

## DIGITAL HERITAGE&DESIGN THINKING: THE RAILtoLAND WORKSHOP AS AN INNOVATIVE PRACTICE IN THE HIGHER EDUCATION SCENARIO

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### ABSTRACT:

The higher education scenario is constantly evolving and COVID-19 restrictions traced a demarcation line with previous behaviours and practices. Even though the European Commission spends many efforts to monitor the progresses, indicate the challenges as well as to give the perspectives, innovating the way in which we teach, especially about heritage & design, is rarely a priority.

The article presents an interdisciplinary learning activity carried out within the RAILtoLAND (RtL) project, a co-funded Erasmus+ project under the Key Action 2 "Cooperation for innovation". RtL is a collective ideation platform to develop innovative tools to communicate the European Cultural Landscapes by train and it has the goal to explore the social and educational value of the railway landscape as a common heritage and as a catalyst for European identity.

The workshop was carried out in the Sub-Appennine area dealing with two complementary and fundamental topics "Digital Heritage & Design Thinking", experiencing virtual events and innovative practices for the knowledge, narrative and design of heritage and landscape. The workshop stemmed from an interdisciplinary approach: experts in digital cultural heritage, survey and representation techniques, geomatics, and urban and landscape designers brought together their expertise and performed a ground-breaking study activity. The learning activities involved areas in the Marche Region (Italy) through on field activities, and the Porto-Vigo railway line (Portugal-Spain) through the experience of a virtual trip.

### 1. INTRODUCTION

The higher education scenario is constantly evolving. Notably, COVID-19 restrictions have traced a demarcation line and it would be short-sighted to come back to previous behaviours and practices. Even though the European Commission spends many efforts to observe and monitor the progresses, indicate the challenges as well as to give the perspectives (Farnell et al., 2021), innovating the way in which we teach, especially about heritage & design, is rarely a priority. There is a need of open forums or experience showcases that might stimulate innovative horizontal practices and that might give students and teachers the possibility to experiment together in an interdisciplinary way. In addition, the universities are requested to continue their work and reinforce transnational cooperation between universities to strengthen their capacities to equip young people, lifelong learners and researchers with the right competences and skills. The Erasmus programme is undoubtedly the larger opportunity at the EU level for experimenting peer learning activities and thriving the potential of transnational good practice exchange. It is also an important driver for shaping a true European identity, bringing transnational cooperation to a higher level and fostering a strong sense of European belonging. In particular, to achieve excellent and relevant higher education it also supports and stimulates pedagogical innovation focused on the learners, with a variety of learning spaces and flexible, interdisciplinary paths (EU Commission, 2022). Given these premises, the article aims to present an interdisciplinary learning activity carried out within the RAILtoLAND (RtL) project, a co-funded Erasmus+ project under the Key Action 2 "Cooperation for innovation". The five days Learning Teaching Training Activity (LTTA) is presented and analysed as a

favourable arena in which different experiences and collaborative tasks were proposed to the students and teachers in a semi-horizontal behaviour, in order to track and verify the peculiarities of different learning methods as well as to discuss the learning results related to two different sights and approaches to heritage: digitization and design. The paper is organized as follows: after a summary about the RtL project, the material and methods paragraph includes the description of the geographical context of the analysed Sub-Appennine area in the North of the Marche Region in which the activities were carried out, the general methodological approach of the workshop, the detailed description of all the events developed in the 5 days, with a special focus on the historical train journey, the virtual gate, the design-thinking tasks and the RtL app evaluation. The results and discussion paragraph analyses the results of the design process, the student's feedback on the virtual gate and tries to depict a general assessment of the LTTA in terms of communities engagement, understandable also to non-specialists.

### 2. THE RAIL TO LAND PROJECT

RtL involved six institutions from four European countries, Spain, France, Italy and Portugal. Specifically, four public Higher Education institutions: Universidad Politécnica de Madrid (UPM), leader of the project; Universidad Autónoma de Madrid (UAM); Université Gustave Eiffel de Paris (UGE) and Università Politecnica delle Marche de Ancona (UNIVPM); an applied research centre, Centro de Computação Grafica de Guimaraes (CCG) and a private entity that represents and coordinates practically all the railway companies in the world,

