interesting lessons learned that will be applied for the improvement of future experimental cases.

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An Artificial Intelligence-based system for fast configuration of cultural and learning paths

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1 Context

Cultural heritage provides a favourable context for stimulating and enriching knowledge. Cultural experiences can contribute to the development of creativity and can be a stimulous for learning. The crisis caused by the COVID-19 health emergency has highlighted, on the one hand, the need to develop alternative forms of learning and enjoyment and, on the other hand, the great opportunities offered by technology.

Some works have been already proposed in this context. For example, simulation videogames for engaging visitors [1] or, more in general, systems allowing extremely realistic virtual tours. Other approaches focus on interactive storytelling like Proteous [2]. It takes advantage from linguistic hierarchies such as WordNet or ConceptNet to introduce new planning actions which produce different stories starting from a storyline baseline. Fidas et al. [3] report some end-user authoring tools to create mobile applications for the cultural heritage domain.

One of the valuable tools used in these approaches is technology-enhanced learning (TEL) to support and enhance learning processes [4–6]. TEL-based systems offer significant opportunities and alternatives to classical learning methods, but suffer from many problems related to authoring, i.e., content creation. It is estimated that for each hour of use 200-300 hours of overall development are necessary [7].

2 The system

In this paper, we present our work toward the development of systems that help content generation for learning paths. Specifically, we present WikiTEL, a system for the rapid configuration of courses to be delivered to learners in a personalized way.

We started with a system, called ExPLoRAA [8, 9], which aims to support experiential learning through the use of automated scheduling. This system has been integrated with an authoring tool, called Wiki Course Builder (WCB) [11], which leverages semantic analysis of Wikipedia pages and allows for the generation of personalized lessons [12] based on appropriate sequencing of Wikipedia pages. Many studies on Wikipedia state that it is a valid learning support both for students and anyone who wants to search for information quickly and satisfactorily. In 2016, the vast majority of university students were using Wikipedia [13] while its use still encounters resistance from lecturers who, consequently, negatively influence students' approach to this instrument.

Additionally, the integration of ExPLoRAA and WCB has been enhanced with more accurate user modeling. The teacher has also the possibility to add content (files, pictures, etc.) in addition to Wikipedia pages.

From a methodological point of view, this work integrates several AI technologies ranging from semantic reasoning to automated planning and machine learning techniques, allowing the implementation of the above services, resulting in the definition of a flexible tool for the management of teaching materials.

Specifically, WCB allows the categorisation of Wikipedia resources that support adaptability, while Exploraa supports the generation of paths by a timeline planner. When the teacher (modelled according to his or her interests) sends a request to WikiTEL, the response is a set of Wikipedia pages selected according to their proximity to the request and the teacher's model. Machine Learning techniques make it possible to establish prerequisite relations between the selected pages [14]. Then, each user will receive a personalized plan with the proposed activities. The personalization depends on the users' interests.

3 Applications and future work

From the application point of view, the proposed system can be very flexible and can be applied to different contexts ranging from the management of educational materials to the creation of fruition paths and visits to cultural heritage. For example, the teacher can create some content about "Matera" by a simple search that returns the nodes linked to the Matera Wikipedia page. The nodes are ordered on the base of their proximity to teacher interests. In this way, the teacher can select the most relevant nodes and deepen into a node to search for further interesting links. Once the content is ready, different people with different interests and objectives can have their own paths to follow. Specifically, if a tourist is interested in Palombaro Lungo he or she will receive a path different from the one suggested to a geologist interested in the structure and materials of the area, or someone interested in the history of the location.

In today's professional contexts, where the interconnections between cultural domains are constantly growing in relevance, the WikiTEL application can be defined as a real *cultural cross-over*, i.e. a tool that focuses on disciplinary connections and helps to deepen the components of cultural heritage knowledge.

We are in the process of setting up the system for large-scale experimentation.

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Transformer-based Recommender

Enabling Automatic Flashcards Generation

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1 Transformer-based Flashcards Generation Framework

Flashcards are the main tool used in the Spaced Repetition [1] evidence-based learning and memorization method, yet there are not always available for many topics due to the high effort required to create them. The combination of Transformer based models [2] with a Recommender System (RS) can enable a dynamic model to auto generate flashcards as recommendations for learners and serious game players, thus improving their learning achievements.

In previous work we introduced an Intelligent Serious Games (ISG) model [3] by combining hybrid Deep Knowledge Tracing (DKT) [4] with a Transformer-based Recommender. The ISG aims to predict the results of the next missions for players in gameplay with enabling flashcard recommendations when needed so that players can complete the missions successfully. However, in the previous work of the ISG model we focused on evaluating the DKT models. In contrast, this work comes to focus and extend the Transformer-based recommender [3] taking into consideration future directions of recent systematic reviews in [5], [6] related to questions and answers generation.

In this study, we introduced a novel architecture and specifications for the Transformer-based recommender [3] (see Figure 1); we also introduced and evaluated a novel Transformer-based Framework tailored to three NLP tasks to auto generate programming skills flashcards (see Figure 2). The main contributions of this work are as follows: (1) we fine-tuned and evaluated the GPT-2 [7] and GPT-Neo [8] models on a new textual dataset called C++ Code Guide (C++CG) to generate paragraphs related to programming skills; (2) we fine-tuned and evaluated BART [9] and T5 [10] models on a new dataset called C++ Summaries (C++SUMM) to generate answers from given paragraphs; (3) we fine-tuned and evaluated the T5 model on a new dataset called C++ Questions/Answers (C++QA) to generate questions. More information will be available in the full paper.

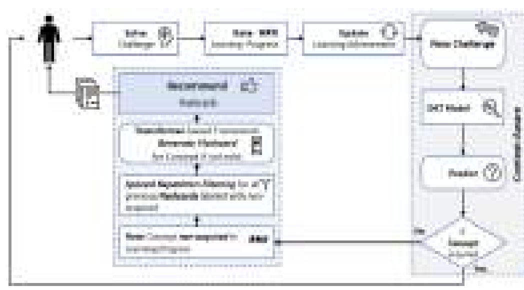

Figure 1. Transformer-based Recommender Architecture

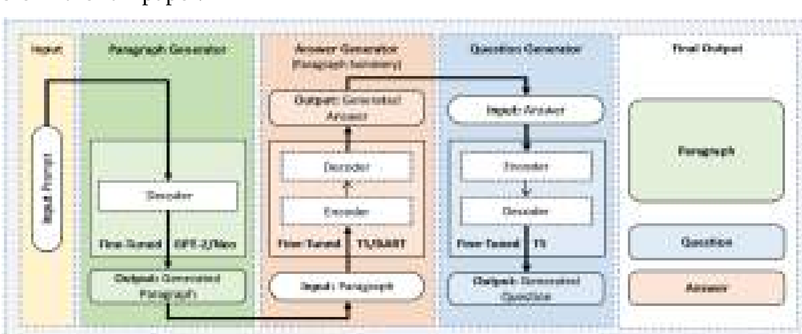

Figure 2. Fully Automated Flashcards Generation Framework

2 Experiments, Results and Conclusions

Using Google Colab, we conducted three experiment sets to generate flashcards in the form of Questions, Answers and supporting Paragraphs as follows: (1) we fine-tuned GPT-2/124M and GPT-Neo/125M on the C++CG dataset to generate C++ related paragraphs; (2) we fine-tuned T5-large and BART-large on the C++SUMM and cnn-dailymail [11] dataset to generate C++ answers by summarizing the obtained paragraphs; (3) we fine-tuned T5-large on the C++QA and on SciQ [12] datasets to generate C++ questions from the obtained answers. We considered three standard metrics to evaluate the N-gram overlaps [13], [14] and the cosine semantic similarity [15] to ensure coherence and semantics of the text.

Table 1. Models' Performance in Generating Paragraphs

Model	Testing Set	Sacre BLEU Precision	ROUGE-1 F1 score	Cosine Semantic Sim.
GPT-2	Set-1	0.808	0.843	0.937
	Set-2	0.918	0.880	0.930
	Set-3	0.901	0.876	0.959
GPT-Neo	Set-1	0.808	0.847	0.944
	Set-2	0.795	0.771	0.860
	Set-3	0.922	0.843	0.965

Table 3. Models' Performance in Generating Questions

Model: T5				
Exp No.	**Percentage of C++ Topics in the Training DS.**	**Sacre BLEU** Precision	**ROUGE-1** F1 score	**Cosine Seman-tic Sim.**
1	0% of Topics	0.205	0.251	0.563
2	15% of Topics	0.503	0.595	**0.768**
3	25% of Topics	0.48	0.576	0.789
4	50% of Topics	0.597	0.631	0.838
5	75% of Topics	0.702	0.666	**0.859**
6	100% of Topics	0.729	0.739	**0.868**

Table 2. Models' Performance in Generating Answers

DS	Model	Search Algo.	ROUGE-1 F1 score	Cosine Seman-tic Sim.	Sum-mary Ratio %
DS1: C++ with cnn-dailymail	BART	Sampling	0.624	0.869	44.0
		Beam	**0.634**	**0.873**	**44.5**
		Greedy	0.622	0.869	46.2
	T5	Sampling	0.558	0.832	57.0
		Beam	0.575	**0.850**	**57.4**
		Greedy	0.564	0.847	57.2
DS2: C++ alone	BART	Sampling	0.595	0.856	43.6
		Beam	0.596	0.856	43.3
		Greedy	0.622	0.870	44.8
	T5	Sampling	0.485	0.792	53.4
		Beam	0.482	0.805	53.1
		Greedy	0.456	0.797	56.4
DS3: cnn-dailymail alone	BART	Sampling	0.515	0.824	16.1
		Beam	0.514	0.827	15.4
		Greedy	0.543	0.837	17.7
	T5	Sampling	0.433	0.773	21.7
		Beam	0.448	0.791	21.1
		Greedy	0.45	0.793	21.0

Table 1 shows that the models are capable of generating paragraphs related to C++ programming skills with F1 scores higher than 85% and 90% for the cosine semantic score. Such high scores for both metrics confirm the models maintained two important factors, namely coherence and meaning. Results in Table 2 evidence that the models are capable of summarizing paragraphs and generating C++ answers with a semantic similarity score always higher than 0.79 and the best summarization ratio reaching 57.4%. Also, combining C++ and cnn-dailymail summaries together achieved better scores on all metrics, whereas using a dataset with only out of topic summaries downgraded the performance. Moreover, the summarization ratio uncovers the importance of using this metric in the summarization task. In particular, the models in some cases achieve acceptable scores, but they are regenerating almost the same input paragraphs such as in DS3. Overall, the BART model demonstrated better metrics scores, whereas T5 model showed better summarization ratio. Finally, the qualitative evaluation uncovers that the beam and the sampling decoding methods are better than the greedy one as the latter is mostly returning the same sentences without rephrasing them in new ones. Table 3 shows that the T5 model is capable of generating coherent questions with a semantic similarity score around 0.87. Also, results highlighted that the model is able to generate coherent questions even including only 15% of the topics in the training data. Furthermore, we investigated the influence of the dataset size on the performance of the generated C++ questions and on the science questions dataset. Results for both datasets show that increasing the number of relevant questions in the training data can improve the performance of the generated questions. These results underline the importance of having a relevant Q&A dataset so that the model can recognize the context and the terms' dependencies for a certain subject. Overall, we presented in this work a novel architecture and specifications of the Transformer-based recommender for the ISG model. We introduced and evaluated a novel Transformer-based framework tailored to three NLP tasks to generate flashcards in a fully automated process.

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Special Track 8

Experience-based training activities for online higher education

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Designing Gamified Learning Activities on Digital Teaching in Higher Education

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1 Introduction

In recent years, due to the Covid-19 pandemic, higher education has been challenged to rethink and reconvert its teaching and assessment practices [1, 2, 3]. Both distance or hybrid modes entered university teaching, involving a massive use of digital technologies [4], and determining social [5, 6] and psychological [7] conditions that have heavily influenced the students' approach to university life. In particular, a sense of declining motivation is reported in several studies [8, 9, 10], urging teachers to find new strategies for engaging students. This contribution intends to present an experience conducted by the authors in the course of "Nuove Tecnologie per l'Educazione e la Formazione" held by Prof. Maria Ranieri at the University of Florence in hybrid mode.

2 Gamification to promote learning and engagement

Gamification was a key ingredient of the course. As well known, gamification refers to "the use of game design elements in non-game contexts" [11, p.10]. It is, therefore, a manipulation of playfulness, intentionally pursued in the design phase, using the game as an educational tool. Clearly, it doesn't happen only by adding points and badges but it requires a preliminary design effort taking into account: how the game is used, its design and elements, the player characteristics and the academic context in which it is applied. This means that the task of the university teacher is not simply to build tools, but to design meaningful learning experiences, characterized by learning by doing; to develop forms of intrinsic motivation to learn; to offer the possibility of conveying knowledge by providing enjoyment; to maintain the authenticity of university instructional design oriented by specific learning goals; to leverage the autonomy of attending students within the process, fostering self-efficacy and self-esteem [12]; and make post-covid university teaching increasingly inclusive and engaging [13].

3 Instructional design of course activities

The designed model was delivered during the five lectures of the course, taking up two of the total four hours of each lesson and addressing topics covered in one of the examination books [14]: Special Needs Education (SEN), game-based learning, design of game mechanics and gamification in education. It was based on three assumptions [15, 16]: a) the relevance of mobilizing pre-existing knowledge, b) the importance of providing learners opportunities to apply knowledge, and c) the value of formative assessment for authentic learning, and involved three phases per lesson: a) introduction to the topics of digital technology for inclusive education, b) collaborative learning activities, and c) formative assessment of results and scoring (Table 1). Game design elements were introduced in each lesson in terms of challenges, winners and scores.

Lesson	**(a) Activation**	**(b) Application**	**(c) Assessment**
#1	SEN	Collaborative creation of inclusive avatar	Peer Evaluation
#2	SEN & Learning	Observation of game-based digital tools	Automatic Feedback
#3	Videogame education	Analysis of the game mechanics of an educational videogame	Self- and Expert Evaluation
#4	Game elements	Writing assignment of a Game play	Peer Evaluation
#5	Gamification	Design of an educational, digital and inclusive game	Expert and Peer Evaluation

Table. 1. Summary of key elements of the course design.

The Moodle platform was used for the general presentation, technical instructions and rules for each phase. As for the five activities, their assessment and reward methods, both internal features (workshop, quiz, assignment, rubric, badges) and external tools (digital bulletin boards, student response systems, forms) were used to create the tasks to be performed collaboratively. Attending students (n=203) were assigned to 20 teams and given instructions for the gamified progression in the course represented by leaderboard, points and grading criteria. Though results on students' satisfaction and learning are still under analysis, it can be observed that a high level of attendance characterized the course with all students participating in a no mandatory course until the end of an intense experience.

4 Conclusion

New challenges are arising on the horizon of higher education systems. Reshaping traditional practices of teaching to increase the quality of education and (re-)engage students, after a tough period of unplanned events, has become a priority for academic institutions. Gamification may provide opportunities to renew university teaching leveraging on students' participation and engagement. The experience presented here was based on the integration of gamified elements in a course on inclusive digital education. Further studies will be necessary to unlock the pedagogical potential of gamification for higher education.

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Online group activities and exercises to replace those in the classroom: indications from the pandemic phase

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1 Introduction

The adaptability of some didactic experiences to digital contexts has actually generated new products and tools that have enormously expanded the offer for academic teaching, even if not always can reproduce some dynamic aspects of group exercises and interactivity between participants [1].

Starting from 2020, universities have adapted their learning contexts to the pandemic situation, and frontal teaching has not suffered significant shocks from the transition from physical to virtual schoolroom; on the other hand, interactive group exercises, group role-playing, and other experiential class activities have been either replaced by other types of mainly individual tasks, supplemented by group discussion tools and applications in a virtual environment or recreated scenarios [2].

However, the exercises and activities in which it is necessary to observe, manage and monitor the relational dynamics in progress appear difficult to integrate into the online mode. There are numerous opportunities for integration between individual and group teaching, but fewer seem to be those for the reproduction of a digital environment in which people perceive live interactive signals from all the participants and participate in the observation and contextual management of group dynamics [3, 4]. Despite the theoretical and applicative importance of this object of study, the research appears to be heavily underdeveloped.

2 The present research

In order to address this current gap in the literature, exploratory research from correlational design was conducted to explore students' perceptions of both online and in-class learning activities., and to compare them with non-academic training contexts.

The research investigated what the possible operational and methodological solutions could be, the possible re-reading of the online interactive learning environment, the implementation of replacement interactive activities through online and digital resources, the evaluation of the results of participation in experiential activities in online mode, the effectiveness of replacement activities, the potential, and limits of online group interactive training.

