

Students Meet Cultural Heritage: An Experience within the Framework of the Italian School-Work Alternation (SWA) – from Outcomes to Outlooks

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Abstract: Cultural heritage is the creative expression of a people’s presence in the past. It represents a driving force to create, develop, and consolidate the sense of identity, belonging, and citizenship, as well as a means to appreciate the diversity of people and develop a policy for peace and mutual understanding. Furthermore, heritage is a source of economic development and a key factor for sustainable development. The dissemination of such values among people and the transmission of heritage to the future generations entail putting into the field proper actions, from the knowledge to the protection and conservation, and from the enhancement to the fruition and management. Such requirements increasingly involve the use of Information and Communication Technologies (ICTs) that can be considered the paradigm shift to create novel job opportunities in the field of cultural heritage. This paper aims to discuss an experience led by the Institute of Archaeological and Monumental Heritage of the (Italian) National Research Council (IBAM-CNR), with students of a secondary school of the Basilicata region (Southern Italy). The experience developed within the framework of the School-Work Alternation (SWA) (recently renamed “Pathways for Transversal Competences and Orientation” by Italian law), a training modality envisaged in the Italian school system to bring the school closer to the world of work by proper partnership between formal education contexts and external organizations. The SWA Project revolves around the acquisition of some technical and methodological tools for the approach to knowledge, conservation, and enhancement of cultural heritage, having particular regard for diagnostic tools and ICTs. This article deals with the outcomes of the activities developed during the Project, discussing both the technical-professional and transversal skills acquired or expected to be acquired by the students. In addition, starting from the results of the activities, the authors speculate about possible outlooks of SWA in the heritage field considering: (i) the role of such a training path in raising young people’s awareness to preserve cultural heritage by becoming active and proactive citizens; (ii) the relationship of SWA with regional and European-supported development policy strategies; (iii) the potential benefits that SWA can provide for cultural heritage from the synergy between different institutional actors.

Keywords: cultural heritage; diagnostic technologies; ICT; secondary school; training; skills

1. Introduction

Cultural heritage (CH) is “a group of resources inherited from the past which people identify, independently of ownership, as a reflection and expression of their constantly evolving values, beliefs, knowledge, and traditions. It includes all aspects of the environment resulting from the interaction between people and places through time” [1]. As a result, heritage represents the legacy of our history, the umbilical cord that links the past with the present day, helping us to understand the latter and building a bridge for a better future. Heritage is also a driving force to create, develop, and consolidate a sense of identity, belonging, and citizenship. It is helpful to shape safer and stronger communities, as well as to appreciate the diversity of people and to develop policies for peace and mutual understanding. Besides, CH is a source for economic development, employment, tourism, and sustainable development, especially for the Mediterranean area, where the touristic exploitation of the cultural assets is one of the main factors of the social and economic progress of the territory [2]. However, CH is a fragile, non-renewable, and non-relocatable resource.

In order to ensure that the values that CH represents can be transmitted to citizens, so as to guarantee cultural resources are passed down to future generations, it is necessary to envisage fitting actions aimed at the knowledge, protection, conservation, enhancement, fruition, and management of what we have inherited. In all these aspects, novel ICTs are increasingly involved, being nowadays fundamental in all areas of society. Actually, ICTs play a crucial role in the CH field, from data collection and recording, interpretation, and communication, to monitoring, preservation, exploitation, and enhancement [3]. In particular, ICTs can be considered as the major driving forces for both preservation and exploiting of CH [4]. The beneficial marriage between ICT and CH benefits enormously from heritage as a creative resource to develop new ways to improve the accessibility of widespread cultural heritage [5], so as to nurture economic innovation and job opportunities [6–8].

In order to increase the opportunities for work and seize the chances and challenges that will involve the different sectors of cultural heritage in the coming years, new generations have to be oriented to become increasingly aware of their potential, attitudes, and skills. These requirements fit with the rationale of the School-Work Alternation (SWA) activities envisaged in the Italian education system to bring schools closer to the world of work through proper partnership between formal contexts and external organizations. Therefore, this paper aims to discuss a training project, centered on cultural heritage, led by the Institute of Archaeological and Monumental Heritage of the (Italian) National Research Council (IBAM-CNR) at a *Liceo Scientifico*, a high school specializing in scientific studies. The Project was planned for the acquisition of some technical and methodological tools for the approach to knowledge, conservation, and enhancement of cultural heritage, paying special attention to diagnostic tools and ICTs.