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the International Union of Railways (UIC), based in Paris. The main Spanish and Portuguese railway operating companies are also collaborating: Renfe Operadora and Comboios de Portugal (CP). The project ran from 2019 to 2022. RtL is *Collective ideation platform to develop innovative tools to communicate the European Cultural Landscapes by train* and it has the goal to explore the social and educational value of the railway landscape as a common heritage and as a catalyst for the consolidation of European identity and the formation of local cultures. It is aligned with the aims of the European Landscape Convention, involving the target population in decision-making processes and designing landscape enhancement initiatives (Europe Landscape Convention, 2000). RtL aims to provide training in the recognition of the values and diversity of European railway landscapes, both to higher education students from partner institutions and to the general public. In the first aspect, the project develops innovative educational practices supported by digital technologies, with learning techniques such as learning by doing, or design thinking. In terms of dissemination to the general public, RtL has developed four informative activities accessible free of charge to anyone interested and whose content can be viewed on the project website, among which we could highlight the round table "European railway landscape as a sustainable driver of the tourism sector" held in November 2020, or the International Seminar "Miradas férreas" held in May 2021, presenting the railway landscape from the perspective of art and technology, including a photography exhibition, a literary competition and a film series. The main output of the project is a geo-localised mobile app, which supports the train journey alongside a pilot line (Porto-Vigo). The app is conceived as an educational tool and allows to virtually interact with the landscape and the points of interests (POI), specifically 3D digitized (Quattrini et al., 2021). The project also implemented other educational activities such as a MOOC (Massive Open Online Course) (Berrocal et al., 2021). The development of the railTOland project confirmed that the railway allows the observation of landscapes in a unique way in comparison with other means of transport. Nowadays, new information technologies offer unprecedented possibilities for widening the traveller's viewing window, allowing new perspectives, which are not visible from the exact angle of the seat he/she occupies on the train or are hidden by other elements, like the train itself or the surrounding landscape. New technologies also make time travel possible by including, for example, images of a particular space in different historical periods. The development of the RtL application for the Porto-Vigo railway line, therefore, allows the traveller to access singular elements, which are called "points of interest" in the developed application, beyond their visual scope and time horizon. It also amplifies the scenic possibilities of the journey, with cultural, symbolic and identity implications (Berrocal & Zamorano Martín, 2022).

### 3. MATERIALS AND METHODS: THE LEARNING TRAINING ACTIVITY

A learning activity was planned during the RtL project. The activity took place in the city of Cagli, Italy (14-18 June 2022) after several postponements due to the COVID-19 pandemic. The workshop was carried out in the Sub-Appennine area dealing with two complementary and fundamental topics "Digital Heritage & Design Thinking", experiencing virtual events and innovative practices for the knowledge, narrative and design of heritage and landscape. The learning activities regarded the Sub-Appennine area around Cagli in the Marche Region through on field activities, and the Porto-Vigo railway line through the experience of a virtual trip. Thanks to this virtual trip the

students also participated in the testing phase of the RtL app. The multimedia gate, a sort of travelling unit including different digital technologies and allowing immersive experiences during its visit, as well as all digital tools during the five days contributed to a new way to enjoy, analyse, study and envision the enhancement of heritage sites and landscapes through design. All attendees had the chance to work in a relevant and stimulating area along the ancient Via Flaminia. They learned in a peer-activity about a multifaceted heritage, both natural and historical, in which there are both disused and recently reactivated railways. The main goal of the learning activity was thus to up-scale skills for students thanks to unusual and collaborative learning activities as well as to improve teachers' skills through digital tools and interdisciplinary insights. The students, two for each participating university (UPEM, UNIVPM, UPM and UAM), were selected among different candidates by their CV, a motivation letter, and a personal interview. As one of the objectives of the activity was to contrast diverse visions, priority was given to the cultural, social and gender diversity of participants. The selected students had a briefing session in their university, in which they were explained practical issues of their travel, training activity and individual safety. They were also asked to follow at least one of the three MOOC proposed by the project to acquire the minimum knowledge required to perform the final evaluation.

#### 3.1 Materials: the context of the Sub-Appennine Railway in the Marche Region

The LTTA was conducted in the Sub-Appennine area of the Appennino Basso Pesarese Anconetano. This is an inner territory used as a pilot area for the Marche Region for the Italian Strategy of Inner Areas (SNAI) (Barca, F., Casavola, P. & Lucatelli, 2014). The SNAI is an innovative policy for local development of marginal areas established at a national level by the Italian Ministry of Cohesion in 2014. The Sub-Appennine area was identified by the Marche Region as pilot area to test the capability of such inner territories to overcome their marginalisation and enable actions against the progressive depopulation and economic stagnation or even decline typical of such contexts (Ferretti et al., 2022). One of the main issues is represented by the difficult accessibility, due to the lack of public transport and the scarce maintenance of street networks. Moreover, the morphological structure of the region, mostly organized in river valleys perpendicular to the coastline that strongly influenced the overall mobility system, has contributed over time to a lack of interconnections among small cities and settlements in the inland. An exception can be recognized in the Sub-Appennine Railway line Urbino-Fabriano, opened in 1895 (Orazi, 2012), which remained partially in use until 2013, at least in the section Fabriano-Pergola (*Ferrovie Abbandonate: Ferrovia Fermignano - Fabriano*, n.d.). Particularly, this railway was one of the few links running parallel to the coast, an unusual setting considering the infrastructural difficulties to overcome natural obstacles such as mountains and rivers in the north-south axis. In 2021, thanks to the initiative of the regional councillor for infrastructures and mobility, part of the railway has been reopened for touristic purposes and in 2022 it has been acknowledged as one of the 26 historical railway lines of Italy. Crossing small cities along its way, the line currently ends in Pergola, a city of Roman origin of about 5,800 inhabitants, very rich in history and culture and hosting the renowned gilded bronzes from Cartoceto, dating back to 23 b. C. Until the second world war, the Sub-Appennine railway would continue until Urbino, crossing Cagli, the main city of the SNAI focus area. The city hosts numerous monuments and treasures among which the famous military architectures of the renaissance