The research was conducted in 3 small samples: 2 cohorts of students of the master's degree of psychology (2020/21, 2021/22) of an Italian university, and a group of students of a course reserved for graduates of the three-year degree (respectively, N = 56, N = 54, N = 89 subjects), with a mean age of 22.9 years. The participants were randomly assigned to groups with digital interactive scenarios and activities or with real physical scenarios. The differences in the score for the different variables were calculated through t-student and ANOVA, through SPSS 22.0.

Students' perceptions in scenario studies (digital vs physical) comparing the following variables, taken from a systematic literature review: the student's computer skills, experience with virtual environments, involvement, entertainment, satisfaction with the activity, and perceived effectiveness.

3 Results

Overall, the results indicate that if digital interactive activities have greater entertaining and involvement than activities in a real physical environment, the perceived effectiveness appears to be lower.

Through a reconstruction of the deficient aspects of the interactive experience, the students themselves collected ideas and proposals from the analysis of the literature and developed projects and improvement solutions. Among the suggestions, several appear to be entirely feasible: the creation of a simul-game in VR, based on video situations, stimuli, and decision-making; use of real physical groups and online observers; development of an online platform for basketball exercises (escape room model) with group comments, live chat and audio.

4 Conclusion

The reproduction of environments and live situations for teaching offers great potential but appears limited in the aspects of dynamic interaction underlying learning, and in the transfer of learning to the real world.

Is it possible to develop a virtual environment capable of reproducing a physical space that makes people interact online as if they were present in the same room? Future research will certainly have to lay the foundations for the development of new learning environments capable of preserving the dynamic-interactive aspects of training and learning, which today are reported among the fundamental life skills to be developed in university students for entry into the world of work [5].

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The invented case: an innovative (but not so new) instrument to teach law at distance

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1 Traditional approach in civil law systems and e-learning.

In Italy, and more generally in civil law systems, the traditional and most widely used approach to teach law at university level today is knowledge-based teaching centered on face-to-face (F2F) lecture [1, 2, 3]. Comparative law analysis reveals the link between the sources of law and the formation of the jurist [4, 5, 6].
On line teaching showed me the limits of the traditional approach: the most evident one was its low efficiency to induce students' skills development, in particular the skill to apply the known rules. It must be also noted that the current context requires the university to deliver more professionalizing education [7, 8].
I teach international contracts law in a degree course in Business Administration (bachelor program) whose aim is to prepare students to managerial responsibility roles in enterprises of every sector and/or to work as business consultants. Managers and business consultants must know law rules and they must be able to apply them in practice in order to choose the most adequate conduct to fulfil their own or their client's interests at best.
Looking for more efficient teaching strategies, in addition to traditional F2F lectures, I used the invented case method and I realized how it is efficient to induce the learning objective skills development. In practice I proposed to my students invented cases concerning explained items. After the theoretic illustration of an argument, I described an event or a situation using ordinary words and then I asked the students to find the solution, i.e. to identify the legal aspects and the position of the parties. The solution of the case implied a careful analysis of the event, the identification of the applicable legal institutions and rule, of the obligations and the rights of the parties and consequently the description of the conduct that each of them should have taken in order to pursue their own interests in the best way. Normally I proposed the case at the end of a lecture, asking the students to imagine the solution individually, looking for the necessary data. After a week, I explained the solution.

In conclusion, the invented case method teaches students how the rules work in practice: to know the rules does not imply automatically the skill to apply them to find the solution of a problem. Invented case strategy offers other important possibilities, especially in a digital learning context: an interdisciplinary approach (cases whose solution requires the application of different type date, for ex. legal and marketing data); a flipped-classroom mode (students read suggested materials about a general topic and then they attend a lesson discussing with the teacher a case involving the application of that general topic); a blended mode (at distance lectures about general topic and in presence meetings to discuss the cases applying explained items).
The author of this paragraph is Alberto Gianola.

2 Case method and case study method.

Case method to teach law is widely used in the USA [9]. The case method in legal education was invented by Christopher Columbus Langdell (Dean of Harvard Law School from 1870 to 1895). Langdell conceived of a way to systematize and simplify legal education by focusing on previous case law that furthered principle or doctrines. Students read the cases and came prepared to analyze them during Socratic question-and-answer sessions in class.
So later the Harvard Business School case study method grew out of the Langdellian method [10, 11]. But instead of using established case law, business professors chose real-life examples from the business world to highlight and analyze business principles. HBS style case studies typically consist of a short narrative, told from the point of view of a manager or business leader embroiled in a dilemma. Cases are based on interviews or public sources; sometimes, case studies are disguised versions of actual events or composites based on the faculty authors' experience and knowledge of the subject.
The case study method is not the Langdellian case method, but it is more of a problem-solving approach to learning. The business school case method presents students with real-life problems, used to identify issues that could occur within the operation of a business. As the decision makers, students review the cases to determine the causes of the problem and enumerate various methodologies to find a solution. The basic premise of this approach is that, rather than simply listening to a lecture about various options, students hone both communication and leadership skills.
New and emerging technologies are having a profound impact on how we learn. The Case Method is not immune to adaptation. The new approach is to facilitate and nurture new case format conversations with key schools to apply digital learning knowledge at the outset of course planning [12]. That way, new Case Studies can be expertly designed – and existing case studies enhanced – by monitoring content interaction via our born digital case platform that is responsive to how students and instructors use Case Studies.
The author of this paragraph is Domitilla Vanni.

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Experience-based activities in a blended model Master's degree

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1 Introduction

As of this academic year, the University of Ferrara has activated the Master's Degree Course “Formazione, comunicazione e cittadinanza digitale” (Training, communication and digital citizenship), belonging to class LM-93 - Theories and Methodologies of E-Learning and Media Education, in blended mode. The degree course is the fruit of a complex series of didactic-pedagogical reflections and many years’ experience built up in the field of media education. In this sense, the course was designed with the intention of responding to the needs posed by the advent of network technologies and the related changes that have taken place in our society and in our lives.

1.1 The context of the trial

Hence this is a highly challenging scenario from the training-educational perspective and which, of course, requires the regeneration of knowledge, contents and teaching practices, but also the promotion of new ranges of skills and competences. Taking into account that social reality is increasingly constructed and determined by digitization, higher education must allow students to develop academic skills on media, which are clearly necessary in the digital age. Indeed, if we think about the pioneering works of Flores d'Arcais [1], Volpicelli [2], Mialaret [3] and Lefranc [4], education sciences have for some time now indicated the elective perspective in education *towards media, with media and for media*, for the promotion of critical thinking, a multitude of viewpoints, discussion and doubt, yet neither schools nor universities have succeeded in embracing this opportunity, if not marginally. Now, precisely in consideration of all this, an educational model has been devised, which is able to: *(i)* combine theoretical knowledge, through the alternation of classroom lectures and video lessons presented on the Moodle platform, and practical knowledge, through laboratory activities to be carried out in person and/or remotely (synchronous and asynchronous); *(ii)* promote principles of responsibility and sustainability with respect to the learning and assessment processes in students, thanks to the reflection induced by ongoing feedback and the delivery of the work produced (e.g. essays, reports, articles, communication campaign projects, training unit projects, creation of media products).

1.2 Research methodology

The choice made clearly calls into question the concept of "authentic task" - educational operation based on knowledge, cognitive and practical skills in real situations - and the methodological option of Hahn, precursor of the current Expeditionary Learning Schools [5], an option developed by Kolb [6] with the stages of Experiential learning, by Mezirow [7] with the reflective experience, by Lave and Wenger [8] with Situated learning in communities of practice, without denying the fact that the real intellectual debt is owed to Dewey [9].

Naturally, all the teachings followed this model with margins of freedom and, in the opinion of the Authors, this will have a role in facilitating the achievement of so-called transversal skills, because it allows students to *(i)* look at problems in an interdisciplinary key, *(ii)* think "by connection" about the different aspects of knowledge, *(iii)* negotiate meanings through discussion with peers.

The teachings of the Authors took place within the didactic framework presented. The purpose of the work is to provide data on the experience gained in the respective three curricular courses, in an attempt to highlight the strengths and weaknesses of the degree model itself. To this end we will use both the testimony-description of what we experienced and the answers to be obtained from the qualitative-hermeneutic investigation in progress, in order to record the point of view of students on the didactic system applied, the perception of effectiveness, the perceived usefulness of the work done in terms of learning, and the difficulties encountered. The tool administered to 83 subjects is a questionnaire, built *ad hoc*, comprising Likert scale questions, with multiple choice and open answers.

The teaching in question took place in the first semester (Ganino) and in the second semester (Zappaterra, La Vecchia) and included practical collaborative activities in order to implement what was contextually presented on a theoretical level. In fact, the authors hypothesized that the conditions for profound, meaningful learning could actually lie right in the intersection between the two dimensions. In brief, the works produced were related to: the preparation of a series of didactic plans with a focus on disability and inclusion (Zappaterra), activities carried out with face-to-face groups and others online; the design and creation of media artefacts with a focus on communication (Ganino), an activity carried out with some groups alternately, in person and online, with others (composed of students who attended the entire online course) exclusively online; the reconversion of media artefacts already produced in an educational key (La Vecchia), and an activity carried out online in asynchronous mode, using a space dedicated to each work group on the Moodle platform.

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Training teachers’ digital skills after pandemic. A start-up study on ‘Didactic technologies’ laboratory at UniBg

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1 Initial training of primary school teachers and digital skills

Comparative research on initial teacher training (1) confirmed a trend towards 'simultaneous' models, experience-based training activities, the flexible offer, also thanks to digital support. Like any other professional higher education course. In Italy, the 'Primary Education Sciences' master degree qualifies future teachers of kindergarten and primary school through a close integration between university and school environment (2) and experimental organizational solutions that integrate lectures, internships and laboratories, also for what concerns the strength of teachers’ digital skills (3). The pandemic emergency has forced to find new solutions to carry out experience-based training activities in order to guarantee the expected outgoing skills, through online or hybrid methods (4) (5). Many investigations highlighted the effect of pandemic on higher education, among other things, the re-think the technological and digital skills of trainee teachers (6), as well as the positive feedback from students regarding virtual or hybrid laboratories (7) (8).

2 Context, objectives and methodology of the study

At the ‘Didactic technologies’ laboratory (3 CFU), held in the fourth year of the master degree 'Primary Education Sciences' at the University of Bergamo, students are asked to produce a digital storytelling (DTS) of about 5 minutes. Students must undertake a path structured in three macro-phases to produce three outputs (description of the project, script and storyboard, final digital story), and for each of the three phases they must evaluate the products of three colleagues, in a peer-evaluation process aimed at stimulating the students' creativity and the quality of their products (9) (10).
In 2021/22 years, a study has been started with the aim of (a.) knowing the perception of students regarding the ‘Didactic technologies’ laboratory experience; (b.) verify if the modality of participation in the laboratory - in-person/remotely - influenced the students' perception of the laboratory. An online 'ad hoc' questionnaire was administered to all attended students (n. tot. 150) - 102 students answered the questionnaire (68%) - at the end of the laboratory activities.
The statistical analysis of the data matrix was made on three levels: a. description of the student population involved – average age of 21-30 (75.49%); 0-1 years of service (50.98%); in remotely attendance (86.27%); b. description of the answers to questions

nos. 5-7 (see Table 1); c. study of the relationship between ‘in person or remotely attendance’ and the answers to the questions nn. 5-7 (see Table 2).

Table 1. Answers to questions nn. 5-7

Questions	N. (Tot. 102)	%
Characterizing didactic methods (n.5)		
content delivery	6	5,88%
alternation 'content-delivery' exercises	92	90,20%
exercises	4	3,92%
Most connection with (n.6)		
lecture	16	15,69%
other laboratories	18	17,65%
internship	68	66,67%
Strength of personal digital skills (n.7)		
not at all	0	0,00%
little	8	7,84%
quite	34	33,33%
very	49	48,04%
fully	11	10,78%

3. Early findings and some considerations

Table 2. Answers to questions nn. 5-7. Difference remotely- and in person-attended students

Questions	In-person, n. and % (Tot. 14)	Remotely, n. and % (Tot. 88)
Characterizing didactic methods (n.5)		
content delivery	0 (0,00%)	6 (6,82%)
altern. 'content-delivery' exercises	13 (92,86%)	79 (89,77%)
exercises	1 (7,14%)	3 (3,41%)
Most connection with (n.6)		
lecture	1 (7,14%)	15 (17,05%)
other laboratories	3 (21,43%)	15 (17,05%)
internship	10 (71,43%)	58 (65,91%)
Strength of personal digital skills (n.7)		
not at all	0 (0,00%)	0 (0,00%)
little	0 (0,00%)	8 (9,09%)
quite	3 (21,43%)	31 (35,23%)
very	9 (64,29%)	40 (45,45%)
fully	2 (14,29%)	9 (10,23%)

The descriptive statistical analysis allows at the moment to infer a difference between in person-attended and remotely-attended students, regarding:

- the characterizing didactic methods - in person-attended students most sensitive to alternation 'content-delivery' exercises; remotely-attended students most sensitive to ‘content delivery’;
- specifically, the connection of the didactic technology laboratory with other training activities - remotely-attended students most capable of grasping the connections with lectures and other laboratories.

In the full paper, data will be integrated with the analysis of statistical significance ($p<0.05$) and with the statistical regression between in person-attended and remotely-attended students.

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A visualization software tool used in teaching of scheduling algorithms

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Introduction

Nowadays, the teaching process is influenced by modern technologies. Therefore, new approaches that use these technologies are often used in teaching [1, 3]. At the Faculty of Management Science and Informatics of the University of Zilina in Zilina, modern technologies are used in several courses, one of which is a course called Principles of Operating Systems [2, 4, 5, 7]. In this course, students deepen their knowledge of the operation of operating systems, such as the modetexl of memory management and its allocation to individual processes, synchronization of processes as well as their planning, etc. Many of these topics are not easy for students, as multiple approaches and algorithms are used to implement them. One of these topics is process scheduling. Within it, it is necessary for students to master not only the scheduling process itself, but also the way of scheduling individual processes according to the given scheduling algorithm. For this reason, we have decided to implement a software tool that will appropriately visualize process scheduling and will take into account several process scheduling algorithms along with their specifics.

1 Scheduling algorithms

The process scheduler must decide which process from the queue of ready processes will processor be allocated to [6]. There are many ways for such decision and in this article we will focus on algorithms that are part of the teaching lectures of the mentioned course, namely: **1. First Come, First Served (FCFS):** This algorithm works in such a way that the process that first requests for a processor also receives it. **2. Shortest Job First (SJF):** The algorithm compares the execution time of individual processes and, based on this length, favors a process with a shorter execution time. **3. Priority scheduling:** This algorithm selects process based on his priority. Priority is the value assigned to a process and can be determined based on various factors. **4. Round Robin (RR):** Scheduling algorithm, in which the queue of prepared processes is traversed by a cycle and each is assigned to the processor for equal time. **5. Multi-level queue scheduling:** Scheduling algorithm, in which prepared processes are arranged in several queues, each of these queues having its own algorithm for planning and planning must also take place between individual queues as well.

2 Visualization software tool

The Visualization Software Tool (VST) is developed with an emphasis on a simple and clear display of the status of individual processes in the system as well as the most important information about these processes. The application includes process scheduling algorithms used in lectures. When VST starts, the main window will appear. This window can be seen in Fig. 1 and contains a form for selecting a specific scheduling algorithm and its properties. It also contains a form for inserting a new process, which depends on the selected scheduling algorithm. The user can easily control the scheduling execution and can define own processes. VST clearly displays information about individual processes during their run.

Fig. 1. Preview from VST

As can be seen in Fig. 1, added processes are placed in the table of processes in the main area of this application. Each row in this table represents one process with each characteristic of this process. Below this area there are buttons for simulation run management and Gantt graph with information about current state of execution of individual processes.

Acknowledgements This work was supported by the Ministry of Education, Science, Research, and Sport of the Slovak Republic under grant "Creation of methodological and learning materials for Biomedical Informatics – a new engineering program at the UNIZA" (reg.no. KEGA 009ŽU-4/2020) and the Slovak Research and Development Agency (APVV) under grant "Risk assessment of environmental disturbance using Earth observation data" (reg.no. SK-UA-21-0037).