The Project, which will be discussed later, is part of the *Catalogo dei Progetti di Alternanza Scuola-Lavoro* (Catalogue of Projects of School-Work Alternation) that IBAM-CNR offers to secondary schools of the Basilicata Region (Southern Italy). In detail, the article deals with the outcomes of the Project, discussing the technical-professional and life skills acquired or expected to be acquired by the students. Beyond these aspects, strictly related to the purposes of SWA, the experience with the students motivated us to discuss about some outlooks of the training activities in the cultural heritage field, such as: (i) the role of SWA in raising young people's awareness about the need to preserve cultural heritage by becoming active and proactive citizens, also by making use of ICT tools; (ii) the relationship of SWA with regional and European-supported development policies; (iii) the potential benefits that SWA can take from the concerted efforts between different institutional actors.

The article is divided into four main parts: (1) the Italian rules on SWA within the European background; (2) the main features and contents of the IBAM-CNR catalogue, within which the Project discussed here is arranged; (3) the activities carried out at the high school, discussing the approach

adopted and results; and (4) conclusions, including some considerations of the outlooks of SWA for supporting actions centered on cultural heritage.

2. The School-Work Alternation: the Italian Context within the European Setting

Since the 2000s, the European Community has given high priority to education and training (Table 1). The European Commission has clearly indicated in many documents (from the first in the 2002 Barcelona “Education and Training 2010”, to the last in 2014 regarding the “2014–2020 Partnership Agreement”) the need for excellent education and training based on the combination of theoretical learning with the acquisition of practical skills in the workplace. As a result, almost all of the European member states have enacted national laws aimed at raising the quality standards of their education systems and their learning outcomes to allow young people to move from the world of study to work more easily. Therefore, there are four main typologies of SWA in Europe:

- (1) Alternation practices as second chance training for students experiencing difficulty in school;
- (2) Practices aimed at socializing students in their future working conditions;
- (3) Practices that assign the main role of training to the concrete exercise of professional activity;
- (4) Alternation practices formalized under a work contract.

Formally, SWA was outlined in the Italian educational system with Law No. 53 issued on March 28, 2003, regulated by the Legislative Decree No. 77 issued in 2005. The Decree establishes the general rules for the implementation of SWA. The Decree indicates, *inter alia*, the aims of the alternation and the ways to arrange the SWA paths.

Regarding the purposes, the Decree (article 3) stresses five significant points, paying attention to the need for:

- (1) Implementing flexible and equivalent learning methods from a cultural and educational point of view, compared to the outcomes of the second cycle courses, which systematically link classroom training with practical experience;
- (2) Enriching the training acquired in school and training programs with the acquisition of skills useful in the labor market;
- (3) Encouraging the orientation of young people to enhance their personal vocations, interests, and individual learning styles;
- (4) Establishing an organic connection of educational and training institutions with the world of work and civil society, which allows the active participation of the subjects involved;
- (5) Correlating the training offer to the cultural, social, and economic development of the territory.

Regarding the method of shaping the alternation pathways, the Decree clarifies that the SWA activities need to have a flexible structure and to be organized into periods of training in the classroom and into periods of learning through work experiences. Furthermore, the Decree stresses that the schools and training institutions design and implement the projects on the basis of specific agreements with the implementing bodies (companies, public, and private bodies, etc.).

Table 1. The main European stages aimed at guaranteeing a proper education and training system (for sources of data to see the Appendix).