architect Francesco di Giorgio Martini. The idea for the LTTA was to travel along the cities crossed in past and in present times by the railway line to unveil the potentials connected to this infrastructure, rich in precious heritage and valuable cultural landscapes. In Pergola the focus of the students' work was the under-utilized station and the adjacent abandoned agricultural consortium. In Cagli the task was to envisage new uses for the S. Francesco convent, a medieval complex including the most ancient church of Franciscan foundation in the Marche Region, displaying an admirable and rare example of middle Apennine gothic style. The current use as a school is soon to be displaced outside the historical centre, thereof the need to imagine new possibilities for this remarkable structure.

### 3.2 The innovative approach

The workshop stemmed from an interdisciplinary approach: experts in digital cultural heritage, survey and representation techniques, geomatics, and architectural, urban and landscape designers brought together their expertise and performed a ground-breaking study activity. The program was mixing more common educational activities introducing to the workshop topics, such as short inputs on digitization of cultural heritage and landscape, regeneration practices, landscape features along trainlines, case study analyses, with experiential moments enabling the interaction with heritage both in digital/virtual and "in person" mode. An assumption by (Lobovikov-Katz et al., 2014) inspired the concept of the LTTA: the revolutionary development in digital theory and technology calls for non-trivial decisions in bridging between the virtual and real worlds, especially with regards to learning, study and investigation of tangible heritage through applications of intangible ICT technologies. Moreover, this workshop aimed to enhance the autonomy and proactive behaviour of students in teamworking as well as to upscale their knowledge also considering the different backgrounds that ranged from building engineering-architecture to landscape, geography and archaeology. The didactic activity was organized around specific topics, clearly identifying the predefined learning objectives. In this context, the LTTA did not involve collaborative teaching but rather interdisciplinary teaching (Achille & Fiorillo, 2022). The team of professors and tutors supervised the same group of students but taught different disciplines and skills. The approach had a strong multidisciplinary connotation because the skills of the heritage digitization are related to the needs of space and buildings envisioning and design. For instance, the survey outputs were expected to boost the comprehension of the areas for the students, facilitate analysis for teachers and students and enable performing tools for the design approach.



Figure 1. The students and a tutor during the TLS acquisition

To the best of our knowledge usually workshops are organized with the aim of training specifically in the area of design or surveying techniques, but in the present case the aim of combining the two disciplines required compressing some activities e.g. only two surveying demos, while students worked on previously acquired data. This choice also took into account the backgrounds of the students, who in some cases were not already trained a remote sensing activity and therefore could not learn it in such a short time.

From a digitization point of view then, the idea was to provide an overview of acquisition techniques and technologies for both architectural and landscape scales, through demos for the San Francesco complex in Cagli (laser scanner + UAV) (Fig. 1) and for the area of the former agricultural consortium and railway annexes in Pergola (mobile mapping + UAV). The main output of data acquisition, previously carried out by the organizing group, were 3D point clouds available for all design-oriented representations.

In general, the proposed approach is in line with previously carried out research, in which the core regarded the use of digital technologies - particularly VR and 3D point clouds - for the analysis of multi-faceted areas characterized by the simultaneous presence of ambivalent conditions and contrasting interests. A path of hybridization between established methods of digitization of heritage and design practices applied to heritage was initiated. Considering a layered area that embeds several archaeological and historical sites and a diversified and rich cultural landscape, the opportunity to explore with a new interdisciplinary work methodology should be boosted by innovative learning methods. The idea was to use VR, digitization, and practices for CH experiencing to possibly produce innovative tools for design and decision-making processes. These might be ultimately utilized with communities and stakeholders to discuss future visions for their territories and to promote new entrepreneurship in creative industries (Ferretti & Quattrini, 2021). Similar attempts are also present in literature where digital tools are often used to analyze and map the natural heritage and ancient footpaths and create a territorial trail system between the small municipalities (Costantino et al., 2022) as well as to develop experiences in the direction of narrative approaches to develop theoretical models of virtual museums (Brumana et al., 2018).

### 3.3 Design thinking & Digital Heritage workshop

The program foresaw for the first day (14th June) learning activities to be held in the historical centre of Cagli: the participants registration at Palazzo Berardi Mochi Zamperoli, the students were welcomed by the Mayor, Alberto Alessandri, and the Vice-Mayor and municipal councilor for culture, Benilde Marini, at the Municipal Hall. After a guided tour in Cagli, the workshop activities dealt with the San Francesco's complex data capturing. The end of the day was dedicated to lectures provided by the teachers of the organizing university and tutorials by the tutors.