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Behind the Scenes of the 2022 Edition of the Italian Coding League: Experience-based Learning for Computer Science Students

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Experiential learning is quite common in Computer Science degrees in the form of capstone projects [1,2] related to programming or data science. In this paper, we present an activity proposed as part of an introductory bachelor course on Computer Science Education, named ICDD (Computer Science for Creativity, Teaching, and Dissemination). The learning outcomes of the course include skills to design and conduct hands-on lab activities for introducing beginners to coding and programming. These hands-on activities are targeted to primary and middle school students and their contents are based on the national directions for teaching Computer Science in schools, proposed by the CINI (Italian Inter-university Consortium for Computer Science) [3]. In pre-pandemic times, our students acquired such skills through design and conduction of in-presence laboratories mainly based on block-based visual languages, such as Scratch [4] and Pocketcode [5]. The need to switch to the online setting gave us the opportunity to introduce an additional gamification element [6,7], by involving our students in the design and realization of an online coding challenge among middle school classes, named Italian Coding League[3] (ICL). ICL, jointly organized by the Digital School Interest Group of the University of Genova and by Edutainment Formula, took place in March 2022 and involved 609 students from 29 classes from 9 Italian regions. (The first edition of the ICL [8] was organized in 2021 with limited student involvement.) The competition was supported by the Smart O.C.A. online game platform [9] and was managed by the authors assisted by 15 tutors for a total of 112 hours of training and competitions among the classes. The involvement of the ICDD students in the experience of the ICL organization pertained several different aspects, as discussed below.

Conceptual Phase: Game Design. The first phase consisted in the preparation of the questions to be used in the challenge. Students were required to prepare quizzes distributed over three main areas of the CINI syllabus, i.e., algorithms, programming and data. A further requirement was to formulate them according to the main principles of Computational Thinking, i.e., relying on daily life algorithm examples (recipes, regulations, etc), and to properties of algorithms, so to distinguish algorithms from ambiguous or incomplete or non-terminating procedures. Many of the programming questions were related to examples of scripts in Scratch. The resulting 32 questions were discussed at length in a very engaging collaborative work involving students and instructors with in presence meetings

[3] https://coding.dibris.unige.it/

(16 hours) and online collaborative work (three weeks). As a second step, students worked on the presentation of the challenge, creating a game board and a graphical layout for the different questions via the Genially editor. The graphical layout was inspired to the 17 Go Goals of the Agenda 2030, a topic of interest by itself for schools. In the last step the questions were linked to the Smart O.C.A. game instance so as to provide a multiplayer game experience.

Concrete Phase: Game Conduction. After several internal tests, our students brought their artefact to the field by conducting 609 participants during both the selection phase and the final match. The tutors guided the different classes with independent online conferences sessions (via Google Meet). In the selection phase, each of the 29 enrolled classes went through a 15-question challenge with the help of their tutors. During the game, responses from individual students (or pairs) in a class were aggregated using WooClap, an online poll app. The answer most voted by the class was then entered by the tutor in the platform. Participants were left free to reason and discuss to avoid putting the brakes on the communication mechanisms already rooted in the class. The same challenge was then repeated in the following days by each tutor with the class, with no scores involved, and students first tried to tackle the questions individually, then the voted answers were commented in a plenary discussion to let the correct answer emerge. The final match was organized as a real competition among the 13 classes selected on the basis of scores acquired during the selection phase. Each class, connected as a single team to the Smart O.C.A. platform, had to tackle a new 17-step challenge. A shared game board displayed the teams position.

Reflection Phase: Learning Outcomes. According to the meta-cognitive [10] activity carried on after the experience, our students recognized the following as the main skills achieved or strengthened by the experience: (i) creating content aimed at middle school, matching CS knowledge and the topics required by the syllabus; (ii) appreciating the difference between knowing a subject and being able to teach a subject; (iii) focusing on the specific skill/knowledge assessed by a question; (iv) formulating clear and unambiguous questions; (v) team work and project management; (vi) inventiveness and creativity. In the same meta-cognitive final feedback, the main difficulties related to the experience emerged as formulating questions, at the appropriate level and targeted to a specific objective, and linking the questions to the Agenda 2030 objectives. Though the online management of the challenge was not simple, this was not perceived as a difficulty by the students. Being part of a bachelor's degree course, the proposed activity was a great opportunity for students to discuss their experiences, to propose and test their work to a real audience, therefore empowering their soft skills, and for instructors to establish a sense of trust and openness with students according to the experience-based learning criteria proposed in [11] and, specifically, concrete experience, active experimentation and reflective observation.

Acknowledgements. The authors would like to thank the students of the third-year bachelor course ICDD and the tutors of the 2021 and 2022 editions of ICL for their support and engagement in participating in the initiatives.

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Special Track 9

Intelligent Analytics for Process-aware Higher Education

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Predicting student's performance using environmental and activity metrics

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1 Introduction

Recently the education sector shows a significant development, in particular, in the research field of Educational Data Mining (EDM) [1]. EDM is a discipline, which through the exploration of big data, deals with the development of methods to better understand students and learning contexts [2], [3], [4]. The EDM also consists of the adoption of Machine Learning (ML) and predicting models to understand and predict students' performance and/or students' dropout [5]. The advantages of the adoption of ML to predict student performance are several including the detection of failure risk for each student, the assurance of student retention, and the course and resource allocations [6],[7].

This study aims to explore a new feature model and a set of machine learning classifiers to predict student performance by monitoring his/her activities in the Virtual Learning Environment (VLE). The features are used to train the classifier to predict the final exam result of each student.

The proposed model is evaluated by using a dataset built at the Open University of London [8]. The results show good performance of the proposed approach also compared to other similar studies [6], [9].

2 Method and Empirical Validation

This study proposes the adoption of ML binary classifiers to predict if the student passes the exam successfully from the analysis of a set of features extracted from data collected from the student's interaction with the learning platform.

The proposed feature model is described in Table 1. The considered features include socio-demographic information, the course characteristics such as the type of assessment, the weight and the score of the assessment, the date the student enrolled and unsubscribed from the module, the number of attempts the student had for the module; the information on the student's interaction with the VLE and study effort such as the number of days the student interacts with the material and the number of clicks on the VLE on that day.

FEATURE	DESCRIPTION
module	Name of the module
presentation	Year and month of the start of the module
date	Date of registration of the student on the module
module-length	Lenght of the module measured in days
gender	Gender of the student ("M"= male; "F"= female)
region	Geographic region where the student lives during the module
education	Highest education level of the student on entry to the module
imd	Indices of multiple deprivation referred to where the student lives
age	Age of student in classes ("0-35"; "35+")
prevattempts	Number of times that the student is attempted the module
credits	Number of credits for the module
disability	The student descaled a disability? ("N" = no; "Y" = yes)
click	Number of the interactions of the student with the material of the module
student	Unique identifiers of the student
unregistration	Number of days until the unregistration of the student from the module
score	Weighted score (student's score * weight of the assessment)
late-rate	Rate of delay in the delivery of the assignment submission
fail-rate	The assignment with a final score of less than 40 (the scoring range is 0-100)
result	Final result of the student ("Fail" or "Pass")

Table 1. The proposed feature model.

The binary classification (failure/success in the final exams) for each student in each considered course is performed using several ML and Boosting algorithms: Logit [10], K-neighbors [11], Random Forest [12], Decision Trees classifiers [13], SVC [14], MLP [15], Gradient Boosting [16], XGBoosting [17], Ada Boosting [18], and CAT Boosting [19].

The suggested approach is evaluated on a real dataset provided by the Knowledge Media Institute of the Open University. The publicly available dataset is obtained from different data sources containing information about 7 courses and 32593 students.

The results obtained (Table 2) show good accuracy for both the train set and the test set; in particular, the best results are provided by iterative methods with strong self-learning skills such as Random Forest, Multi Layers Perceptron, and Boosting methods.

Table 2. Accuracy of the considered classifiers in predicting students' performance.

ML Classifiers	ACCURACY	
	TRAIN	TEST
LOGIT	0.75	0.75
KNEIGHBORS	0.70	0.70
RANDOM FOREST	**0.78**	**0.78**
EXTRA TREES	0.74	0.75
SVC	0.66	0.66
MLP	**0.78**	**0.78**

BOOSTING Classifiers	ACCURACY	
	TRAIN	TEST
GRADIENT BOOSTING	0.71	0.71
ADA BOOSTING	**0.78**	**0.77**
XGBOOSTING	**0.78**	**0.78**
CAT BOOSTING	**0.80**	**0.79**

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Explainable fuzzy models for Learning Analytics

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1 Introduction

The educational field is benefiting from the use of Artificial Intelligence (AI) which is transforming the way of teaching and learning. The explainability of these automatic techniques has become mandatory to inform the user about how results have been obtained. In this context, the use of fuzzy logic for explanation purposes becomes critical [1].

In this work, we focus on the use of fuzzy models for students' assessments prediction. Fuzzy Inference Systems (FISs) use IF-THEN rules and fuzzy term to define the expert knowledge and reasoning, being thus easy to explain. However, the manual definition of fuzzy rules is a complex task, whilst their automatic definition through learning from available data is feasible. To this aim, hybridization of fuzzy inference systems and neural networks has been proposed in the form of neuro-fuzzy systems (NFSs), which are hybrid models possessing the ability to learn from real-world observations and whose behavior can be described naturally as a collection of linguistic rules. Particularly, we use NFS to learn accurate fuzzy models from clickstream data collected through the Virtual Learning Environment (VLE) of the Open University for predicting students' outcomes.

2 Experiments

The Open University Learning Analytics Dataset (OULAD) collects information about students attending the Open University [2]. Since the goal of our analysis is to define students' behaviors models, based on their interactions with the VLE, to be used to assess the students' performances and thus to predict them, a student-oriented data, composed by the nine most discriminant activities for the predictive task [3], has been selected [1]. Data is composed of 25,819 samples representing the students interaction with the University VLE for a given subject, in terms of these nine features. The target class is the students' outcomes which can assume the two values *Pass* and *Fail*.

The work aims to verify the effectiveness of neuro-fuzzy systems in the context of learning analytics. For this purpose, neuro-fuzzy models (NFM), based

[1] Student oriented subset of the Open University Learning Analytics dataset: https://zenodo.org/record/4264397#.X60DEkJKj8E

on Gaussian fuzzy sets are proposed, and their effectiveness is compared with baseline machine learning methods Random Forest (RF), Multilayer Perceptron (MLP), Multiclass support vector machine (SVC), XGBoost (XBG). However, whilst these methods are very effective for the classification tasks they are not explainable. Morover, a feature selection method, based on the Univariate ANOVA, is applied to reduce the complexity of the neuro-fuzzy model explanations.

A quantitative comparison with black-box models has been carried out to verify the effectiveness of the NFS predictions. Comparisons have been conducted on the original data and after the feature selection phase to verify if it impacts the performance (Table 1). Overall, ensemble methods outperform the others without feature selection. However, these are ensemble methods, which combine different classifiers to improve the performance while losing explainability. When feature selection is used, the maximum performance values decrease, and all the algorithms are comparable.

	without FS				with FS			
model	**A**	**P**	**R**	**F1**	**A**	**P**	**R**	**F1**
NFM	0.73	0.72	0.71	0.71	0.73	0.72	0.71	0.71
RF	0.82	0.82	0.80	0.81	0.72	0.72	0.72	0.72
MLP	0.72	0.72	0.73	0.72	0.74	0.74	0.71	0.71
SVC	0.60	0.80	0.50	0.37	0.67	0.76	0.59	0.55
XGB	0.80	0.79	0.78	0.78	0.75	0.75	0.72	0.73

Table 1: Quantitative evaluation of the NFS model and the black-box models, without and with feature selection.


If homepage is low and quiz is low THEN failed = 1.0, passed = 0.0
If homepage is low and quiz is medium THEN failed = 1.0, passed = 0.0
If homepage is low and quiz is high THEN failed = 0.0, passed = 1.0
If homepage is medium and quiz is low THEN failed = 1.0, passed = 0.0
If homepage is medium and quiz is medium THEN failed = 0.0, passed = 1.0
If homepage is medium and quiz is high THEN failed = 0.0, passed = 1.0
If homepage is high and quiz is low THEN failed = 1.0, passed = 0.0
If homepage is high and quiz is medium THEN failed = 0.0, passed = 1.0
If homepage is high and quiz is high THEN failed = 0.0, passed = 1.0

Fig. 1: Example of fuzzy rules generated by the neuro-fuzzy model with the feature selection process.

In addition, we performed a qualitative evaluation of the NFS model to appreciate its explainability, in the context of learning analytics. The feature selection process reduces the number of fuzzy rules thus making the model easier to handle and more *"readable"*. Figure 1 shows the fuzzy rules generated by ANFIS with the feature selection process.

3 Conclusions

To conclude, the NFS model has shown to be effective and also explainable when feature selection is applied. Indeed, in this case, its performance is comparable with those obtained with the other black-box methods. Moreover, in the context of Learning Analytics, the NFS model has been useful to explain why a given result has been obtained. This explanation is crucial for both the learners and the teachers, who can improve their study or their course, respectively.

Acknowledgment

Gabriella Casalino acknowledges funding from the Italian Ministry of Education, University and Research through the European PON project AIM (Attraction and International Mobility), nr. 1852414, activity 2, line 1. All authors are members of the INdAM GNCS research group.

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Fuzzy Hoeffding Decision Trees for Incremental and Interpretable Predictions of Students' Outcomes*

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1 Introduction

In the last years, also thanks to the spreading of the COVID-19 pandemic, distance learning and the usage of Virtual Learning Environments (VLEs) have experienced a steep increase, becoming powerful tools to support higher education throughout the world. VLEs allow also to continuously collect logs and information, non-stationary by nature, regarding how and when students interact with the educational platform. Artificial Intelligence (AI) methods, capable to analyze streams of data (such as logs), can be effectively employed to extract knowledge from them, being useful for all stakeholders involved in the learning process, especially students and teachers. They have proved to be more effective and accurate than traditional batch-based techniques, also in the educational context, since they are able to capture the inner evolving and adaptive nature of the learning process [1].

In this abstract, we summarize the results obtained by two stream-based classifiers, namely Hoeffding Decision Tree (HDT) [2] and its fuzzified version FHDT [3], to predict the students' outcomes in sequential semesters. Moreover, a feature analysis suggesting the most discriminant features for the predictive task has been discussed to explain the reasons behind the success (or failure) of given students in the regarded semesters.

2 Materials and Methods

In this abstract, we have exploited a subset of the Open University Learning Analytics Dataset (OULAD)[6] [4], with data belonging to the academic years 2013

* This work was partially supported by the Italian Ministry of Education and Research (MIUR), in the framework of the CrossLab project (Departments of Excellence)

[6] Dataset: `https://zenodo.org/record/4264397#.X60DEkJKj8E`

and 2014. Thus, a data stream of 4 sequential chunks, containing the instances of each semester, in chronological order, has been considered. Each instance is composed of 18 features, describing demographic information, student's performance and the interactions with the VLE, and one categorical class (Pass/Fail).

Regarding classification models, we have adopted HDTs, whose structure can be updated incrementally while new chunks of labeled semester data are available. Moreover, we have also considered FHDTs, which ensure a good trade-off between their classification performance level, the overall model complexity, and their explainability level. Indeed, explainability of AI models is one of the current hot topic in the specialized literature [5].

For the simulations, we have considered the Test-the-train scenario and the Adaptive Naive Bayes voting strategy.

3 Results and Discussion

In Table 1, we compare the two predictive methods (HDT and FHDT) on the considered dataset, in terms of classification performance and model complexity. For the former, we considered the Area Under the Curve (AUC), while for the latter the number of leaves of the derived trees. Moreover, we have compared two FHDT models, endowed with 3 and 5 fuzzy sets, respectively.

Overall, HDT and FHDT have output very good predictive performance, with FHDT having almost always results, which are better than or similar as those of the traditional HDT. However, a drastic reduction in the number of leaves is observed passing from HDT to FHDT, thus suggesting a strong decrease in the complexity and a high increase in the model interpretability. The analysis of the final decision trees shows different subsets of the most discriminant features, varying the classification algorithms. However, all of them agree on the *number of assessments* feature, which represents the number of intermediate assessments the student has performed.

To conclude, Hoeffding Decision Trees have proven to be effective in predicting the students' outcomes, by taking into account the time (the semesters). Moreover, their fuzzy variant has shown to be easier to understand, having a lower number of leaves. This is crucial in domains, such as the educational one, where the final stakeholders are not technicians, so they need to trust and understand the computation behind the results.

Table 1: Comparison of HDT and FHDT in terms of classification performance and model complexity, for the tested chunks of the considered stream dataset.

	AUC			**No. of Leaves**		
Tested chunk	**FHDT-3FS**	**FHDT-5FS**	**HDT**	**FHDT-3FS**	**FHDT-5FS**	**HDT**
Chunk 0	0.9145	0.8849	0.9155	17	37	96
Chunk 1	0.6336	0.7993	0.8072	17	37	96
Chunk 2	0.9040	0.9154	0.8877	17	41	249
Chunk 3	0.9028	0.9043	0.8916	19	41	362

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Students' dropout predictive models in higher education

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1 Artificial Intelligence for Education

The international scientific literature highlights how artificial intelligence (AI) is assuming an emerging role in the field of educational technology [1] [2]. Specifically, the Artificial Intelligence in Education (AIEd) is the subject of a wide debate which is increasingly characterized by a broad interdisciplinarity: education, psychology, neuroscience, linguistics, sociology and anthropology. As Luckin & Cukurova [3] affirm, to create meaningful connections between AI and the educational sphere, it is necessary to ensure that "the fields of research and experimentation contaminate each other in a synchronous and reciprocal way, finding a space for comparison, design and of development through a joint negotiation of models, values, intentions, actions and effective results". Today, a particularly significant space for discussion on AI issues in education is that of the Global Partnership on Artificial Intelligence (GPAI): an international and multi-stakeholder partnership with the mandate to guide the development and responsible use of AI in a consistent with human rights, fundamental freedoms and shared democratic values.