Document date	Object of the Document
March 15–16 2002	During the European Council of Barcelona, priority attention was established for the interconnection between European countries. In 2006, the agreement was translated into the document of “Education and Training 2010”;
December 15, 2004	Europass Decision of the Parliament and European Council for the transparency of qualifications and competences (2241/2004/CE);
December 18, 2006	Recommendation of the European Parliament and Council to establish key competences for lifelong learning (2006/962/EC);
April 23, 2008	Recommendation of the European Parliament and of the Council on the establishment of a European framework for qualifications for lifelong learning (EQF);
May 12, 2009	The ministers of education of the countries of the Union adopt the second "Strategic framework for European cooperation in the field of education and training", called "ET 2020" ("Education and Training 2020");
June 18, 2009	Recommendation of the European Parliament and of the Council on the establishment of a European reference framework for quality assurance in vocational education and training (EQAVET);
2010	Communication from the Commission "A strategy for smart, sustainable, and inclusive growth";
November 2012	Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, and the Committee of the Regions entitled "Rethinking education: investing in skills for better socio-economic results";
December 20, 2012	Recommendation of the Council of the European Union on the validation of non-formal and informal learning;
December 5, 2012	"European Alliance for Apprenticeship" (Youth Employment Package);
April 22, 2013	Recommendation of the European Council on the "Youth Guarantee" (2013/C 120/01) and on other instruments to facilitate the transition from school to work;
June 2, 2014	Recommendation of the European Council on the 2014 Italian national reform program, highlighting the objectives of improving the quality of teaching and ensuring an easier transition from school to work, particularly in the high secondary education cycle and tertiary education;
October 29, 2014	Approval by the European Commission of the "2014–2020 Partnership Agreement", in which the application of the aforementioned European regulations in Italy to promote the quality, effectiveness, and efficiency of the national school system is confirmed;
February 8, 2018	Amendment of the agreement of October 29, 2014, following the programming of the resources allocated to Italy with the technical adjustment of the 2014–2020 European Multiannual Financial Framework, as required by article 92, part 3 of the European Union Regulation.

Ten years after the issue of Decree No. 77, SWA was the subject of another legislative act: Law No. 107, issued on July 13, 2015, concerning the “*Riforma del sistema nazionale di istruzione e formazione e delega per il riordino delle disposizioni legislative vigenti*” (reform of the national education and training system and delegation for the reorganization of the laws in force). In order to increase job opportunities and student orientation skills, the norm organically introduces SWA in the formative

offer of all high schools, as an integral part of the educational paths. Therefore, SWA is set up as a strategy to design and implement training courses based on partnerships between the world of education and external organizations. The aim is to guarantee the new generations orientation skills, technical and professional hard skills, and the development of soft skills, that is, those abilities that allow us to acquire versatile and positive behavior, thanks to which we can effectively deal with requests and challenges of everyday life. From the point of view of which students are involved, the law establishes that the formative strategy addresses the last three years of schooling and its duration changes according to the type of school it addresses (technical and professional institutes with 400 hours, and "Licei" with 200 hours). Compared to the course of study chosen, Law No. 107 establishes a mandatory number of hours to activate the SWA experiences. However, the Italian Law that approved the last annual budget of Italy made changes to the discipline of SWA: starting from the 2018/2019 school year, SWA courses are renamed "*Percorsi per le competenze trasversali e per l'orientamento*" (pathways for transversal competences and orientation). The same Law establishes a drastic reduction of the duration of the alternation. This reduction, depending on the type of school involved, ranges from a minimum of 48% to a maximum of 63% with respect the total amount of hours indicated in the Law issued in 2015 [9]. The rationale of this decision seems to be the need to increase the quality of the projects.

3. The SWA Catalogue of IBAM-CNR

The Institute of Archaeological and Monumental Heritage of the (Italian) National Research Council (IBAM-CNR) is a multidisciplinary research institute with high expertise and specialized skills in the field of knowledge, documentation, diagnosis, preservation, enhancement, fruition, and communication of archaeological and monumental heritage. The Institute has its main headquarters in Catania and two research offices in Lecce (Apulia, Southern Italy) and Potenza (Basilicata, Southern Italy).

Recently, IBAM (Potenza office) developed the Catalogue of SWA projects addressed to the secondary high education institutes of the Basilicata region (Southern Italy). The Catalogue was planned bearing two circumstances in mind. The first regards the fact that Law No. 107 stresses the importance of involving organizations, among them CNR, active in the field of cultural heritage for planning and developing SWA. The second considers the recent agreement signed between the head of CNR and Ministry of Education [10], which establishes the role of CNR in contributing to implementing SWA paths in cooperation with formal education systems. To these two considerations, we have to add the circumstance that the school system is increasingly oriented towards teacher training, or towards the presence of external skills, able to determine a democratic society through the proposal and planning of cross-knowledge [11].