The second day was the so called "train day". Indeed, the group experienced the historical railway Fabriano-Pergola and its landscape. After the outward trip, a stop in Pergola station was foreseen. This 6 hours' time was planned to enjoy the virtual trip of the Porto-Vigo line, displayed in the virtual gate, but also to attend a second demo session of survey techniques. The return trip on the historical train was also useful for brainstorming on the values of the Marche landscape.

The third day was totally dedicated to the Design thinking workshop and the students worked at Palazzo Berardi Mochi Zamperoli in Cagli: work group and tutorials on data processing, construction of the narration on three specific

themes, experimentation, work group and ideation of the design proposal on the 3 areas were carried out.

The morning of the fourth day was dedicated to the usability test of the RtL App, with the synchronization of the app experiencing with videos taken alongside the Porto-Vigo line. In the afternoon the RtL multiplier event was held: a conference at the Cagli Municipal Theatre, titled "European landscape and heritage in the digital age. Promotion, public engagement and participatory design of cultural heritage". The invited speakers were: Anna Maria Marras, Maurizio Forte, Mario Santana Quintero, Livio De Luca, Roberta Bartolone & Giulio Mangano. The conference outlined trends in European landscape and heritage research fostered by the pervasiveness of digital tools and helped addressing future challenges and opportunities. Given that the digital transformation in the way cultural heritage is accessed, enjoyed and thus interpreted is now real, also as a consequence of the pandemic, the current paradigm of spatial perception is multidimensional thanks to digital facsimiles, the democratization of 3D digitization and cyber-physical systems. Researchers showcased recent research in their field of expertise, complementary to represent advances in best practices on heritage and landscape, currently enhanced by technologies in all domains: museums, archaeology, architectural knowledge and restoration, urban regeneration and design. In addition, the conference included an overview of the results of the RailToLand project and a final panel discussion with public institutions. The last half day was dedicated to report the learning activities and to the presentation of the results by students (evolution phase of design thinking). Moreover, a sum up of the activities by teachers and a first analysis about the usability test was carried out by CCG and UPM.

### 3.4 The train journey alongside the Sub-Appennine historical line

During the RAILtoLAND learning activity students and teachers also enjoyed a fantastic landscape by train: the Sub-Appennine Italian Fabriano-Pergola railway. The line, recently reopened after 8 years of inactivity, was also recommended in 2022 as one of the most beautiful train itineraries by the CNN Travel, the travel magazine of the largest US television. The main goal of the train trip on the historical line Fabriano-Pergola was to make students and foreign teachers aware of the Marche region valuable landscape (Fig. 2).



**Figure 2.** A picture taken from the window on the historical railway line Fabriano-Pergola (photo by A. Tessadori).

Especially in inner areas, this landscape has been widely preserved and it represents a fundamental asset for the region. Additionally, the day on the train was thought to take advantage of its several potentials in a learning activity: form the historical and cultural learning, the train journeys passed through areas and little centers with interesting historical and cultural significance, crossing also different industrial, craft and natural areas, giving to the students an overview of different values and resources to be taken into account for the design phase.

Also, a geographical learning, then boosted by cartographic and aerial drawings readings and analysis, was possible. Indeed, travelling by train allows learners to acknowledge geographical features such as hills, mountains, valleys and rivers. These experiences can enhance students' understanding of the geomorphological structure and spatial characteristics of a territory and help them appreciate natural areas as well as uncommon, yet fascinating features of, for example, abandoned productive areas. This comprehensive approach to the activity also includes learning a sensorial and perceptive learning: train journeys offer a unique sensory experience, considering the sound inside the train and the smells of the environment, while the perception of spaces and landscape is also influenced in a positive way by the slowness of historical trains, that can enhance students' sensory experience and perceptive knowledge.

In addition, the day on the train also contributed to team building and social skills (Fig.3): the train journey promoted team building as students were free to interact with one another during the journey, as well as other collateral activities such the show offered by the Cagli Municipality and the social dinner.



**Figure 3.** A moment during the Fabriano-Pergola trip (photo by A. Tessadori).

### 3.5 The virtual trip and the multimedia gate

The RtL proposal foresaw a virtual Lab and trip along side the Porto-Vigo railways line to be carried out in the first months of the project: its goal was originally to give to the students an overview of the main key points and highlights alongside the line and get them quickly prepared to participate in the design thinking workshop for the app ideation. Considering the postponement of the LTTA after the app design and contents construction, the goal of the virtual Lab was changed in a larger perspective of training the students on several possibilities of remote interaction and enjoyment of the cultural heritage. Thus, after the train trip in the "real world" on the Subappennine area, the virtual one alongside Porto-Vigo was made available to the group on a multimedia gate, equipped in the Pergola station.