Education can benefit from AI support in several ways, one of these is the usage of predictive models to mine student's data and forecast problematic situations which can affect the learning processes.

Historical and personal data about students have been used to predict the dropout risk. Here we want to propose a novel approach which can integrate this kind of data with information from a survey where students can express their point of view about the courses and evaluate how this can help in predicting and reducing the dropout rate.

2 Predictive analysis in higher education

Both at the national and international level, sector studies report the experimentation of predictive models for dropout risk detection. Specifically, machine learning models have been developed to build predictive tools both in distance education [4] and in-person courses [5]. These models usually exploit data collected at the time of enrolment (e.g., gender, age, educational qualification, high school grade) [6], including characteristics regarding the provenance of students [7] or richer datasets of characteristics, which also involve the state of family and the living conditions of each student [8]. In a previous work, we investigated the correlation between the student's condition at the time of enrolment and the probability of study interruption [9] by developing a machine learning model capable of predicting the risk with an accuracy ranging between 65-75%. However, it should be noted that data on students' behaviours and their cognitive processes could be highly informative with respect to students' performances. In this regard, the authors in [10] propose a predictive model for the final performance of students in distance education. In these cases, the use of specific technological devices allows for enriching the dataset (e.g., consultation of the task submission registers, scrolling behaviour) and improving the model performance. In a similar way, we aim to exploit qualitative data and trace cognitive and behavioural aspects in a face-to-face teaching context through students' self-assessment feedbacks.

3 Integration of students' dropout predictive models

With reference to this general framework and to our previous work [9], we aim to present an extension which includes quantitative and qualitative data on the students' learning process. This extension phase of the research project was launched in the 2020-2021 academic year at the Department of Educational Sciences (EDU) and at the Department of Computer Science and Engineering (DISI) of the University of Bologna by expanding the dataset with student performances (examination assessment) and data from quality assessment questionnaires. Our aim is to study each feature's contribution to the description of the phenomenon of interruption or continuation of the course. Specifically, we aim to improve on previous results by integrating into the predictive model qualitative information concerning how students learn and how they assess the quality of teaching by means of NLP techniques, as we consider the contribution of this representation in the evaluation of dropout risk to be crucial. Our goal is to extract relevant information and collect evidence that allows us to analyse those aspects of the learning process related to the learner's experience within a specific learning environment. The research involved first year students of four EDU and DISI courses. In this first phase, a questionnaire was administered to these students to extract data relating to the course of study carried out during the first year of university. In particular, the questionnaire analysis is aimed at identifying significant correlations between the student's study / learning methods and the amount of credits acquired during the first year of the course.

The novelty of the proposed approach is twofold: i) the integration of quantitative and qualitative information into a single machine learning model for describing the dropout phenomenon; ii) the interdisciplinary nature of the research, which, starting from specific educational goals [11], proposes an automatic, data-driven analysis involving different disciplinary fields – education and computer science – and contributes through an integrated methodological approach and a shared lexicon to the development of new organizational systems for teaching.

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An Experience of Integrating Flipped Classroom Strategy in an Academic Course

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1. Introduction

This paper describes an experience on integrating the "flipped classroom" approach for one selected topic in a second-year programming university course, Programming II, focused on Object-Oriented paradigm. A flipped classroom is a form of blended learning focused on student engagement and active learning where students must tackle the course materials before the classroom [1]. We have devised a flipped classroom approach to let the students carry out the learning activities before coming to the class where they then apply the knowledge during face-to-face lessons for a more engaging learning experience. In this experience, the authors have chosen a topic that presents a low difficulty to be understood, differently from a previous experience [6] where they chose a topic with medium difficulty. Support slides and videos readily available online and designed by the teachers themselves were provided to the students. This experiment aims to stimulate the integration of flipped classrooms for some appropriate topics taught in object-oriented programming.

2. Experiment

To explore the possibility of integrating the flipped class teaching we selected the "SEt and List" (SEL) topic. This topic, according to our experience, is considered as a low difficulty topic in our Programming II course. This course is delivered in the first semester of the second academic year of the bachelor's degree course in Computer Science and Technology for the Production of Software at the University of Bari Aldo Moro in the academic year 2021/2022. Since we are interested in studying the effect on programming accuracy after training subjects on the proposed topic, only students that had no previous knowledge and experience on SEL were involved in the study. This requirement ensures us that all the students have a similar background on the SEL topic. The selected subjects were then organized into two groups using profiling and assessment test information:

- FlippedGroup: students to which training was provided according to the flipped classroom;
- TraditionalGroup: students to which training was provided according to the traditional approach.

Both groups were consisted of 32 students where 16 of them had academic average score (AVS) 25/30 or lower and 16 had an AVS equal to or higher than 25/30. The two lessons (flipped and traditional) were carried out in parallel according to the scheme of Table 1 where the second and third column list the tasks to do by, respectively, FlippedGroup and TraditionalGroup. To full integration with e-learning web technologies requires each individual resource to be included in a Learning Management System (LMS) [5]. The teaching materials provided to students were:

- introduction to SEL (30 minutes): these lecture slides provide a good overview of the SEL concepts;
- explanation of SEL (60 minutes): these lecture slides summarize the key points and emphasize the different conditions for choosing between Set and List in Java;
- examples and practices on JHE (30 minutes): this video conveys the practical considerations to decide when and how to adopt a Set or a List in a Java program.

The expected learning outcomes to achieve if the trial is carried out successfully are listed: to be able to understand the concepts and basic notions on SEL by answering to a theory questionnaire of ten questions; to be able to insert and use in a little Java program, comprising four classes, the right collection (either Set or List).

The worksheets and programs were collected by the tutors for marking.

Table 1. Flipped class schedule

Week number	FlippedGroup	TraditionalGroup
1st lesson of the semester	Brief explanation to students on how to learn this topic	
Week n.7 of the semester	Learn the topic on their own	Frontal Lesson
Week n.7 of the semester	Training on their own	Individual Study
Week n.8 of the semester	Flipped Lesson (an activity, conducted by the teacher, of elaboration, reflection and comparison on what has been learned)	Training on their own
Week n.9 of the semester	Questionnaire session (10 minutes) - Development task (20 minutes)	

3. Results and Discussion

Students of the FlippedGroup gave 74% of correct answers while TraditionalGroup only 71%. Both results, obtained before the end of the course, could be considered positive and comparable to one another. Concerning the programming task, the accuracy of the proposed solution by the students was manually evaluated by the instructors. In the case of the FlippedGroup 75.27% of the students performed the learning verification test with 0 errors, 17.13% made only one error while only 7.60% made multiple errors. On the other hand, the TraditionalGroup achieved worse results, where 62.32% of the students performed the learning verification test with 0 errors, 16.92% made only one error while only 20.76% made multiple errors. These results demonstrate the superior performance of the students belonging to the FlippedGroup. Moreover, in the data collected it is seen that in the FlippedGroup the number of students who commit multiple errors is drastically reduced. This ultimately confirms the effectiveness of flipped learning in the classroom especially in maximizing the involvement of students.

These results confirm the positive ones obtained in our previous experience [6]. Thus, topics with low and medium difficulties present similar results. The authors are also aware that improving the quality of the online learning materials and strengthening students' motivation for self-learning are both necessary to integrate the flipped approach successfully. In our future experiences, we plan to simultaneously investigate topics of different complexity and investigate the degree of satisfaction of students.

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Special Track 10

The digital innovation of university teaching observed through the prism of emotions

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Pedagogical Strategies based on Socio-affective Scenarios: application and evaluation

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1 Introduction

Distance Education (DE) over the last ten years has been changing in Brazil [1], as it demands greater student autonomy. In this modality, it is essential to adopt practice capable of dynamizing the classes [2], as is the case of the Pedagogical Strategies (PS) that are ways of supporting the professor [3], especially considering the social and affective aspects of the students in the VLE. The objective of the research is to apply and evaluate the use of PS based on Socio-affective Scenarios in a VLE. The Scenarios are understood as the intersection between the indicators of the Social Map (SM) and the Affective Map (AM) present in the VLE of the Cooperative Learning Network (in Portuguese: ROODA). The SM presents the social relationships established in the environment, and the AM comprises the subjects' moods [4].

The work is organized into four sections. Next, the research methodology is described. In the third section the results are presented. Finally, the conclusions are listed.

2 Methodology

The methodology of this study has an interpretive qualitative approach. The qualitative choice is justified as a result of the research object involving the Socio-affective Scenarios that are inferred in the ROODA, expressed subjectively through the exchange of messages, texts and the relationship between the participants. From the mapping of social indicators and moods, 38 Socio-affective Scenarios (https://bityli.com/oDTJok) were created. In this bias, based on the Scenarios, a strategy was developed for each of the 6 functionalities used to generate the Social and Affective Maps (Chat, Contacts, Diary, Forum, Library and Web Portfolio), totaling 228 PS (https://bityli.com/EwOGVf). Thus, after the creation of the PS, they were applied and later evaluated through a questionnaire in two graduate disciplines. It should be noted that the PS are in the Portuguese language of Brazil, since it is a study specifically applied in the country.

3 Results

The research had six professors and three monitors who applied and evaluated the PS. Therefore, from the analysis of the answers obtained in the questionnaire, the main points were raised: the creation of a functionality so that it is possible to automatically apply PS; the importance of considering the context, profile and technological resources; the use of PS served to intensify social interactions and exchanges in the VLE, the role of professor and monitors in personalized monitoring was fundamental for students.

4 Conclusions

In Distance Education, the physical distance between the participants makes their relationships unique. In this way, considering the needs of each student, when applying Pedagogical Strategies (PS) can be an instrument of support for the professor, making it possible to personalize teaching and learning. The study analyzed 228 PS prepared, being possible to apply 83 that were considered the most relevant and corresponded to the Socio-affective profile of the classes.

The possibility of future research is related to the creation of a functionality that makes the automatic analysis of the Socio-affective Scenarios and indicates their PS to the professor.

Acknowledgment

"This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – Finance Code 001".

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The didactic use of video and perceptual processes. A Pedagogical reflection

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1 Introduction

We can reduce the main variations of the didactic use of video to three. The oldest is as "content"; than as "tool"; finally, and most in recent years, as "environment ". Therefore, if on the one hand this medium is characterized by a "semantic complexity" determined by the different linguistic codes that it recalls (image, sound, text, shot, color,...); on the other hand, it is characterized by a "functional complexity" that has multiplied its aesthetic forms, think, for example, of its use in social networks (Montani 2020). Therefore, among the different media that characterize current teaching (Rivoltella, 2017), the video requires an indispensable pedagogical study to propose aware and effective uses of it in training contexts.

2 Method

We will use an interdisciplinary approach that reports the most recent reflections on video and its perception: aesthetics (Montani), history of cinema (Alovisio, 2013), neuroscience (Gallese, 2007; Gallese, Guerra, 2015), pedagogy (Rivoltella, 2015, 2017). Then, we will focus our attention on a specific form of video: the autobiographical video-narration.

Starting from this model we will focus our attention on what is one of the principles of video editing, that is, the process of deconstruction and reconstruction. This will allow to deepen the process of semantic composition and recomposition that the forms of representation induce in the observer, thus involving him in a process of construction of menaning. Therefore, we will try to highlight the teaching potential of this model by reporting an experience held at the University of Macerata.

3 Experience

We will introduce a video format where telling the life stories of people with disabilities is configured as the central fulcrum for future teachers' inclusive education. In line with the experimentation of lifelong learning courses for inclusion, the format, designed by the research group of Special Pedagogy at the University of Macerata (Giaconi et al., 2021), wants to orient educational courses in a circularity between practices and theories around the foundation of life stories in order to reflect on the repercussions in terms of a teacher's professional profile.

This experience allow us to reflect on the potential of using videos in the entire curriculum of teacher education, opening up new scenarios for strengthening research in terms of circularity between practices and theories.

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A STUDY ON EMPATHY FROM SOCIO-AFFECTIVE INDICATORS IDENTIFIED IN A VIRTUAL LEARNING ENVIRONMENT

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This article aims to present a study on empathy as a socio-affective competence to be considered in the interactions and relationships formed in virtual learning environments (VLE). In the schools and universities, teachers and students felt uncomfortable with the mandatory remote teaching during de COVID-19 Pandemic. This was due to the isolation feeling, to the little resilience, and to the face-to-face deprivation. The first reason was due to the lack of infrastructure technological or the competence to use them, as well as asking (and offering) help to better use them. The second was the inability to cope with difficulties, crisis situations, and fast adaptation of changes. And the third was the displacement of face-to-face to virtual classes in an imposed way.

Thus, one of the factors that regulate or determine these motives is empathy. Empathy is understood as the subject's ability to experience events and emotions the way others experience them [1]. That is, the empathy involves sharing the feelings, emotions, mood, etc. of another, whether positive or negative, by indicators such as facial and corporal expressions, voice and writing cues, and behavioral signs [2].

In Distance Education context, we believe that the construction of empathic competence can be a catalyst for both students and teachers with regard to social presence in the VLE and resilience as a way of adapting to emotional issues that arise in relationships from VLE. In this study, competence is understood as the set of conditions and resources that must be mobilized to respond or act in a given situation [3]. A socio-affective competence is understood as the subject's ability to mobilize their social and affective aspects to interact and relate to others based on affection, mutual respect and welcoming.

Therefore, this article presents the results on the mapping of empathy carried out from the social and affective indicators identified in the VLE. The identification of the students' socio-affective profile is made using the Social Map and Affective Map tools. These tools are implemented on the ROODA (Cooperative Learning Network) platform, one of the VLEs at the Federal University of Rio Grande do Sul, Brazil. The Social Map generates sociograms from user interactions in synchronous and asynchronous communication tools in ROODA. The teacher can graphically visualize the relationships established based on six social indicators: (1) Informal Groups: it presents the constant exchanges established by groups formed between three or more students; (2) Collaboration: it indicates how much the student contributes with the exchange of ideas and posting of materials in the class; (3) Popularity: it shows which students stand out for maintaining a higher frequency of interactions than the rest of the class; (4) Class Distancing: it points out the student who comes into contact with colleagues and does not receive feedback; (5) Absence: it signals the student who enters the environment and does not return the class's contact requests; and (6) Dropout: specifies the student who does not carry out the course activities and does not establish exchanges. The Affective Map [4] offers information on student 's moods (animated, discouraged, satisfied and dissatisfied) with the interactions and content development. The mood inference is done by analyzing of (1) subjectivity affective in text (messages available from asynchronous communication tools), (2) motivational factors (deducted from the behavioral pattern in the AVA) and (3) personality traits (obtained from the Big Five inventory).

The research methodology was conducted from a descriptive quantitative and qualitative approach of the single case study type [5], in which the moods and social interactions of students were mapped and identified, with the objective of evaluating the possible contributions of the affective and social aspects for the empathy recognition in the Distance Education. The case study was applied in a Postgraduate course offered in 2021, distance modality, at the Federal University of Rio Grande do Sul (UFRGS), Brazil. The class had 27 students enrolled. In all classes, students had to participate in group work. Data collection was performed using three instruments: a) inference of social and affective indicators in the Social Map and Affective Map; b) application of a questionnaire adapted from Branco [6]; and c) researchers participant observation.

The results show that the social indicators Class Distancing, Absence, Dropout and Informal Groups did not present data. Regarding the Informal Groups indicator, it was verified that there was no spontaneous grouping among VLE participants because they grouped in the beginning of course. On the other hand, one student was the most Popular and for Collaboration only six students contributed a lot of to the classes. As for affective indicators, two students remained satisfied during all classes; none of student felt dissatisfied; eight of them at some time felt discouraged; and the rest oscillated between animated and satisfied. The correlation between students' collaboration and discouragement was analyzed and, initially, it was verified whether the most collaborative students were empathetic with students discouraged. No correlation was found. The analysis was extended to verify if any colleague expressed himself empathically. No correlation was found either. Analyzing the logbooks, it was found that two students in a state of discouragement received empathic feedback from the teacher.

The results indicated that although most students were animated and satisfied with the classes, many do not express affection with their colleagues, especially with those who showed discouragement at some time. In this way, it is verified how much research is needed on empathy in virtual learning environments.