The IBAM Catalogue includes sixteen projects focusing on cultural heritage. The projects aim to train learners in one or more of the following areas of cultural heritage [12] (also see Table 2):

- (i) *Knowledge*, understood as the set of activities aimed at the knowledge of the historical and artistic value, of the physical consistency, and of the constructive technique of cultural heritage;
- (ii) *Protection and conservation*, the activity oriented toward the protection and maintenance of heritage in good conditions, from the preparation and application of legislative instruments to maintenance and restoration;
- (iii) *Enhancement*, the activity aimed at the dissemination of the historical and artistic values of the asset, its value, and its placement in cultural circuits;
- (iv) *Fruition*, the activity aimed at creating fall-out effects on the community in terms of both enjoyment and cultural growth;
- (v) *Management*, the actions that consist of organizing activities, according to a planning logic, aimed at the conservation, enhancement, and use of the asset.

The projects, taken as a whole, are planned for a number of students ranging from 15 to 60, while the duration of each path ranges from 12 to 80 hours. Each project is accompanied by a general plan description of the activities. However, in order to fit the requirements of the laws regulating SWA (in particular, Decree No. 77 issued in 2005), the school interested in a project will be involved directly

in the detailed planning of training activities. This phase is crucial for the effectiveness of the alternation path, as the activity planning will have to take into account, inter alia, the *curricula* of the students involved [13].

Each project looks at the direct involvement and accountability of the learners with the assignment of specific tasks, including the coordination of individual modules, into which each project is divided. The projects include two or three main phases: introduction, on-site survey(s), and computer lab activities. The introductory phase (or theoretical one) is minimized and it is usually accompanied by the participation of learners in training activities mainly based on the use of technology tools. Therefore, the core of the projects are on-site surveys or computer lab phases.

Table 2. The sixteen projects included in the SWA Catalogue of IBAM-CNR. The projects cover the following areas of interest of cultural heritage: Cs = Conservation; En = Enhancement; Fr = Fruition; K = Knowledge; Pr = Protection; Ma = Management. The detailed planning of activities will be carried out with the involvement of the schools.

ID	Title	Area(s)
1	Infrared thermography for the diagnosis of CH	K
2	Development of digital terrain models from Global Position System and drone surveys: theoretical principles and practical applications	K
3	To make the invisible visible through geophysical methods	K
4	From risk assessment to the protection of archaeological heritage through Geographic Information System (GIS) technologies, Remote Sensing, and Historical Sources	K,Pr
5	The rocks, the degradation and the characterization of the stone used in CH	K,Cs
6	Knowledge and enhancement of Industrial Archaeology	K, En
7	Landscape you go... flavors that you find!	K, En
8	The drones: potential and fields of use. New tools for inventing a profession	K, En
9	3D models for CH: from creation to printing	K, En
10	Methods, tools, techniques, and technologies for knowledge, conservation and enhancement of CH	K, Cs, En
11	Conservation and management of the archival-book heritage	K, Cs, En
12	Conservation and management of the demo-ethno-anthropological heritage: the museum	K, Cs, Ma
13	Protection of the territory and conservation of CH through GIS technologies	K, Pr-Cs
14	ICT, New Geography, and open source for the protection and enjoyment of CH	K, T, Fr, Ma
15	APPs for mobile devices: applications to CH	En
16	Virtual Reality (VR) and use of CH	Fr

In order to fit with the needs of the school, the activities carried out by IBAM experts will take advantage of a special kit: the DSA-KIT or DIGITAL KIT DSA. The DSA-KIT is a digital box that contains all of the information used by trainers to make the text of the slide and the digital material also readable by students with *Specific Learning Disorders* (DSA). In compliance with the recommendations issued by the "Consensus Conference" (Milan, January 2007) and in line with the Ministerial Decrees and methods and practices implemented by the Italian school system, the DIGITAL KIT DSA was planned as a basic tool for inclusive teaching to be calibrated on the needs of the students [14]. The kit includes *Font Dislexie*, *Graphic schemes*, and *Tables*. Font Dislexie is made up of letters designed taking into account the different characteristics of dyslexia [15]. In order to attract the attention of the student, the font allows easier and more attractive reading. The unique shape of each letter allows the overcoming of the most common limits of dyslexia: exchange, mirroring, change, rotation, and fusion of letters. The graphic schemes used deliberately refer to the structures of conceptual or mental maps. The use of diagrams or maps, instead of a text in its entirety, responds

to the visual learning theories. Visual learning has the advantage of making reading easier, allowing the understanding and absorption of knowledge and the organization of thought. The Tables allow the clear display of each number reported within a sequence. They are also useful for recording formulas and procedures. The use of a suitable font, graphic patterns that guide the speech and the understanding, and tables for a visual and immediate reading are specific digital strategies within well-established consolidated digital methods to determine a learning path that stimulates the intuition and creativity of each student. At the end of each project, a day of dissemination is scheduled where the activities carried out or the products developed during the activities are disseminated to the wider public, with an active role of the students.