The idea on the basis of the phygital solution was the exploitation of the several devices in the multimedia gate for the Virtual Experience Porto-Vigo. The phygital solution was designed according the most recent trends (NEMO Network of

EuropeanMuseum Organisations, 2023) and exploiting the cutting-edge technologies as well as the contents developed thanks to the Distori group expertise.

The Multimedia gate (Fig. 4) has the internal dimensions of 6 x 1.95 mt. of length and mt. 2.45 of height. It includes the following devices: a) 2 synchronized large video projections (digital library 195 X h 165 cm + immersive video projection 230 x h 165 cm) b) a touch screen 45", c) an holographic display; d) a multimedia carpet (140 x 170 cm).

The main device (a) was dedicated to the virtual trip from Porto to Vigo, and the video with the storytelling was designed in order to guarantee that the experience doesn't overlap with the real trip, but enables the following App testing and validation. Considering the internal space, the users of the experience are asked to stand, consequently their stay inside the virtual gate should be reasonably of 10/15 minutes. Beside the preparation of the contents and the audio-visual assembly for the virtual trip, some choices were made for the other devices. For the multimedia carpet different video and images solutions were prepared to be tested in the device, vertical and interactive projection. For the holographic projection some videos about artefacts and buildings in the Marche region were selected among the data already processed by the Univpm group. With the same concept to incorporate the virtual experience Porto-Vigo with the knowledge-based interaction with the Marche heritage, some promotional videos regarding the region were showed.



**Figure 4.** The internal equipment of the multimedia gate, with the virtual trip as the main content.

Considering that the visit of the multimedia gate was considered as a part of digital learning for the students they were asked to reply to a questionnaire. Its results are analysed in the discussion paragraph.

### 3.6 A design methodology

The design thinking approach is based on some acknowledged references and in particular the one developed by IDEO, a company for design and innovation that has launched the method on a global level also in the business sphere. In the context of the LTTA, IDEO steps (Brown, 2008) were adapted and adjusted to match with a spatial design approach addressed to a specific context or area, which was the main goal of this activity.

Therefore we identified the following steps: 1) Discovery: through on field research in the first two days of workshop the students collected information and developed a deeper understanding of the problem; 2) Interpretation: through data processing, also in the first two days, they made sense of what

they had collected, clearly articulating the problem they wanted to solve; 3) Ideation: this phase is the most complex and delicate as the students and teachers, through dialogues and brainstorming, had to formulate ideas related to the opportunities identified in the previous step and start to highlight potential solutions to develop; this step happened in the morning of the third day; 4) Experimentation: through the development of concepts and visions, in the afternoon of the third day, students were asked to put previous ideas into practice by building (or in this case designing) prototypes to test all or a part of the envisaged solutions; 5) Evolution: through the presentation of first results and their discussion with a public audience, the students' groups managed to question and review initial ideas and tried to evolve them; this allowed to learn perhaps the most difficult aspect of the process, namely to engage with a continuous short-cycle innovation process to continually improve the design.



**Figure 5.** A group at work during the ideation phase of the Design Thinking (photo by G. Plescia)

The third step of ideation was a moment of strong interaction among students coming from different backgrounds and teachers of diverse disciplines, with very distinct focuses. Indeed, the dialogues were organized using a similar methodology such as the "Feral Business Clinic" (Elzenbaumer, 2020) combined with a "Pro-Action Café" approach (Baeck & Leoprechting, 2010). Three tables and three different topics are set, each supervised by a fix coordinator who is visited by 'travellers' moving from table to table in three different moments: round 1 is for the construction of a word cloud of values / risks / challenges; round 2 is to identify a key-concept to point out objectives / strategies / programs; round 3 is the articulation of elegant steps, namely operative actions / actors / processes that lead to the achievement of an envisaged transformation. The three analysed topics were: San Francesco convent and the community (table 1); San Francesco convent and the touristic potential (table 2); Pergola: the landscape, the railway and the built heritage (table 3). Each group (Fig. 5) was asked to contribute to the ideation of possible transformation of the cultural landscape and heritage resources detected in each context. Through the help of the coordinator (a selected teacher, mostly expert in the assigned topic) each group produced a first set of ideas to be further developed into design proposals during the experimentation phase (only for students). With the aim of proposing an innovative learning experience, it is remarkable that each group featured local participants to provide the place knowledge, as well as a design-expert tutor and a digital-technology-expert tutor to strengthen interdisciplinarity. Also,

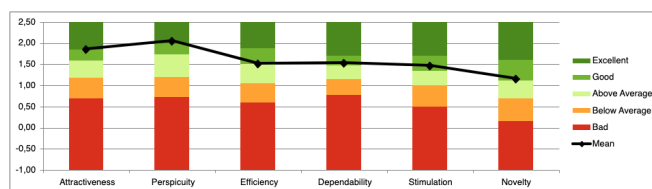
due to the short time available for this activity, basic data were provided by the organizers, whereas data collected during demo sessions had a mainly demonstrative purpose. Already available data included drone images, panoramas, point clouds and 3D models of the intervention areas which facilitated and fastened the understanding of the areas by the students.