The contribution of this research is to provide subsidies for building an Empathy Perception Model (EPM). The EPM will be part of the technological resource to be implemented in the AVA ROODA. This resource will inform the teacher about the need to apply pedagogical strategies for the construction of socio-affective competence Empathy towards students. The objective is that such strategies will help the teacher in the application of actions that strengthen the interaction and intensify the teaching and learning processes in the VLE.

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The invisible bridges: the functions of technology and emotions in rehabilitation programs for prisoners

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1 Introduction

The pandemic has left a profound mark on people's lives and institutions around the world. Digital communication has proved to be an effective substitute for denied presence in work contexts and in numerous environments, including prison settings [1]. Recognizing the place that technology has played in guaranteeing minimum forms of contact that would allow the survival of social networks, family, and friends in different spheres, it remains however to understand what the effects of digital communication have been in the various areas and not least in a context extremely specific such as prison. With this goal, I reconstruct the experience of the post-graduate internship in Psychology at the prisons of Opera, San Vittore and Bollate. Aimed at understanding the most relevant psychological dimensions that intervene in the rehabilitation programs for prisoners, the internship owes its originality to the discovery of unexpected effects: on the one side it confirmed the functions of emotions in rehabilitation programs, on the other side it showed their expressions during digital communication. The study is divided into two sections: the first is dedicated to the description of the internship, the second to the analysis of unexpected effects.

1.1 The experience of the post-graduate internship

During the pandemic emergency period, I began my post-graduate training with the Onlus Trasgressione.net Association of Milan, founded and coordinated by the Psychotherapist Angelo Aparo. The psychological activity conducted by the Group consists in bringing out the inmate's emotions and conscience to induce him to undertake the process of change that places him in front of the consequences of his actions. What I am engaged in is a work of mutual knowledge and learning. In fact, in observation, through an ethnographic method, I note the emotional trans- formations of the prisoner and at the same time the changes in my way of considering him, my possibility of seeing the person beyond guilt and punishment. Post- graduate internships allow universities to generate situated learning and reveal the proximity existing between multiple contexts, frequently unknown, discovered and networked through a work of care and social rehabilitation.

1.2 Unexpected Effects of Technology. Emotions travel in social relation- ships

The internship, in addition to highlighting the importance of the work conducted by the Group, a research laboratory that aims to recover and enhance emotions, it was an opportunity to understand the most relevant psychological dimensions of emotions during pandemic isolation. The closing of the prison doors was the moment when the already precarious equilibrium of the prison was broken. If we consider prison the maximum expression of communication deprivation, imagining what emotions the inmates felt while watching death images on TV is simple: anguish, panic, uncertainty, loss, and abandonment. Many prisoners have experienced the most painful period of their entire detention. Inside the prisons, radios, TVs, books, and newspapers are allowed which, although important for people's lives, respond to security needs, given the characteristic of the mono-directionality of the message in which the inmate represents a mere passive user [1]. In addition to representing a learning, information and communication tool, ICT has transformed into an environment in which to build social, cultural, and re-educational activities [2]. Prison cannot remain a world unto itself [1]. The introduction of means for making video calls between inmates and their families has been "pure oxygen" and a salvation. Needless to say, these technologies have helped to keep alive the emotional ties already heavily undermined by confinement and physical distance. The results of the interviews conducted with prisoners from the maxi- mum security of the Opera prison were touching. Men in prison for 25/30 years for life imprisonment were able to meet their family on video call but also relatives whom they had not seen for a whole life, because they were unable to reach the prison from Sicily. Seeing after such a long period, even if only through a smartphone, the courtyard where you played as child, home where you lived with your family, the kitchen where the mother prepared a snack is something exciting. The daily use of ICT should become a possible horizon, a right, especially in conditions of cultural and psychological fragility of which most prisoners are carriers [3]..

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The sociological relevance of public emotions in online university education. A nussbaumian intepretation

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1 Introduction

The numerous virtual learning environments experienced during the pandemic in the academic field highlight the need for a theoretical pragmatic approach that considers the centrality of the pedagogical experience and its personal and social consequences [1]. The possibility of analysing the pedagogical experiences diffused in academic environments in relation to contemporary societies invites us to put the political dimensions of higher education at the center of the analysis [2, 3]. Recently, the problem of education in the formation of democratic and more just societies was raised by M. Nussbaum [4]. The philosopher supports the importance of arousing public emotions in young people by proposing the thesis that public emotions shape the democratic form of societies. Grafting Nussbaum's proposal into a sociological-pragmatic framework [5], the contribution proposes a reflection on teaching practices that in an online university could arouse public emotions. The methodology used is that of action-research [6, 7, 8]. The study is divided into two phases. The first is reserved to the exploration of the sociological-pragmatic relevance of Nussbaum's approach to public emotions. The second to the analysis of an experimental teaching practice: the intensive semi-in-presence week in which the author of the research was also a teacher.

2 The sociological relevance of Nussbaum's approach to political emotions

Moving away from a substantialist conception of political emotions present for example in Comte and deepening a pragmatic conception [9], Nussbaum investigates public emotions considering them a form of life necessary rather than to maintain the democratic order to innovate it. The fulcrum of her approach is on the one hand the need to make people participate, to make them feel protagonists of their political community, on the other the awareness that the chances of participation in public life are different for different citizens. Political emotions, in Nussbaum's conception, are social sentiments [10, 11] that promote, in the members of a political community, the desire-action to perceive their uniqueness not in opposition but in harmony, in agreement with other political communities, in a broader effort of discovery-enhancement of the political community as a human community.

Nussabaum's approach, if applied to academic training in a semi-presential situation, highlights the possibility of the virtual and the presential didactic environment to promote a link between educational tools, including digital ones, and emotions [12], it raises the theme of how to arouse not only community feelings of solidarity among students and teachers but universal feelings linked to the sharing of the same human condition.

3 An experimental teaching practice: the semi-in-presence intensive week

Why could a university e-learning environment be particularly consistent with Nussbaum's proposal?

The analysis of a teaching practice experimented at the eCampus online University in 2019: the intensive semi-in-presence week, a mixed teaching practice, that involves, in two cycles, 40 students, shows the construction between teacher and students of a common emotional world full of memories of the future. The researcher-teacher of the course of Sociology of Economic Processes reveals the birth, during the online phase, of a personal historical relationship between teacher and students based on the common discovery of the hermeneutic sense of knowledge, on the possibility to understand their reciprocal participation, through the knowledge, to a bigger common world. Reciprocal attention and care and compassion are the emotions most widely manifested and recorded in this phase, they seem correlated to the experimentation with digital didactic tools. They occur in 30 out of 36 interventions and they seem *democratic emotions* since they allow to discover the similarity between individuals, because they cure social resentment by bringing out feelings of similarity and mutual respect. Instead, during the phase in presence, the teacher notes the activation of a meta-knowledge based on the desire of students to share, within the class, future projects, concerning their future active life. In the presentations of the contents of the course to the whole class in presence there is the research for a human reciprocal recognition, in the students' presentations the social significance of projects occurs in 80% of cases. The practical-discursive analysis of the students' interventions reveals the recurrence of a transformative tension, the desire to get involved; the hope for the future and trust in oneself and in others is the emotion that occurs in 27 out of 30 interventions and which nourishes the teacher's commitment and didactic action in an atmosphere of reciprocity. In such a situation, the semi-in presence didactic environment is transformed into a didactic and social laboratory which promotes technological experimentation but also which prepares the discovery-demonstration of the human value of each participant, which allows, in the teacher and in the students, a thought that becomes free for the other.

Within the limits of this case study, an attentive educational scheme emerges. This scheme has its fundamental points in the possibility of the teacher to engage in the *capability enhancing of students*, in its ability to guide students in the discovery of their future, in the desire and the commitment for a more human society.

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eLearning,

technology as a factor in enhancing the person in higher education and in the world of work

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1 The context

The entrenchment of the COVID-19 pandemic in the daily lives of billions of people around the world has had a profound impact on the way in which activities involving human-machine interactions are carried out, requiring rethinking and careful preliminary planning of individual processes.

Studies have shown that an effective online transition requires the integration of syn-chronous and asynchronous tools into a seamless online distribution, overcoming bar-riers to access to technology, improving online skills for students and teachers, the op-timal management of privacy and confidentiality policies. In the context of these stud-ies, some answers emerged for a framework of best practices of online education: 1) technological support for teachers and students, in addition to the careful development of online teaching materials 2) design of blended learning paths, which combine the online experience to that of physical spaces, in preparation for the post-covid period 3) offering specific training on educational technologies and their effective use, for both teachers and students 4) enabling a strong sense of connection among students through their active participation in groups / communities. The real challenge, cross to these issues, however, remains that of using the technological and innovative potential of digitalisation in order to always and in any case enhance people.

2 Use case

Starting from the importance of personal enhancement, even in a digital environment, this contribution illustrates how the digitization of the onboarding processes of new graduates within a complex organization can respond to the training needs related to hard skills, but at the same time, to enable a path of insertion of young people in a completely new organizational, cultural, social and productive context, through the articulated and creative use of the technical capabilities that the various company tools offer, for the purpose of enhancing soft skills. The use case refers to the It department of Intesasanpaolo, and in particular to the Domain Investimenti, which in the last 3 years has hired 13 recent graduates and is ready to hire another 199 in the next 50 months. Aware of the importance of socialization processes within organizations, the classic training courses were integrated with:

- Sessions to enable mutual knowledge between newly hired people
- Meetings to set up a community for discussion and knowledge sharing
- Increase in the number and form of surveys administered, structured or not, to detect self-confidence on the objectives assigned, the level of autonomy achieved and any pain points on one's insertion / orientation
- Identification of "Angels" figures (tutor) who had the purpose of driving new hires on practical matters, logistical issues, social life and unwritten rules of the organization
- Significant use of feedback, emoticons during the Group webboards, distance tutoring with "world caffee practice", shared information repositories (via Teams).

The educational background of the students, all from recent university courses, facilitated a digital and innovative approach, participating in the first person in the transformation of consolidated modus operandi. A newcomer's time to productivity is not necessarily one trajectory of learning, but a combination of multiple domain (and company) specific knowledge.Virtual onboarding of employees is destined for an increasingly intensive use and for this reason it is important that organizations understand the need to implement innovative tools and techniques, but at the same time also to enhance the aspects of socialization and mutual knowledge, activating a process of multiplying through the new hires themselves, who from users become builders of improvement.

3 Statistics

To date, only 1 girl has resigned, 7 boys occupy a role of responsibility, 2 have become Tutors for new hires and 5 have brought significant improvements to the internal onboarding processes. The following Table 1 gives a summary.

Table 1. Current roles and active involvement of the 13 new hires

id	Name	City	Gender	Contractual status to date	Responsability role	Tutor/"Angel" for following new hires	Reviewer processes&tool for onboarding
1	DS	Bergamo	F	Employee	Yes		
2	DFS	Bologna	F	Employee			Yes
3	GAR	Bologna	F	Employee		Yes	Yes
4	ML	Padova	F	Discharged			
5	BC	Torino	M	Employee			
6	CN	Bologna	M	Employee	Yes		Yes
7	DN	Padova	M	Employee			
8	GP	Bologna	M	Employee	Yes		Yes
9	KV	Bologna	M	Employee			yes
10	SM	Milano	M	Employee	Yes		
11	PS	Milano	F	Employee	Yes	Yes	
12	BS	Milano	M	Employee	Yes		
13	LR	Milano	M	Employee	Yes		

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Special Track 11

Empowering soft skills and digital competencies in higher education

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University Teachers' Technology Acceptance and Mobile Education

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1 Digital University Education

1.1 21st Century Skills and Digital Skills

The intertwining between education and technology has led to a groundbreaking rethinking of the role of university education to prepare students to their future integration in the 21st century knowledge society, rooted in networked teaching, learning, and working environments, and in technological contexts, requiring embedded multimedia digital skills and literacy. Knowledge development is nowadays narrowly related to the enhancement of 21st century skills – as creativity, problem solving, critical thinking, flexibility, and self-regulation [1], but also interaction, participation, and teamwork [2] [3] – in agreement with 21st century *digital* skills. This is because digital literacy is no more seen only in its technical use as a competence to effectively cope with digital resources and devices, but instead it is today considered as the entanglement of technological, cognitive, and emotional aspects. The core idea of 21st century skills as investing both learning, literacy, and life fields meets digital skills. The shared overlapping between the two domains – general and digital skills – has been re-designed through the co-creation of two emerging and interactive research areas – core skills and contextual skills [4]. Since there is a basic common significance ground between general and digital 21st century skills, the aim of university education to integrate students in the current and evolving knowledge society cannot avoid focusing on their continuous overlapping, and the linked consequence is that university digital education has gained a leading role in educational research. The re-designing of teaching practices for the strengthening of digital skills is becoming a key point of discussion [5].

1.2 21st Century Teachers' Digital Skills

In the last years, The European Commission boosted a developing Digital Education Action Plan [6] [7], which has been recently renewed as a policy initiative for 2021-2027. The original aim was to improve into educational contexts the use of digital technology for teaching and learning by enhancing teachers' digital skills. Nowadays, the Digital Education Action Plan has been enriched of two priority areas, respectively concerning the development of a high-performing digital education ecosystem, with digitally competent and confident teachers managing user-friendly digital learning content, and the enhancing of advanced digital skills and digital literacy for the digital transformation, which requires specific competences in digital studies. The teaching approach towards educational technology has been classified in different educational aspects, concerning first the basic skills involved in access to technology and then the competencies related to the use of educational software and gamification in classroom, by computer assisted learning. Technology-related knowledge, skills, and attitudes of teachers, named KSA, also regard online learning and the design of Open Educational Resources (OERs), Learning Management Systems (LMS), and Massive Open Online Courses (MOOCs) [8]. A Synthesis of Qualitative Evidence (SQD) model has been introduced to explain how technology is embedded in every kind of education [9]. Teachers' motivation and confidence with educational technology is to be really supported [10] through training and professional development because technology in education is considered as a means rather than as an end [11]. Any process of educational change needs a significant rethinking of teachers' practice and behaviors, which – if applied to technology – may widely range from rejection to adoption.

2 Digital University Teachers

2.1 University Teachers' Technology Acceptance

The relation between education and technology has been discussed because technology – and, particularly, mobile technology [12] and virtual environments [13] – may negatively affect users' attention and can be related to disorientation and loneliness phenomena, so influencing teachers' openness or closure to technology, and their educational approaches. To explore the levels of teachers' technology acceptance in a university context, this research has been carried out with a volunteer sample of 56 university professors from the Department of Humanities of the University Federico II of Naples (25 men and 31 women aged between 34 and 69 years). A questionnaire of 6 items has been administered to the volunteer sample. Questions were about the importance of co-creating digital learning communities; if to encourage formal or informal digital study; if it's appropriate to let students have digital chats on learning materials without the online teachers' presence; how to respect students' personal differences; if students can be allowed to modify their own digital learning environment, co-creating flexible didactic interactions; how digital content should be shaped, provided, and made available. A sentiment analysis has been added to the questionnaire. Results have been analyzed and discussed. Results show that many university professors have a contrary attitude towards educational technology and has low levels of acceptance of the use of technology in education.

2.2 iMILK Innovative Mobile Interactive Learning and Knowledge

To encourage and enhance university teachers' technology acceptance, this research suggests carrying on a Learning Management System project to co-create a mobile educational path for university digital education. iMILK Innovative Mobile Interactive Learning and Knowledge [14] is introduced here to co-create a Learning Management System for university mobile education.

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Observing the effectiveness of a distance remedial course for the key-competences to enroll in university: the case of PER.S.E.O

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1 Introduction

In this paper we intend to observe the effectiveness of a remedial course for the fulfilment of the educational lacks (O.F.A) accrued by those freshmen who did not pass the entrance test of the University of Genoa. We offer a quantitative and qualitative analysis of scores obtained by students before and after the training intervention and of their answers to a final evaluation questionnaire.

The topic is of a great interest in the field of higher education, particularly in relation to the design and administration of remedial courses in the basic skills of literacy and mathematical literacy [1, 2, 3, 4, 5, 6]. In 2019 the University of Genoa's Teaching Commission began to work in the direction suggested by the Skills Agenda for Europe [7] and the OECD Programme for International Student Assessment (PISA) [8], reflecting on how to assess the initial knowledge required of newly enrolled students and on the allocation and fulfilment of any Additional Educational Lacks (O.F.A.) that they may have accrued.