4. Materials and Methods

Teaching and Learning Methods

According to that suggestion by Tino and Fedeli [16] and Tino and Grion [17], SWA can be based on *learning by doing approach* and *situated learning* experiences. These approaches allow students the growth of both *hard* (technical and professional) and *life* or *transversal* skills (see also “Discussion” paragraph).

The situated learning approach was considered in the planning and development of the SWA Project activities. Situated learning is considered or suggested as an approach in cultural heritage education by some researchers [18,19]. Now, we describe the main concepts on which situated learning is based, making the reader aware of the criteria followed in the planning and development of the Project.

The *situated learning* is inserted in the wider panorama of the theories of constructivism. This can be divided into psychological and social areas. The first focuses on the person in the learning process, believing that learning means possessing knowledge individually, while the second looks at learning as a social process. Numerous research indicates that learning is a social and participatory activity rather than a cognitive one [20–22]. The supporters of situated learning agree with this vision [23]. Situated learning is a theory based on the *learning by doing* approach, which in turn refers to the assumption that people learn better when they are personally involved (active involvement) [24,25]. This theory reverses the teaching paradigm that traditionally sees the learners as passive actors in the school. The main difference between learning by doing and situated learning refers to the circumstance that the former looks at the specific learning activities, while the latter concerns the environments where learning by doing takes place [26].

The term *situated learning* or *situated cognition* was first defined by Brown et al. [27] and then clarified by Lave and Wenger [28]. Since those works, the learning theory has emerged as an alternative to the dominant cognitive perspective on learning [29]. A peculiar characteristic of this approach is the ability to learn in relation to the ability to perform tasks; learning involves the person in activities, tasks, functions who are part of systems of relationships of social communities.

There are three fundamental principles of situated learning [26,30]:

- (1) Knowledge has to be presented in a realistic environment resembling, as closely as possible, the setting where typically that kind of knowledge is required;
- (2) Learning takes place as a function of the activity, context, and culture in which it occurs;
- (3) Learning requires social interaction and collaboration.

Examples of situated learning are activities in museums, field trips on archaeological sites where students are involved actively, labs emulating real work situations, cooperative education and internships, in which students are immersed and physically active in an actual work environment, and laboratories used as classrooms, in which students are involved in activities that reproduce real work settings [30]. In the situated learning paradigm, the beginner does not gain a defined amount of abstract knowledge to be applied in other contexts, but acquires the ability to act effectively, engaging in the context of reference to solve the problems and demands of the practice. In other words, learning cannot be considered as induced by the teacher, but is rather understood as a social interaction and collaboration within the “community of practice” [28]. In this perspective, learning

becomes a procedure of reflecting, interpreting, and negotiating meanings among the participants of a community [31]. Students that are attempting to learn a profession or a practice are in a position of "legitimate peripheral participation" [28], but their role changes from being beginner to an expert. Every actor involved in learning processes—novices and experts—have useful and expendable knowledge for the community to which they belong, which if made to be emerged, shared, and negotiated together in a targeted project, can generate new knowledge. Therefore, situated learning is based less on cognition, which takes place in the minds of individuals, and more on the involvement and practical participation of people in groups [32]. Teachers play a vital role in this pedagogical approach: their role must not be like that of a transmitter, but a *facilitator*. Firstly, the teacher needs to instruct and then observe the students, providing weighted recommendations, assessing outputs produced by learners, encouraging reflection, and helping them become more mindful of contextual cues to support understanding and transference. However, scaffolding by the teacher needs to be progressively decreased as soon as the learner acquires additional skills. Once these have been acquired, the teacher has to guide the student towards self-guided learning, and therefore towards the transfer of the skills that will lead them to participate and collaborate in the environment [31,33,34]. Situated learning has some benefits. These include the encouragement of deep learning and student collaboration, and the increase of students' engagement and skills [29,35–38]. However, some limitations can also be found for the approach, such as the circumstance that the activities based on situated learning take a long time to develop and require active and motivated learners [35].