The ideas collected during the ideation phase were experimented through design prototypes developed by the students in one afternoon, and they were presented and discussed with the community on the last day. The achieved results are synthesized in the "Results and Discussion" paragraph.

### 3.7 Evaluation of the RtL app

The evaluation of the RtL app was intended as a learning experience for students and teachers, but also a way to collect suggestions for improving it. It's interesting to highlight that the questionnaires were filled when participants had already attended different conferences and workshops, in the last but one day of the 5 days of activities. Participants in the survey knew the objectives of the RtL project and had acquired a certain level of knowledge related to railways and landscape interpretation. Nevertheless, participants in the survey didn't know the app before. When doing the questionnaire, it was their first contact with the application. The app users were also located in a room with screens showing the lateral view of the train, because the core section of the RtL app is related to the journey and it is intended to complement the trip experience.

The survey was developed in two different sessions with a specific observer during the whole duration of the survey activity. The objective of the first one was to acquire some personal skills of the participants while the second aimed directly to evaluate the app. The evaluation was anonymous allowing a more open and dynamic participation. In both sessions a moderator explained the development of the event and asked for the signed consent to record the sessions and use the results.



**Figure 6.** Survey results deriving from the User Experience Questionnaire (UEQ) tool

The aim of the survey was to know the attractiveness and the pragmatic and hedonic quality of the app. Pragmatic quality (Perspicuity, Efficiency, Dependability) describes task related quality aspects, while hedonic quality (Stimulation, Originality) describes the non-task related quality aspects. The range of the scales was between -3 (horribly bad) and +3 (extremely good). The main results (Fig. 6) of the answers analysis can be summarized as follows: Attractiveness and Pragmatic Quality are near 2, which is a high notation while hedonic quality is below 1.5, could be improved. All the evaluated aspects were up to 1, in a range of good for novelty, stimulation dependability, and efficiency and excellent for perspicuity and attractiveness. When analysing the distribution of answers by item, the most appreciated are easy, pleasing, secure, clear, practical and organized while the less appreciated (but always in the positive range) are exciting, predictable and inventive.

## 4. RESULTS AND DISCUSSION

A critical discussion on the results of the here presented LTTA could be based on the survey carried out about the multimedia gate. It was planned in the middle of the learning experience (2nd day) so it was considered also an intermediate feedback for the lecturers and teachers, in order to track the progress and eventually correct the communication with the students. The questions were: a) Did you like the Porto-Vigo virtual trip in the multimedia gate? Which is the part that you enjoyed the most? b) Which technology inside the gate do you think is more effective?

Almost all students (9 out of 10) participated in the feedback collection and the part they enjoyed the most was undoubtedly the virtual trip Porto-Vigo. The motivations in the replies were however diversified: someone said "The mix of sound, image and video in a harmonical way that made the experience really immersive" as an example, but some replies seem more technical oriented citing lidar scans and orbital views in combination with Google Earth. Regarding the technology inside the gate and its effectiveness, the most appreciated was again the tech supporting the virtual trip, nevertheless also extended reality and holographic display (ghost window) were cited.

Considering the smallness of the sample, this survey cannot be considered from the point of view of technology validation or multimedia gate in its entirety, but it is a tool to verify the effectiveness of training activities with regard to user experience technologies. It is surely possible to conclude in this light that the results were satisfactory.

The three design proposals developed for the railway station of Pergola and the convent of S. Francesco in Cagli focused on different possibilities of transformation and enhancement of European railway landscapes and built heritage through the aid of digital tools and techniques. The available data and the first ideas collected in the morning dialogues / tables allowed students to envisage three proposals to discuss with the local community on the last day of the LTTA. Indeed, the focus of this innovative interdisciplinary method is to explore possibilities of hybridization not just in the survey phase, but also in the design phase, allowing common people, which have normally a limited understanding of technical drawings, to be part of the decision-making process by being 'immersed' in the project using virtual and mixed reality. In the current activity students made use of drone images, panoramas, and point clouds to display clearer and more communicative images of their design proposals in order to include a wider public in the discussion of their first results. This was particularly productive on the learning side as well as for the audience.

Given this background, group one, with the title "Pasos", aimed to reimagine the convent of San Francesco through a step-by-step process. The group first acknowledged the values, namely the central location, the current use as a place of knowledge, and the presence of a vast inner open space; and the risks, namely the seismic vulnerability, the surrounding noise, the scarce accessibility and the presence of cars. On these premises, it outlined a complex proposal entailing objectives, strategies and a detailed program for the building, focusing on limiting parking and reserving places for art installations, while involving the community in participatory activities, especially addressed to schools (Fig. 7). Finally, these *pasos* would lead to envisaging a school of arts and crafts in the former convent, holding the current education use, and restoring the building with grants and funds coming from European and International organizations for heritage.