2 The TE.L.E.MA.CO test

In the A.Y. 2020/2021, the TE.L.E.MA.CO test (TEst di Logica E MAtematica e COmprensione testuale), which is ideally placed in the continuum traced by the INVALSI test [9] and the TECO-T test [10] in the assessment of basic skills, was administered to all freshmen enrolled in open access courses (except for Humanities, History, Conservation of Cultural Heritage, Modern Languages and Cultures) at the University of Genoa. The TE.L.E.MA.CO test consisted of 30 multiple choice questions aimed at testing the transversal skills of text comprehension and knowledge of the Italian language (literacy), and logical reasoning skills (mathematical literacy), plus an extension consisting of 15 specific questions for the access to courses in the scientific-technological area. Students who had not passed one or more sections of the test or had not taken it in any of the three available sessions, had some O.F.A. to be filled through a PERcorso di Supporto per Eventuali O.F.A. (PER.S.E.O), a remedial course provided entirely by distance learning and self-study material [11].

3 The remedial course PER.S.E.O

PER.S.E.O. included two courses focusing on literacy and mathematical competences respectively, whose remediation was checked at the end by a new test (TE.S.E.O). PER.S.E.O was an asynchronous online course delivered via Aulaweb, the Moodle-based e-learning platform provided by the University of Genoa.

The part of PER.S.E.O focusing on literacy consisted of three sections covering the cognitive and linguistic processes that are activated before, during and after reading a text, including exercises to improve reading skills and to introduce students to the main features of texts.

The part focusing on mathematical skills, on the other hand, is aimed at ensuring that students can solve problems involving basic algebraic knowledge, simple expressions and factor decompositions; it also covers Cartesian geometry and the elementary properties of geometric figures in the plane, strategies for interpreting graphs and functions and for deriving the data needed to calculate a probability from the description of a situation. Candidates' problem-solving skills are reinforced through critical and guided analysis of the information provided in the proposed texts.

The time gap between the first test (TE.L.E.MA.CO) and the remedial test (TE.S.E.O) ranged from 40 to 90 days, depending on whether students enrolled in the first or last session of TE.S.E.O. [12].

4 The effectiveness of the PER.S.E.O course

In order to observe the extent to which PER.S.E.O. was effective in remediating the basic literacy and mathematical literacy skills of students with educational lacks, we made an average comparison between the scores of the target population in the TE.L.E.MA.CO and TE.S.E.O test, applying a paired t-test. The quantitative and qualitative data were synthesized by reports downloaded from the platform on which students sustained the tests; they were then statistically analyzed by means of combined electronic sheets, so as to maintain the student-by-student data correspondence before and after the remedial course. We obtained a value of 1 for both remedial courses and p-values of 3*10^(-23) for Text Comprehension and 3*10^(-101) for Basic Mathematics. Therefore, the course appears to be an effective aid for students to pass the remedial test.

In order to assess students' satisfaction in attending the online remedial course, we also designed a questionnaire along the lines of the one designed by Bolliger and Martindale [13, 14]. Students could rate PERSEO by assigning a grade from 1 to 5 to several specific aspects related to their learning experience, where a grade greater than or equal to 3 was interpreted as an expression of clear satisfaction. Overall, 80% of the students e pressed a clear satisfaction with their experience of using PER.S.E.O., while the percentage of students who rated the course negatively was around 6%.

5 Conclusions

The analysis of data extrapolated from the two tests and those derived from the final satisfaction questionnaire, allow us to consider our online remedial course PER.S.E.O. as a potentially repeatable model in universities where a compulsory test is required to verify students' initial knowledge.

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The training potential of collaborative writing mediated by digital technology in times of pandemic: analysis of best practices

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Today's school is called upon to support students toward the formation of a conscious identity and a sense of responsible citizenship through the development of key competencies for lifelong learning. For these reasons, it must develop new pedagogical models and new teaching tools in order to succeed in meeting the ever-changing needs of students. Information and communication technologies, in this sense, represent useful resources to focus attention on the learning of each individual learner understood as a dynamic and relational process of shared and participatory meaning-making, [1] in which there is, precisely, sharing of knowledge and skills, by all actors [2]. For these reasons, cooperative modes of knowledge construction, including through ICTs, must find fertile ground in different school contexts, as, due to their pedagogical potential, they foster the elaboration of educational content [3] and the development of useful skills for future citizens [4]. Among the many cooperative modes of knowledge construction mediated by digital technologies, collaborative writing with apps represents an active and shared participation activity that is finding increasing application, both in school and informal educational settings, as it holds a yet-to-be-explored formative and learning potential in terms of life skills. In this approach, each pupil usually works in small groups sharing a learning resource and experiencing the skills and competencies that every other pupil in the group possesses. Each pupil's knowledge, therefore, becomes an exchange asset and, at the same time, a common asset. The logic is the same as that of the many experiences of collaborative online work (how can we not think of Wikipedia). From an epistemological point of view, collaborative writing mediated by digital technologies represents a social challenge, which assumes the paradigm of social learning and is based on Vygotsky's socio-cutural theories, according to which cognitive activity and knowledge construction are socially mediated [5], but also on Celestin Freinet's collective writing experiences, through which the French pedagogue helped children explore its pedagogical potential. As a tool for liberation and openness to the world [6] as the French pedagogue had been able to verify. A collaborative writing experience with apps takes the form of a hybrid learning space, in line with the latest perspectives in educational theory on learning in mixed spaces [7] and with the Trialogic Learning Approach [8] according to which technologies should be used by students not as tools to store information, but as real learning environments in a mutual influence approach, because in this way they are useful to activate the right motivation to develop skills [9] and produce cognitive artifacts. It represents a "different" way of expressing the learning needs that come from pupils with different cultures. The paper aims to reflect on the formative value of collaborative writing through apps and to analyze some online proposals at school during the pandemic period, when threats to emotional and social stability young people come from multiple directions. The aim is to analyze the learning outcomes of cognitive, character and personality skills and to understand what relationship may exist between emergent period, computer-mediated collaborative writing and skill development. Best practices selected have indeed highlighted the important social and cognitive function of computer-mediated collaborative writing in pandemic times [ex. 10]. In some cases, collaborative writing highlighted the existence of multiple modes of interaction that greatly complicate collaboration [11], but that if managed with shared rules through scripts and without the obligation to follow scripts imposed by teachers can improve “agency” in students [12].

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Development of Communication Skills Using Silent Video Task

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1 Introduction

During the pre-service physics teacher education, emphasis must be placed on the development of all the competencies necessary for his profession [1]. Given that the development of each student's communication skills is time-consuming, it is necessary to find a way to effect this development.

It turns out that a silent video task could be a suitable means. A silent video is a video sequence that normally lasts one to two minutes, shows some physical phenomenon, trial or experiment whereby student‘s task is to create and record a voice-over to this video sequence. [2]

The silent video is also used by teachers at Ludwig Maximilian University in Munich as a type of task in the pre-service physics teacher education. [3] Based on their work and our previous experience and the results of the silent video research, we believe that such a task is providing us with space for the development of communication skills in the education. In this contribution, research aimed at developing these skills is presented together with partial results, given that the research is still ongoing.

2 Research

2.1 Research question

As it is important to us to find a way to develop key teacher competencies even better, especially communication skills, the research question is asked: Can a silent video task help to develop the communication skills of pre-service physics teachers?

2.2 Hypotheses

The first step in developing students' communication skills is to find out the relationship between knowledge and success in commenting on silent video. The first hypothesis is formulated:

H1: Students with a higher level of physical knowledge will achieve a better rating per comment than students with a lower level of physical knowledge.

It is suggested by Schweinberger and colleagues [3] that the presentation skills of pre-service teachers could be developed using a silent video task. Presentation skills are closely related to communication skills, which according to many authors [4 - 8] are a necessary competence that a future teacher should have. Therefore, it is expected that the communication skills could be developed by using silent video in their education. Therefore, the following hypothesis is established:

H2: If the silent video tasks are implemented in the education of pre-service physics teachers, their communication skills will be improved.

2.3 Methods and the research sample

Since we want to verify the hypothesis that the communication skills of pre-service teachers are developed using silent video task, it need to be implemented in their education. The experimental method will be practiced [9] and it will take part of one semester at the subject aimed at school experiments. The first step is to determine the baseline composed of two-part pretest. At first, the test focused on students‘ physics knowledge will be taken. As the next part the presentation of selected physics experiment will be recorded by each student.

Students' communication skills will be developed by gradually implementing five silent video tasks into their education. The voice-overs for the first silent video will be used to verify hypothesis H1. For this the correlation between the knowledge of physics and the success in creating a voice-over to the silent video will be determined. Then before creation of another voice-overs the strategy of commenting on the silent video will be progressively introduced to the pre-service teachers. After creating each comment, students will be provided with feedback on their voice-overs. After the experimental work, a posttest will be performed, which will also consist of two same parts – test focused on knowledge of physics and the same experiment as at the beginning of the semester. As for control group, the pretest at the beginning of semester and a posttest at the end will be carried out. Students of the control group will take part at the course in the same way as those of the experimental group, except for the implementation of activities with silent video. To verify hypothesis H2, the average values of the shift in terms of knowledge and success in presenting the experiment of the experimental group students will be compared with the control group students.

As a research sample, students of physics teachers who were attending the subject School Experiments in Physics in the winter semester of the academic year 2021/2022 were chosen. Due to the low number of students in the class, the students who will attend this course a year later were chosen as a control group. In the contribution, we will present the partial results we have obtained so far.

Acknowlegments

This contrubution was elaborated with the support of the projects KEGA no. 013UK-4-2021 Methodical materials focused on the systematic development of critical thinking and UK/81/2022.

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Self-Reflection and Digital Wisdom Development of Future Teachers

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1 Introduction

Given the increasingly digital nature of our societies, an educational planning becomes essential that intends to develop the technological competence linked to the concepts of digital wisdom and digital citizenship [1]. Increased knowledge in the era of globalization in the 21st century has resulted in the activities of daily life including in the world of education cannot be separated from the development of information technology [2]. As a result, today's world requires students to have skills, knowledge and abilities in technology, media and information, learning and innovation skills as well as life and career skills [3]. At the same time, the education in this era is expected to obtain graduates who are competent in terms of utilizing digital technologies but also competent in literacy, critical thinking, problem solving, communication, collaboration, and have good character quality [4]. The increasing online risks raise ethical questions about how to use digital technologies in a critical, competent and responsible way with users required to engage in processes of moral decision-making online, from observing copyright laws to navigating forms of incivility on social media platforms [5,6]. Being digitally wise allows today's students not only to strengthen their natural abilities through existing technologies, but also to respond appropriately to learning networks that are increasingly complex [7]. Therefore, it is important, teachers and educators to continually update and expand their professional knowledge base and to improve or revise their practices so as to meet the learning needs of their increasingly diverse students [8].

2 Methods

The research has been conducted during the academic year 2021-2022 with the participation of 1173 teacher trainees enrolled in the Primary Education Degree Program of the University of Palermo. The trainees carried out their activities through digital tools. Brown and Green's (2006) Wisdom Development Scale tool [9] was used to measure eight factors of wisdom development - across 79 seven-point Likert-type scale items - i.e. level of self-knowledge, emotion management, selflessness, judgment, inspirational commitment, knowledge of life, life skills and a willingness to learn. In addition, some items were selected from the SELFIE for Teachers tool to help student teachers to review and get feedback on how they are currently using digital tools and technologies for their future their work.

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Developing teachers' leadership skills with coaching

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1 Introduction

It is not possible for schools to stay out of change in the rapidly changing world with the effect of globalization. In this case, schools will continue their lives as organizations that are either only affected by their environment or affect their environment by being integrated into change. Effective implementation of innovation initiatives in schools depends on the participation of teachers as practitioners in these processes and the creation of new behaviors for teachers. In this context, it is crucial to support teachers' leadership behaviors and to create leadership behaviors in teachers [4,10]. In order for schools to be pioneers in the process of change, there is a need for leader teachers who can influence their environment. Teachers need special skills to be effective leaders [11,14]. Leader teachers need development in the dimension of reflecting their talents in order to evaluate their own views and practices. They need development in terms of communication and facilitation in order to ensure that the change to be experienced at school takes place in cooperation [7,9].

Teacher leaders exemplify certain defining characteristics. While all teachers possess several of these traits, only teacher leaders consistently and simultaneously integrate them into teacher leadership. Teacher leaders are able to set healthy boundaries to cope with overworking, to regulate emotions, to use assertiveness to respond properly to colleagues, students, and families' demands, and they know how to maximize their strengths in order to minimize hurriedness and time-wasting [3,12].

Coaching can play a significant role in leadership development because it echoes strongly the process of how adults learn. It seeks to help leaders understand the meaning they bring to their surroundings and the actions they take [1]. Working within the domain of how leaders see the world it strives to build competency development and to leave the leaders self-correcting and self-generating [6].

Coaching provides a structure for the follow up to training that is essential for acquiring new teaching skills and strategies. It can help building communities of teachers who continuously engage in the study of their craft. Coaching is as much a communal activity, a relationship among seeking professionals, as it is the exercise of a set of skills and a vital component of training [5]. Moreover, coaching develops the shared language and set of common understandings necessary for the collegial study of new knowledge and skills. Especially important is the agreement that curriculum and instruction need constant improvement and that expanding our repertoire of teaching skills requires hard work, in which the help of our colleagues is indispensable [13].

This paper aims at analyzing the empowerment of leadership skills and soft skills of teachers through an individual coaching intervention.

2 Methods

The study adopts a mix-methods approach using a pretest-posttest design without a control group. The research lasts for three years. A sample of 15 schools was selected for each year. On the basis of their individual availability, for each school the head teacher has identified 4 teachers with staff functions. A total of 60 teachers participate in the experimentation started in the first year.

Each teacher is involved in an individual coaching intervention lasting two and a half months, consisting of 5 individual sessions fifteen days apart.

Two measures were administrated before and after the coaching sessions:

a) Soft Skills Inventory [8];

b) Teacher Leaders Self-assessment tool [2].

At the beginning and at the end of the coaching sessions, for each school, two focus groups were planned on some of the strengths or weaknesses that emerged from the administration of the Teacher Leaders Self-assessment tool. Qualitative data were analyzed using MAXQDA and quantitative data were analyzed using ANOVA and Cohen's d for pretest-posttest design was calculated.

3 Conclusions

Since the first year of the research is still in progress, the results of the intervention are not yet available. Preliminary results will be presented at the conference.

From the results of the study it is expected to find that coaching sessions have a positive impact on improving both leadership skills and soft skills of teacher leaders. Positive repercussions are also expected with regard to a higher executive effectiveness in teacher leaders' practices and a better ability to achieve the programmed objectives, as well as on the climate of the school community itself. The reflections on the strengths and weaknesses that emerged during the focus groups could also be interesting.

The results of the research could also help review the same research design to be repeated in the next two years.

Finally, the findings from this study may be useful for both educational and scientific purposes and they encourage proceeding with a larger study to evaluate coaching intervention's effectiveness on leadership and soft skills and dispositions.

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Coding Maps: A Planetary Journey into Computational Thinking and Digital Skills

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In this paper we present the Coding Maps project [1] carried out by a team of students and teachers of the computer science bachelor's degree of the University of Ge-nova, aimed at the creation of a computational thinking distance laboratory for the 2021 edition of the Genova Science Festival.

The main challenge for the team was to create an online laboratory that could be engaging for students of different ages (middle and high school) making the most of what was learned (both as teachers and as students) in the distance learning experience due to the pandemics. For this purpose, the team decided to adopt the metaphor of gamification and interactive applications [2,3] via the online game platform Smart O.C.A. [4] in combination with more traditional computer science orientation ap-proaches based on computational thinking and problem solving [5,6].

Computational thinking [5] involves solving problems, designing systems, and understanding human behavior, by drawing on the concepts fundamental to computer science, such as breaking down problems, abstract thinking, algorithmic lens for formalizing solutions. The setting of the Coding Maps game was a planetary journey during which participants faced questions and solved problems associated with basic computational concepts presented in four different galaxies: logic, control flow, variables, and input/output. Recreating a journey into space was an attempt to create an inclusive activity, e.g., to reduce the gender gap in introductory coding activities [7], since space exploration refers to a vast and mysterious topic that interests all young minds.

Before exploring a galaxy, a tutor, connected via video conference with a group of participants logged into the game platform, provided a brief presentation of the main concepts behind the galaxy topics. Every question proposed to participants within a galaxy presented a different type of difficulty: notion understanding, reasoning, programming, etc. The first two groups of questions, logic principles and control flow, were related to propositional logic and first-order statements and to basic programming constructs such as repetition and alternative. Logic has a strong correlation with natural language, making it a perfect transition topic from "human thinking" to "computer thinking". Control flow such as if-then-else and repeat statements were used to implicitly present the concept of algorithm. These groups of questions were also related to the idea of breaking down problems and solving them using the basic constructs. The third galaxy introduced the concept of computer memory, implement-ed using variables. Finally, the concept of input/output was introduced by using the metaphor of communication between astronauts (the participants) and a base station on planet earth. Even though this interaction is only simulated, it's enough to give an intuition of what a flow of information means in a computer system. Correct answers allowed participants to receive additional information to continue their journey moving from galaxy to galaxy, and from planet to planet. Additional explanations were given in case of wrong answers. The last quizzes of the game, with increasing difficulty, required to reuse concepts introduced during the journey. This way, students had the opportunity to apply the knowledge they had just acquired.