5. Results

5.1. The School Involved

During the 2017–2018 and 2018–2019 school years, IBAM led a SWA project with students of the *Istituto di Istruzione Superiore "Giustino Fortunato"* (Rionero in Vulture, Basilicata, Southern Italy), a High Education Institute including four "Licei", high schools specializing in: (1) art subjects, *Liceo Artistico*; (2) classical studies, *Liceo Classico*; (3) scientific studies, *Liceo Scientifico*; and (4) human science studies, *Liceo delle Scienze Umane* (<https://www.liceirionero.edu.it/>) (Figure 1).

The SWA project entitled "*Metodi, strumenti, tecniche e tecnologie per la conoscenza, conservazione e valorizzazione del patrimonio culturale*" (methods, tools, techniques, and technologies for knowledge, conservation, and enhancement of CH, project number 10 in Table 1) involved the students of three classes attending, during the 2018–2019 school year, the fourth and fifth year of the *Liceo Scientifico*.



Figure 1. Geographical sketch of Rionero in Vulture (Basilicata, Southern Italy), the territory where the High Education Institute is located. The same area, with its cultural heritage, was considered as the subject of the SWA project activities (see text).

5.2. The Activities and Their Organization

In order to meet the needs of the school, the activities took place in the afternoon and involved the learners in many direct activities, both on-site (field trips) and in the computer lab, for a total of eighty hours. The territory considered as the subject for the on-site practical experiences on heritage was the same as where the Institute is located (Figure 1).

The Project activities were planned to give the students some of the technical and methodological skills for the approach to knowledge, conservation, and enhancement of cultural heritage. From the point of view of medium- to long-term impact, the activities were designed to support the students in identifying attitudes and personal interests for future work paths, training them especially in the field of ICTs.

According to what requirements by SWA official rules (Decree No. 77), the Project was co-planned with the school to fit and integrate effectively the students' *curricula* in the activities, accommodating them with the pre-knowledge of the learners. Furthermore, the Project also fits the law requirements of connecting the SWA activities to the cultural, social, and economic development of territories (article 2 of Decree No. 77). Indeed, heritage is one of the main factors that make the territory in which Rionero is located attractive. This territory, known as the Vulture area, has been inhabited since pre-Roman times. Later, it saw the flourishing of chief Roman cities such as Venusia and had an important position in the Middle Ages, when several castles, some of which were linked to the figure of the Suevian Emperor Frederick II, were built. Cultural heritage is widespread, rich, and with unique elements from the historical, artistic, and landscape values point of view.

The Project was designed in seven modules. The first five (a–e) were organized with didactic-operative purposes, while the last two (f,g) were planned to prepare the final report (posters) and disseminate the Project outcomes:

Introductory (frontal lessons), with the aim of providing the historical evolution of definitions and meanings of cultural heritage and making the students aware of different phases of approaches to heritage and tools to be used;

To know local cultural heritage (frontal lessons), to make the students confident with official tools to be used to assess and catalogue heritage;

To use Information and Communication Technologies for cultural heritage (in the computer lab), to train the students in the use of tools to catalogue, manage, and enhance cultural heritage;

- a) To survey cultural heritage (field trips), to train the students in acquiring basic skills about architectural relief by new technologies and recognize main degradation forms affecting built materials by using direct investigations and advanced technological tools;
- b) To elaborate survey data (in the computer lab), aimed at training the students on how to process the data acquired during the previous (d) phase, using dedicated software;
- c) To prepare final reports of the activities performed, also in view of the dissemination day (module g);
- d) To disseminate the Project outcomes to the wider public by a dedicated date.

The activity developed in the modules from (b) to (e) led the students to build the five main Project outputs (Figure 2):

1. Knowledge of the Rionero cultural heritage;
2. Development of aGeographic Information System (GIS) to catalogue and manage Rionero cultural heritage;
3. Release of the mobile application (APP) to enhance local cultural heritage;
4. Realization of the architectonic survey of the chosen building heritage by drone;
5. Analysis of the conservation state of the chosen heritage by direct and indirect surveys.

As for the outputs 4 and 5, the selected architectonic heritage to be analyzed was chosen in cooperation with the local authorities. The choice fell on the *Villa Granata*, a building that due to its recognized historical-architectural value, its state of preservation, and the consequent planned restoration, was considered as a suitable open-air laboratory for the students.