Group two, with the title "A window through Cagli", proposed to work on the former convent of Cagli through a combination of short- and long-term actions. In the short-term the temporary occupation of the courtyard and of some rooms would serve for local arts and crafts, food spaces, and a showcase of local products and it could attract a "bottom-up tourism" to give a first economic impulse to the place. In a second phase the adaptive reuse of the building, funded through European programmes, could involve key actors to transform this religious space into a place for long-term cultural activities such as a library. Finally the project proposal highlights the use of digital technologies assets in the promotion and restoration of the San Francesco convent by proposing the creation of an app, both for tourists and inhabitants, to book the spaces of the renovated convent for temporary uses, in order to keep the space alive and dynamic.

Group three, with the title "Pergol-hub" worked on a proposal for the station and the former agricultural consortium in Pergola. In line with some examples of recycle of former industrial areas in Germany (e.g. Ruhr area), the hub is re-imagined as a new cultural centre and a place for cinema and dancing, as well as a restaurant. Next to the station, a new bike lane and electric buses facilitate the connection to the historical centre of Pergola, thus improving the current accessibility to the city for enjoying its rich cultural heritage and strengthening its touristic potential. Also, a good territorial analysis and the involvement of stakeholders are seen as fundamental steps to achieve a convincing and effective regeneration as a hub for the region.

The results of these design explorations were presented in the Ridotto of Cagli Theatre during the last LTTA's morning and were discussed with an audience of teachers and participants of the RiL workshop and with Cagli's experts and politicians as well as with the local community. Even if students' proposals were generally appreciated for their freshness and innovativeness, feedback and comments from the public helped them enriching their perspective and thinking further about how to embed additional elements in their projects.

At the end of the LLTA, and also after some months from its conclusion, it is possible to state that the presented learning training activities had a positive impact on the community of the inner areas. Higher education students and teachers get to

contribute to the development of the community through their analysis and ideas, but also because the event put for some days those communities at the center of a scientific and cultural debate, thus creating a positive influence on the area.

In terms of personal growth, the displacement of the LTTA outside the university and in a small city implied to engage closely with communities and consequently to ensure a mutual beneficial relationship between 'foreigners' and citizens. Both had the possibility to improve their social skills, gain self-confidence and learn about other cultures. Regarding the benefits for the students, improved communication skills and enhanced collaboration behaviour are clearly recognized from similar real case scenario work, also considering the associated compressed time frame. In this case we can conclude that group learned to better communicate effectively and enhance its intercultural competence, also thanks to the engagement with the community.

## 5. CONCLUSIONS

The 5 days activity represents a good example of how students can be trained to work on challenges in a holistic way across disciplines, and how to support students' critical thinking, problem-solving, creative and entrepreneurial skills as well as the capacity to translate knowledge into innovation. Particularly, the HE students trained their skills of team working and on field work, developing relational capacities in a horizontal cooperation (teachers & students) within internationally mixed groups. Collaborative and interdisciplinary approaches were favoured by the presence of expert students (tutors) coming from different backgrounds (digital heritage, design, geomatics) and supporting ideation and experimentation as well as representation and data extraction. As a consequence, the acquired skills entailed communication and design skills, data management for the user interaction with heritage and a proactive behaviour while engaging with an audience/client. Finally, an important outcome of the LTTA for the students was to overcome strictly disciplinary boundaries and practice hybridization of different approaches.

The development of the learning activity added significant value to the overall RiL project for several reasons.



**Figure 7.** "Pasos" proposal for the regeneration of the former convent of San Francesco. Cross section of the point clouds model with highlights of new possible activities in the open public and semi-public spaces. Image by Group 1.

It allowed complementing the virtual training of the Micro-master with applied workshops in which students learn by doing. For them, activities were designed, where they had to delimit visual basins and had to identify key elements of the landscape. This type of skills can only be achieved through a dynamic face-to-face and hands-on work. This experience strengthened transversal competencies in students such as communication, critical thinking and teamwork. The dynamics of the collaborative platform applies the educational innovation technique based on the fragmentation of a problem into other more approachable ones. Applied collaborative design solutions have been based on creativity and horizontal communication among participants. Furthermore, the activity allowed each student to appreciate different points of view on the same reality. This is due to the fact that the participating students come from different cultural realities, and, above all, they have different academic backgrounds (engineering, architecture, geography, geography, tourism...), which provides a very enriching vision.