The project was developed and hosted on the Smart O.C.A. platform [4], a web application to create games inspired by the "Snake and Ladders" game, developed by the Edutainment Formula company in the context of a collaboration with our team. Each cell of the game board can be associated with a video quiz. Multiple participants can challenge each other in the same session. To improve user experience, we integrated Smart O.C.A. with Genially, an online tool for producing interactive education material resulting in public web pages. In our extension, each cell of a Smart O.C.A. game instance can be associated with an interactive mini game prepared in Genially. The mini game exploits interactive buttons to navigate through the different web pages of the presentation: display of the question; presentation of the answer options; presentation of result (correct/wrong answer) with explanations in case of mistakes. The integration of Genially and Smart O.C.A. allowed us to associate reactive presentations with a catchy graphical rendering hosted on Genially to the game instances in the multiplayer Smart O.C.A. platform. A dedicated Javascript library was developed, to provide interoperability between Smart O.C.A. and the embedded Genially web pages displayed during the game. Decoupling the quiz creation in Genially from the game design phase in Smart OCA turned out to be quite effective for improving productivity in the design phase. Indeed, we were able to work in parallel on different quizzes and/or on modifications of the game structure.

The Coding Maps project was accepted as a DigiLab in the program for schools of the Genova Science Festival. Several computer science students entered our team as tutors to conduct online the lab with the registered classes. In total 370 online participants took part in the activity in the different time slots in which it was offered. The project required a lot of efforts and allowed the entire team (both students and teachers) to improve their digital and soft skills. More specifically, designing and conducting the laboratory during the Science Festival allowed the team members to experiment a non-standard combination of technologies for distance learning, online games, and polls with more traditional computer science orientation approaches. Thanks to this project, several computer science students got interested in principles and tools used in computer science education and several other projects aimed at exploring digital technologies (e.g., AR and XR) emerged as possible interesting future directions for continuing our work.

Acknowledgements. The authors would like to thank the students involved as tutors in the Coding Maps DigiLab at the Science Festival for their support and engagement in conducting the lab.

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Blended Learning and new scenarios

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1 Conceptual background

In recent years, technological advancements related to education and digital culture have played a fundamental role in learning processes. The aim of the work and efforts made by institutions to integrate innovative methodologies into teaching is to overcome obstacles, simplify learning processes, and make them more motivating. Distance learning, which happens online, has now become deeply rooted in the mindset of the community, because it guarantees flexible access to educational content at any time, from any place, and through diversified means. In this work, we focus particularly on Blended Learning (BL), a phenomenon that has recently attracted the attention of the scientific community [1, 2, 3, 4, 5], especially within the emergency framework of the COVID-19 pandemic, to a great extent, so much so that, in the latest Horizon Report of 2021 [6], an entire section was dedicated to BL. With the advent of new technologies, the learning environments where the practice the educational process are changing themselves [7]. In fact, today's learning environments are very different from traditional ones [8]:

Table 1. Categorization of the modern learning environments.

Type of environment	Description	Materials and tools
Smart classroom 1.0	Use of non-immersive media tools (synchronous activities only)	Interactive blacboards, video projectors, etc.
Smart classroom 2.0	Use of immersive media tools (synchronous or non-synchronous activities)	VR/AR Headsets, websites, etc.
Online classroom 1.0	Use of non-immersive media tools (synchronous or non-synchronous activities)	Video-conference softwares, chats, online forums, etc.
Online classroom 2.0	Use of immersive media tools (synchronous or non-synchronous activities)	VR/AR Headsets, websites, etc.

2 Purpose of the study

Firstly, this work introduces readers to the use of BL in educational institutions, from a historical-narrative perspective. Secondly, a theoretical framework will be built, in which the latest developments of BL in higher education environments are reported, with an examination of the digital services that are made available to teachers and students during the pandemic. The main purpose of this work is, therefore, to present a critical reflection on the possibilities that BL has offered during the COVID-19 pandemic and what it will be able to offer in the post-pandemic age. In the first part of the work, the intrinsic constructs and crucial aspects of digital culture in the contemporary world of education and training are highlighted, outlining an essential theoretical path that emphasizes the substantial advantages and tools offered by technology. A definition of BL is provided below, based on the definitions given by authors who have received the most international credit for their work. The study is presented, in the main section, as an exploratory investigation of the blended model for higher education, and is articulated with various references to the most recent strategies implemented by educational institutions. The main reference is the aforementioned Horizon 2021 Report, published by EDUCAUSE. Based on the results of this analysis, we can gauge the willingness of educational institutions to invest in the design of new educational paths that use a blended methodology, to provide concrete support to teachers to fill in any gaps with respect to their digital skills. The reflection, as already mentioned, is supported by concrete examples that demonstrate some good practices that were followed at international universities, and provides as an outcome, an updated list of best practices using which it is possible to stimulate a constructive debate, innovative study, and research projections for the global scientific community.

3 Results

In the final part of the work, the authors focus on the case of the University of Foggia, in particular on the answer provided by the university about the contemporary needs of higher education. The University of Puglia, which was one of the first to adopt the BL methodology, has a multi-year history of technological innovation; in this work, the fundamental stages of the university's progress in technological innovations are retraced, through the pre-pandemic and then the emergency phase, highlighting its strengths, presenting the services offered, and outlining possible future development paths. In conclusion, some reflections are presented on the applications of BL in educational institutions in the future. Therefore, this work intends to provide new perspectives for the study and implementation of the BL models tested during the pandemic, with an aim of promoting faculty development and modernizing the higher education sector, making it more efficient, flexible, and in step with the current times.

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Special Track 12

Manufacturing Education for a Sustainable fourth industrial revolution

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Manufacturing Education Transformation during Covid-19 Pandemics

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1 Introduction

To become more sustainable and successfully transition from traditional manufacturing to Industry 4.0, today's industries must face many challenges and overcome a range of obstacles [1]. Higher Education Institutions (HEIs), especially in the field of manufacturing, must therefore adapt their educational process and educate Industry 4.0-capable engineers. One of the main aspects and also challenges of this transition, is the ubiquitous digitalization. HEIs must provide students with the necessary skills and introduce digital technologies into educational process at all levels. With the outbreak of the Covid-19 pandemic, the need for digitalization became even more evident and a significant surge in the application of digital technologies at various aspects of the educational process has been observed [2-4].

The main aim of this paper is to present an overview of Covid-19 related aspects of the manufacturing education transformation at the University of Ljubljana, Faculty of Mechanical Engineering, and to identify the good practices adopted during the pandemic. We wanted to investigate whether some of the practices that were initially implemented as a necessary measure to carry out the educational process during the covid-related restrictions, could be beneficial even after the pandemic. Based on our experience, we provide some important implications for HEIs on how to exploit the novel digital technologies to improve educational process in the future. We also address some potential benefits these practices could have in terms of sustainability and competencies of future engineers. Ideas for future research are also provided.

2 Short presentation of University of Ljubljana and Faculty of Mechanical Engineering

University of Ljubljana is the oldest, largest, and internationally best ranked university in Slovenia. It encompasses 23 faculties, 3 art academies and 3 associated members, and ranks among the largest HEIs in Europe with more than 40.000 students and approximately 5.700 employees. It covers all ISCED areas in the 1st and 2nd cycle study programs, and leads the way in some new developments in technology and research. Faculty of Mechanical Engineering is one of the largest members of the University of Ljubljana. It consists of 16 chairs, 33 laboratories, and approximately 400 employees. In the year 2021/22, there were 1894 students enrolled.

3 Overview of Covid-19 related actions by the University of Ljubljana and Faculty of Mechanical Engineering

In order to manage and restrict the Covid-19 outbreak, University of Ljubljana and Faculty of Mechanical Engineering adopted various measures, the first one being a transition from live lectures to online ones in the beginning of March 2020. Soon, the (lab) exercises were also performed fully remotely. For the execution of the online lectures, the first application of choice was GoToMeeting. In the next semester, when the University managed to provide the license, GoToMeeting was replaced by Cisco Webex. Later on, Zoom and Microsoft Teams have also become a popular option for practitioners.

In order to ensure a continuous educational process during the pandemic, another important challenge to address is the online execution of exams [5]. For that purpose, interactive digital applications such as e-classrooms have been introduced.

Gradually, when both lecturers and students adapted to the remote educational process, digital technologies began to be exploited also for other purposes. Interactive courses [6], virtual experiments [7], etc., started to appear on a regular basis. Employees at the Faculty of Mechanical Engineering have also started to study more extensively other good teaching practices reported in the relevant scientific literature [8-10].

4 Implications

When the Covid-19 pandemic was over, the teaching and learning practices did not return to the state prior to the pandemic. Many good teaching practices were kept. Online lecturing/meeting platforms (GoToMeeting, Webex, Zoom) are still being used in many situations. Online exams have also been preserved in some courses. The syllabus for most courses also predicts a further use of digital technologies, such as e-classrooms and virtual labs.

The necessity of online activities and the use of advanced digital technologies has forced both teachers and students to improve their digital competencies. A significant increase in digital literacy/proficiency is thus expected, and future engineers will therefore be more competent to work in Industry 4.0 environment and drive the development of smart and digital companies.

In terms of sustainability, there have also been some indications of potential benefits the digital transformation of educational process could have. The transition from on-site to online education is not only more convenient and time saving, but can also aid in lowering transportation costs and consequently carbon footprint [11].

In the future, good practices of different manufacturing/engineering HEIs worldwide should be thoroughly analyzed (timeline of measures, syllabus changes, satisfaction of different stakeholders (students, teachers), etc.), and an extensive comparative analysis of this larger sample should be carried out. Based on the findings, the pedagogical approach should be properly aligned and curricula's content adequately renewed.

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How much digital learning is enough? Lesson learned from Covid-19

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1 Introduction

The recent Covid-19 pandemic forced educators at HEI to shift from almost non-existing use to full adoption of digital tools [1]. Literature shows how this spontaneous experiment produced different results, some positive, mainly streamlining of activities, and some negative such as problem with assessment and impossible transmission of functional knowledge [2]. In view of this, the body of literature generated during the pandemic, and the teacher experiences, have a huge potential to reveal what is a "well-conceived" blended learning strategy in different educational situation. This work aims at investigating what would be the relevant pedagogical constructs to consider and their impact on an optimal blended learning strategy for the after-Covid phase based on the experience of instructors during the pandemic.

2 Method

A widely accepted description of Blended learning strategies proposed by literature includes an array of six approaches in which different digital tools are used in combination with traditional face-to-face activities with specific timing [3]. For the purpose of this exploratory study the *definition of Blended learning* strategy for an educational unit can be simplified as *the percentage of hours, included preparation, of activities classified as digital learning on the total workload, digital plus face-to-face, of the educational unit*. The selected methodology is a focus group, involving expert teachers, themed: *impact of covid on work in higher education in the context of adoption of blended learning strategies.*

The focus group was organized within the framework of the Erasmus+ BLISS project [4] and involved 13 teachers, including the authors, from the consortium. The preparation to the discussion included a few interactive presentations about the following topic: (1) impact of the pandemic as depicted in literature, (2) pedagogical concepts such as taxonomies of learning [5] [6], constructive alignment [7], communities of enquiry [8] and approaches/tools for digital learning [9] and (3) the double role of universities in forming the students – including knowledge transfer as well as hub for meaningful social interaction. Documentation of the preparation activities and recording of the session are available at [10]. The focus group session was moderated and documented by the authors and lasted around 45 minutes. The specific sub-themes and answers by the audience are summarized in the following section.

3 Results

The main findings of the focus group are as follows:

Blended learning strategy before and during Covid. The group answers confirmed the finding of mainstream literature: the % of digital learning on the total volume of learning activities was in the range 0-5% before the pandemic and rose to 90-100% during the pandemic.

Optimal Blended learning strategy post Covid. The group considered the impact of two main factors influencing the optimal blended learning strategy: (1) the social dimension of students' interaction with peers and teachers and (2) the Bloom's level of understanding of the specific educational unit considered. The (1) factors optimal strategy consists of having a higher amount of face-to-face activities during the first years of study, to encourage early interaction among students. The factor (2) discussion indicates that the % of acceptable digital learning activities is higher in the lower level of understanding and decreases as one goes up in the taxonomy. This is based on the assumption that interaction with teachers is more and more necessary as the complexity of the learning goals increases.

Obstacle/Challenges with implementing optimal Blended learning strategies. Difficulties were mentioned in bringing back the students to class for activities, such as lectures, that the students appreciated in digital, asynchronous form during the pandemic. This is especially true for working students.

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Introducing sustainability themes in STEM education: evidences from some European countries

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1 Introduction

The Sustainability Development Goals (SDGs) adopted by United Nations in the 2030 Agenda for Sustainable Development will modulate the efforts toward a better world considering the pillars of economic, social, and environmental sustainability [1]. The Industry 4.0 (I4.0) framework is emerging from the introduction of several advancements in a way that substantially and rapidly transforms the design, manufacturing, operation and services related to manufacturing systems or products [2]. I4.0 technologies are expected to have a significant impact on the achievement of the SDGs. The 'MAnufacturing Education for a SusTainable fourth Industrial RevOlution' project (MAESTRO, E+ 2019-1-SE01-KA203-060572) is an ongoing research collaboration where experts from diverse engineering disciplines and seven European institutions from Sweden, United Kingdom, Italy, Portugal, Poland, and Slovenia are putting together efforts to define and deliver the key new competences required by the future engineers who will be part of the I4.0 revolution, focusing on SDGs [3, 4].

The SDGs relevant to the teaching of I4.0 were introduced in different academic courses, mainly taught online, by strictly following the Constructive Alignment (CA) principles. CA was devised [5, 6] as a paradigm for the design of effective and efficient pedagogical activities in higher education. CA is based on two main concepts: the constructivist understanding of the learning process, and the practical need for aligned and outcome-based curricula design. Teaching and Learning Activities and Assessment Tasks are therefore planned in a way that is aligned with their Intended Learning Outcomes. The underlying hypotheses that were verified were related to:

1. the sensitivity of people from different countries to sustainability themes
2. the different degree of confidence in the possibility of learning a sustainable use of technologies
3. the different perception of the proactive role of digital technologies in achieving sustainability goals.

2 Design of the survey and discussion of results

A survey aimed to verify and quantify the possibility of communicating the impact of Industry 4.0 on sustainability, through new didactic modules, has been conducted in different European universities. The survey, inspired by [7], was created for the purpose of testing the hypotheses listed in section 1 and was distributed to students after reaching a consensus on the questions to be presented. The main sections of the survey are pertaining to the evaluation of I4.0 technology impact on education profile, the evaluation of sustainability awareness as well as the evaluation of course alignment with the overall education profile. A four-point Likert scale is used to produce a forced choice of the respondents between agreement and disagreement. Data collection is going on, with 132 forms analyzed by now from Italy, Poland and Sweden (63 female and 69 male students). Results passed the consistency test. Krusk Wallis one way ANOVA by ranks was used for testing the significance of the different factors. There is a strong country factor while all the I4.0 technologies have a similar influence on SDG goals, as can be seen in Fig.1. Learning a sustainable use of technology is considered effective only by the students of some countries. Student perception about the impact of I4.0 technologies was compared to the experts' opinion about the impact of I4.0 technologies on main SDG goals [4]. I4.0 technologies mainly affect the SDGs related to health, industry, growth, production and consumption. Another result is the lack of confidence among the students on the effectiveness of reaching sustainable goals through professional training. This is just the starting point of an improvement process that will align stakeholders' expectation with the actual course embodiment.

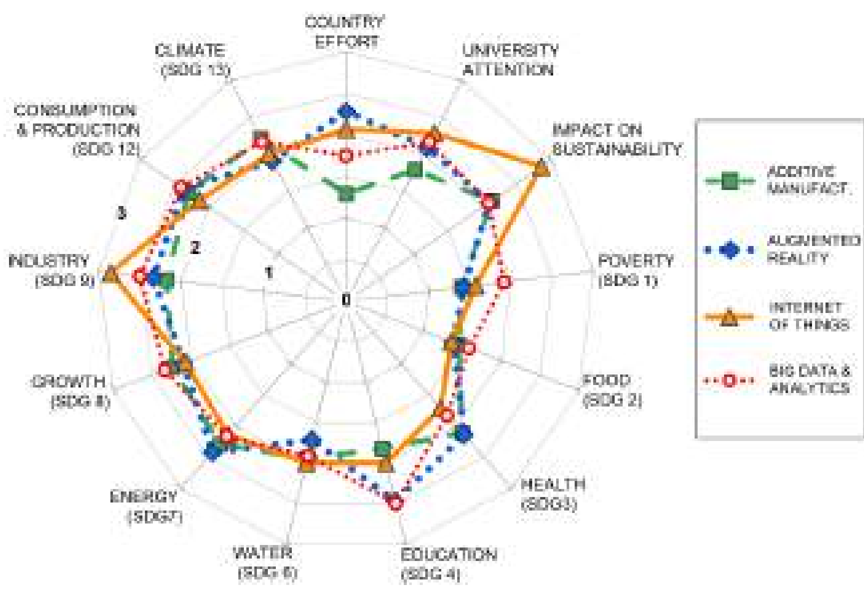

Fig. 1. Radar diagram showing the mapping of specific I4.0 technologies on selected SDGs

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An Archetype for Engineering Education Towards Industry 4.0 Enabled Sustainability

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1 Motivation

Educational accreditation bodies provide standards of the programs that students should meet. This is a high-level and broad perspective guideline [1]. On the other hand, educational institutes define course syllabi or Intended Learning Outcomes (ILOs) to guide the learning process and proffer a sense of measurable statement of acquiring a specific skill, which are used by academics and students [2]. There is a massive gap in engineering education to match the higher-level standards and the lower-level ILOs with the industrial needs. At the same time, these standards and ILOs are rigid and do not accommodate current edge technology advances (I4.0), especially those with promising potential for sustainable development [3]. Harmonization quantitatively with sustainability goals is another major challenge [4].

Archetypes (aka personas) have been widely applied in marketing segmentation and human-centered design, taking a singular fictitious instance mirroring people of the target markets (i.e., reflecting enduring personas that feed into the human experience) [5]. The archetypes allow communication of user needs and orient teams towards user experience [6]. The same abstraction process can be applied to the identification and representation of professional educational figures (e.g., engineers, biologists, designers), summarizing the specific set of possessed skills in between the higher-level standards and the lower-level ILOs [4].

Among the tangible benefits arising from the introduction of the professional profile archetypes is the definition of a common language between stakeholders (i.e., university and industry). This guarantees objective, repeatable, and standardized views, which enable the realignment of the educational and occupational framework and simplify the design of educational courses and communication between academia and industry.

2 Methodology

Defining engineering archetypes is a challenging process (cf. Figure 1). On the one hand, challenges are rising from potential inputs of educational bodies and the needs of the industrial sector. Different institutions adapt to different educational body standardizations. Numerous low-level ILOs for each course (average 250) do not help the industrial sector find its needs. Despite the global skilled worker market, there is a skill gap in many industries. One of the main reasons is the lack of common competencies standards. Rigidity in evolving existing frameworks with current edge technology is another challenge, especially with the rapid technology advancement.

On the other hand, defining archetypes that can match the industries and education is challenging. At the same time, the archetypes should enable the vital role of education in preparing new engineers who can realize social, economic, and environmental sustainability. Archetypes should be evolvable with technology and reliable to ensure that the competencies are required for a foreseen period. Another challenge is to define measurable archetypes that help different stakeholders find and satisfy their needs. Defining clustered competences is one way toward this end. The authors have learned many lessons from the previous attempt, a manual approach that relied mainly on experts [4], including time-consuming, non-comprehensive, and subjective to some extent. This highlights the need for more advanced techniques in a more comprehensive and systematic way, which is what is currently under development.

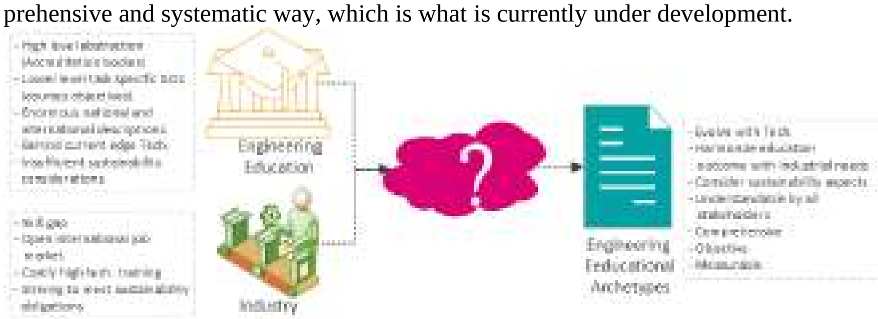

Fig. 1. Challenges of defining engineering educational archetypes.

3 Conclusion

The mismatching between education and industry calls for urgent identification of standardized professional figures descriptions for course design, assessment, communication, and job market integration. Two crucial topics for the industrial sector are the I4.0 contemporary edge technologies and sustainability. Unfortunately, they are not harmonized in the educational and occupational engineering frameworks. This work introduces a standardized professional figure description via archetype concept, representing the artificially generated centroid of a set of instances. The potential of archetypes is a clear, structured, measurable, comprehensive, and dynamic description of the main skills of a professional figure.

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Additive Manufacturing for Sustainability

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1 Framework

The Constructive Alignment (CA) builds upon the constructivist understanding of the learning process and it is based on the principle of an aligned and outcome-based curricula design [1]. Implementing CA means devising Intended Learning Outcomes (ILO) that are based on an Educational Goal Verb (EGV), derived from the Bloom taxonomy, which refers to the action the students are expected to learn after completion of the educational unit. The ILO, and related EGV, are then enacted through Teaching and Learning Activities (TLA) and verified through Assessment Tasks (AT) [2]. The alignment between ILO, TLA and AT is achieved by using the same EGV [3].

Sustainable development (SD) and Industry 4.0 (I4.0) are considered two of the major trends in current production systems and their combination opens up promising scenarios in the manufacturing and beyond [4]. The shift toward SD in the engineering disciplines has never been so urgent and the upcoming smart manufacturing scenario triggered by I4.0 enablers (i.e., IoT, big data and analytics, additive manufacturing, simulation, etc.) call for intensive commitment in the engineering course rethinking [5].

This works stimulates on the need to include sustainability topics in the existing I4.0. related curricula via dedicated educational units and evaluate the impact of such thematic from the students and educators perspective.

2 Methodology

The selected course for pilot study is the biomedical technologies course at the University of Pisa. It focuses on conventional and unconventional manufacturing processes with particular attention to Additive Manufacturing (AM) technologies (i.e., fusion, binding, or solidifying liquid resin and powders) in the module of manufacturing technology laboratory. Following the framework of the Erasmus+ MAESTRO project [6], a new educational unit on sustainability has been included in order to meet the Sustainable Development Goals (SDGs) according to the selected I4.0 technology enabler (i.e., AM). This new perspective has been developed by following the CA framework for the definition of TLA and AT (Table 1) starting from the defined ILO: *The student should be able to design and* *optimize the environmental impact of AM processes for single medical devices production.*

Table 1. Constructively aligned Teaching Activities (TA) and Learning Activities (LA) (i.e., TLA) for the SD educational unit included in the AM course.

	Description
TA	TA 1.1: Present and explain energy analysis for rapid prototyping approaches, design methodology, pros/cons, environmental impact frameworks and standards. TA 1.2: Provide updated case studies through seminars on medicine and AM prosthesis by a sustainable perspective. TA 1.3: Set brief and provide ongoing feedback on project work. Organise students into groups of three or four and provided with a real case study project. TA 1.4: Provide prompt feedback to each group during the project development.
LA	LA 2.1: Listen, query, discuss with peers and produce an infographic to explain, describe, and visualise the information at the end of each lecture. LA 2.2: Listen, query, discuss with peers and seminar guests experts as well. LA 1.3: Discuss within the group members and provide/share ideas by a 30 minute final presentation. Check understandings with one another. Take back to the group and improve the project in a second round based on peers and teacher review. LA 1.4: Provide 1 hour final presentation to the whole class.
AT	Each project group present a final written report of the project to the professor. The group is assessed on the main standard attributes of the project: Problem presentation, CAD design, AM software and implemented solution, practical prototype realization and sustainability assessment.

3 Results

A survey after delivering the course in 2022 to 20 students and 4 educators has clearly shown that AM does not only affects sustainability in manufacturing (9), but also health (3), because it allows the mass customization of human parts. The experts have identified a focused impact on a subset of SDGs (9 and 3) vs a broader sustainability potential according to the students.

4 Conclusion

This work aims to stimulate the integration of SD dedicated modules into engineering courses. A specific focus on the process followed to add a new educational unit on sustainability for the AM course at the University of Pisa is offered. The adopted methodology in accordance to CA theory is detailed. A final survey was submitted to 20 students and 4 educators to validate the implemented topics and the perceived integration between sustainability topics and I4.0.

Acknowledgements The authors gratefully acknowledge cooperation from the MAESTRO team [6] and Carmelo De Maria for the insightful discussions.

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Adapting education programs to the requirements of industry and society

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1 Introduction

To implement the knowledge and skills related to technologies from the Industry 4.0 area in the education process, universities monitor the situation in the industry, identify newly implemented technologies, conduct a dialogue with the industry, analyze their own study programs, and then introduce improvements to the existing study programs or offer new programs. For some time, universities have also started to become interested in introducing issues related into sustainable development to their study programs. The introduced issues emphasize not only the economic analysis of production processes, but also the environmental analysis of the work carried out and the impact of these processes and the methods of their implementation on employees and, more broadly, on society. In addition, the recent pandemic has also required the introduction of new teaching methods, as existing methods were not appropriate during the isolation period. Furthermore, it was observed that even after the pandemic period, when it was possible to implement activities again and no online tasks were required, the public saw the benefits of minimizing travel and found that the new methods could be equally effective in achieving educational goals. This work presents activities and results of four international projects, the aim of which was to conduct research to identify changes necessary in the educational process and their implementation to prepare staff for the industry of the future.

The paper deals with the following aspects: (1) distance learning techniques to activate students to work independently, (2) methods of motivating students to expand their knowledge and present solutions for specific industries, (3) industrial research to identify currently used technologies and strategies for implementing new technologies, and (4) analysis of educational programs offered by universities in order to identify opportunities for their improvement and better matching of graduates' skills to the needs of the industry. Some previously published works elaborate these issues [1, 2, 3, 4, 5].

2 Review of completed work and achieved goals

The work on better preparation of graduates to perform tasks in the industry is carried out in many ways. In this article, we refer to four selected projects and selected works carried out in their field to show the complementarity of implemented projects and their joint efforts to better prepare graduates from different points of view (Fig.1.).

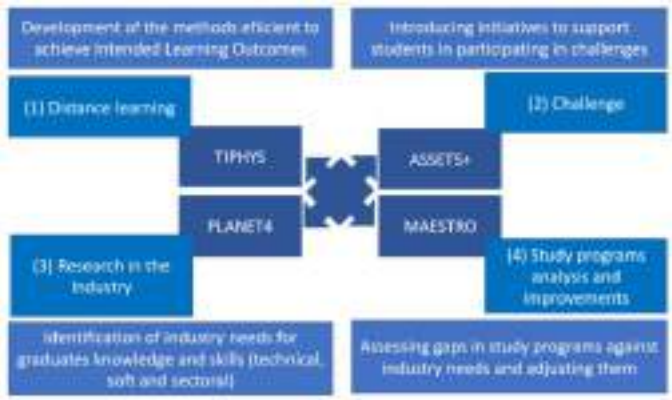

Fig. 1. Complementarity of projects in providing personnel to work in the industry of the future.

In the context of the TIPHYS project [6] a distance learning methodology was discussed which activates students to perform independent work and at the same time is based on the need to achieve goals as part of the cooperation between students. In the frame of ASSETs+ project [7] a methodology of the competition that motivates students not only to independently search for knowledge, but also to present their proposals was developed. Information on the two completed editions of the challenge is available in [8]. In the framework of the PLANET4 project [9] industrial research was carried out, the main purpose of which was to identify the needs of industry and related technologies. It was found, among others, that there is relatively little knowledge about the possibilities of practical application of edge computing. Finally, in the MAESTRO project [10], a way of introducing sustainable development into education was proposed.

Acknowledgement

This work has been partially funded by Erasmus+ Programmes: No 621639-EPP-1-2020-1-IT-EPPKA2-KA, PLANET4: Practical Learning of Artificial iNtelligence on the Edge for indusTry 4.0; No 2019-1-SE01-KA203-060572, MAESTRO: Manufacturing Education for a Sustainable Fourth Industrial Revolution; No 612678-EPP-1-2019-1-IT-EPPKA2-SSA-B, ASSETs+: Alliance for Strategic Skills Addressing Emerging Technologies in Defence; No 2017-1-SE01-KA203-034524, TIPHYS: Social Network Based Doctoral Education on Industry 4.0.

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A metacognition approach to engineering management education: the Debatethon

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1 Introduction

The complexity and multifaceted nature of current technological and social changes requires new skills and values to properly tackle the posed challenges. Educators and teachers are therefore called to implement novel practices and approaches to stimulate learners and contribute to the development of a critical mindset. This is particularly true in the context of engineering, where traditional face-to-face lectures, typically used for the fundamentals and technical concepts, may fail in preparing students for the intricate real-world dynamics [1]. Debate can be one of the methodologies highly effective to this end [2]. It has been recognized in literature as a valuable approach to foster critical thinking and communication skills [3; 4], it encourages students to analyze an issue in multiple perspectives [2] and promote students' participation and discussions [5]. The debate is a pedagogical approach consisting of a verbal challenge in which two parts confront each other on opposing positions: debaters argue on a specific topic in a limited time and following specific rules to present their theses [6]. This approach relies on the theory of constructive pedagogy, leveraging on the concept of cooperative learning and peer education and it is included among the interactive teaching methods [7]. The dialogic classrooms engage students in learning activities into the higher levels of the Bloom's Taxonomy, *analysis*, *synthesis*, and *evaluation* [8]. In addition, dialogue and discussion are a fundamental part of human beings, consequently, fostering learning and understanding in such a social process as debate can contribute to the development of social abilities of the learners [9]. Debates can be implemented in various disciplines, such as accounting [3], marketing [4], both for adult learning [2] and for adolescents [10]. The application of such an approach in the STEM field is rarer, even though some peculiar cases are reported in literature, e.g., the authors in [11] propose the debate for discussing ethical issues in the degree of Biomedical Engineering, [12] presents the use of debate in English Foreign Language course, and [13] illustrates the model of mathematical debate.

In the current work, we propose the *debatethon*: a marathon of debates in which participants discuss dichotomies of a given topic. We realized the pilot of the *debatethon*, involving the students of the bachelor's and master's degree courses in Management Engineering of the University of Pisa. The debate was organized in a one-day session of 5 hours, and it was held in the Museum of Calculus (Museo degli Strumenti del Calcolo) of the University of Pisa. The objective of such a location was to motivate students and encourage them in an open-minded interaction both with peers and facilitators. The implementation of educational activities out of the classroom can enhance interdisciplinary learning and teaching experiences [15; 16]. The preposition focuses on the conceptual dichotomies of the figure of the management engineer, that are: (a) methods: engineering versus management; (b) skills: soft versus hard; (c) approach: process-based versus goal-based; (d) performance: effectiveness versus efficiency; (e) working environment: physical versus digital. The expected learning outcomes of the proposed activity are to develop analytical, critical, argumentative and communication skills. The evaluation is based on the changes in the audience's sentiment, measured before and after the debate.

2 Pilot experience of the *Debatethon*

The debate requires a well-defined format, with specification on roles for people involved, rules for conducting the session and duration. In our pilot *debatethon*, the following roles are set up: *Facilitators*, which are professors of the Department of Management Engineering, researchers and PhD students from the Departments of Management Engineering and Computer Science. The presence of different figures can enable a distributed moderation, considered as a vantage point for success in discussions [14]; *Tutors*, i.e., Master's degree students in Management Engineering, who performed this activity as part of the capstone project "SMART INNOVATION 2022"; *Debaters*, who are bachelor's degree students in Management Engineering. Then we defined the preposition of the debate, namely a concept characterized by several dichotomies, and so we described this concept in terms of the identified opposite features. Before the event, we submitted a questionnaire on the dichotomy to *ex-ante* position the students. The initial preferences of the students on the opposite positions are used to select the opposite features which polarize at most the audience and to group the students based on their homogeneous answers. Six groups of five students were formed, and each "pair of groups" was assigned to the 3 most polarized dualities (a, b, d). The day of the event, each group worked on its own argument with the support of its tutor and the stimuli of the facilitators. After the oral presentation of both positions of the dichotomy, all participating students voted on the argument deemed most convincing. The groups that managed to be more persuasive with the arguments, bringing the audience to its side, was able to win the challenge. We collected the final preferences of the students on the opposite positions. The presentation confirmed the sentiment for the dichotomies (a) and (d), while they completely turned the game for the feature (b).

The presented pilot of *debatethon* is a powerful approach for cooperative learning and peer education. Its strengths are the presence of different facilitators and students from different degrees, the implementation out of the classroom, and the development of the transversal skills. Finally, the *debatethon* is a game: getting involved in the dynamics of the team and the competition is the best way to learn.

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