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### REFERENCES

- Achille, C., & Fiorillo, F. (2022). Teaching and Learning of Cultural Heritage: Engaging Education, Professional Training, and Experimental Activities. *Heritage*, 5(3), 2565–2593. <https://doi.org/10.3390/heritage5030134>
- Baeck, R., & Leoprechting, R. (2010). *Pro action café*. <http://storage.ning.com/topology/rest/1.0/file/get/2653318837?profile=original>
- Barca, F., Casavola, P. & Lucatelli, S. eds. (2014). *Strategia nazionale per le Aree interne: definizione, obiettivi, strumenti e governance*. [https://www.agenziacoesione.gov.it/wp-content/uploads/2020/07/MUVAL\\_31\\_Aree\\_interne.pdf](https://www.agenziacoesione.gov.it/wp-content/uploads/2020/07/MUVAL_31_Aree_interne.pdf),
- Berrocal, A. B., López Rodríguez, A., & Zamorano Martín, C. (2021). RAILtoLAND, a colectivo ideación platform to develop innovative tools to communicate the European Cultural Landscapes by train. *4th International Conference of Education, Research and Innovation*, 8942–8949. <https://doi.org/10.21125/iceri.2021.2054>
- Berrocal, A. B., & Zamorano Martín, C. (Eds.). (2022). *The Porto-Vigo Railway. An approach to its landscapes*. Universidad Autónoma de Madrid Publications Service.
- Brown, T. (2008). Design thinking. *Harvard Business Review*, 86(6), 84.
- Brumana, R., Oreni, D., Caspani, S., & Previtali, M. (2018). Virtual museums and built environment: narratives and immersive experience via multi-temporal geodata hub. *Virtual Archaeology Review*, 9(19), 34–49. <https://doi.org/10.4995/var.2018.9918>
- Costantino, C., Mantini, N., Benedetti, A. C., Bartolomei, C., & Predari, G. (2022). Digital and Territorial Trails System for Developing Sustainable Tourism and Enhancing Cultural Heritage in Rural Areas: The Case of San Giovanni Lipioni, Italy. *Sustainability*, 14(21). <https://doi.org/10.3390/su142113982>
- Elzenbaumer, B. (2020). Community Economies, a Practice Exchange: 7-8-9 June 2019, Vallagarina Italy. *Alpine Community Economies Laboratory, Snapshot J*, 26–31.
- EU Commission. (2022). *COMMUNICATION FROM THE COMMISSION ON A EUROPEAN STRATEGY FOR UNIVERSITIES*.
- Europe Landscape Convention, 8 (2000). <https://www.coe.int/en/web/conventions/full-list?module=treaty-detail&treatynum=176>
- Farnell, T., Skledar Matijević, A., & Schmidt Šćukanec, N. (2021). *The impact of COVID-19 on higher education: a review of emerging evidence*. <https://doi.org/10.2766/069216>.
- Ferretti, M., Di Baldassarre, M. G., & Rigo, C. (2022). Reactivating Built Heritage with Shared, Creative, and Transcalar Approaches: An Exploration of the Marche Apennine Inner Area. *Sustainability*, 14(23), 16196. <https://doi.org/10.3390/su142316196>
- Ferretti, M., & Quattrini, R. (2021). Digitization and Design of Archaeological Heritage: An Interdisciplinary Research Approach to Flaminia Cultural District. In F. Bianconi & M. Filippucci (Eds.), *Lecture Notes in Civil Engineering* (Vol. 107, pp. 909–930). Springer International Publishing. [https://doi.org/10.1007/978-3-030-59743-6\\_42](https://doi.org/10.1007/978-3-030-59743-6_42)
- Ferrovie abbandonate: Ferrovia Fermignano - Fabriano*. (n.d.). [https://ferrovieabandonate.it/linea\\_dismessa.php?id=25](https://ferrovieabandonate.it/linea_dismessa.php?id=25)
- Lobovikov-Katz, A., Moropoulou, A., Konstanti, A., Ortiz Calderón, P., Van Grieken, R., Worth, S., Cassar, J., De Angelis, R., Biscontin, G., & Izzo, F. C. (2014). Tangible versus Intangible in e-Learning on Cultural Heritage: From Online Learning to On-site Study of Historic Sites. In Ioannides Marinos, N. and Magnenat-Thalmann, and F. Eleanor, and Ž. Roko, and Y. Alex-Yianing, & and Q. Ewald (Eds.), *Digital Heritage. Progress in Cultural Heritage: Documentation, Preservation, and Protection* (pp. 819–828). Springer International Publishing.
- NEMO Network of European Museum Organisations. (2023). *Digital learning and education in museums - Innovative approaches and insights*. [https://www.nemo.org/fileadmin/Dateien/public/Publications/NEMO\\_Working\\_Group\\_LEM\\_Report\\_Digital\\_Learning\\_and\\_Education\\_in\\_M](https://www.nemo.org/fileadmin/Dateien/public/Publications/NEMO_Working_Group_LEM_Report_Digital_Learning_and_Education_in_M)



useums\_12.2022.pdf

Orazi, S. (2012). *La linea ferroviaria Fabriano-Urbino-Santarcangelo di Romagna tra storia e immagini*. Argalia editore.

Quattrini, R., Pierdicca, R., Berrocal, A. B., Zamorano, C., Rocha, J., & Varajão, I. (2021). Uncovering the Potential of Digital Technologies to Promote Railways Landscape: Rail to Land Project. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, 12980 LNCS. [https://doi.org/10.1007/978-3-030-87595-4\\_23](https://doi.org/10.1007/978-3-030-87595-4_23)