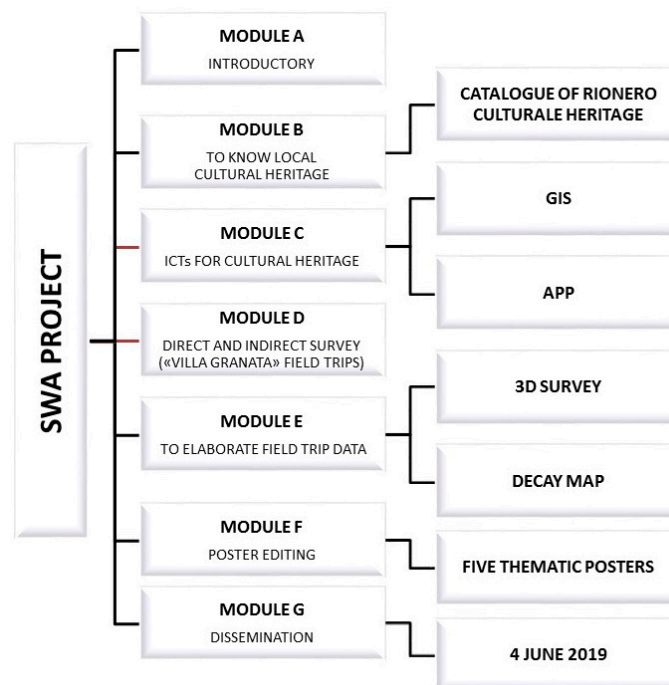


Figure 2. Activity modules, their mutual relationship, and main outputs.

In order to disseminate the activities, each Project output was also summarized as a poster by the students. To facilitate the drafting of the posters, students were divided into five groups, with each of them having a leader that coordinated the activity. These reports along with slide presentations were the base from which the students disseminated their activity to the public and the heritage stakeholders on June 4, 2019 (see Section 6).

5.3. Outputs of the Modules

5.3.1. Knowledge of the Local Cultural Heritage

The cultural heritage of the Basilicata region is rich and heterogeneous. It consists of numerous assets or sites of cultural interest that are often little known, but of high historical, archaeological, artistic, architectural, and landscape value. Developing the knowledge of this "cultural wealth" gives way to protecting it and enhancing it.

In this activity, the learners were trained to know which tools are useful in knowledge of local cultural heritage. Official tools were considered, among which was *Vincoli in rete* (<http://vincoliinrete.beniculturali.it/VincoliInRete/vir/utente/login>), which allowed the students to access some basic information on architectural and archaeological heritage of Rionero. The learners were made familiar with the fact that knowledge of heritage involve its cataloguing. Knowledge of a single element, be it a historical building, an archaeological site, a fresco or a painting, a historical center or a specific landscape, a photographic or cinematographic production, or a theatrical representation, is fundamental for any action of conservation and restoration, protection, and enhancement. It is accomplished primarily through careful historical research and one or more site inspections. Therefore, the types of official files adopted by the Central Institute for Cataloguing and Documentation (ICCD) to catalogue heritage were analyzed jointly with the learners, divided by the official categories of assets (movable, immovable, immaterial) together with the relative compilation rules. The students were engaged actively in filling-in a simplified version (Figure 3) of the original cards adopted by ICCD, with particular attention paid to the architectures (*Scheda A*). The teacher's role consisted of guiding the students to be autonomous in compiling the cards so as to insert them into social communication with other schoolmates. By compiling the forms, the students performed ad hoc historical investigations, consulting bibliographic sources and proper online resources. In order to build a realistic environment for learning, the students utilized the school library, as well as cartography and additional iconographic and written sources brought by the experts in the classroom.

Catalogue Form (Architectural Heritage)	
OBJECT	
Typology (e.g. church)	
Typology details (e.g. abbatial, benedictine)	
Name	
Description (e.g. plan, decorative elements)	
LOCATION	
Region	
Province	
Municipality	
Address	
HISTORICAL INFORMATION	
Summary Information	
Information	
Source	
Source references	
CHRONOLOGY (first building)	
Century	
Date	
CHRONOLOGY (last restoration)	
Century	
Date	
SOURCES	
PHOTOGRAPHIC SOURCES	
Description	
Date	
DOCUMENTARY SOURCES	
Tipology	
Date	
Archive	
COMPILATION	
Date	
Compiler	

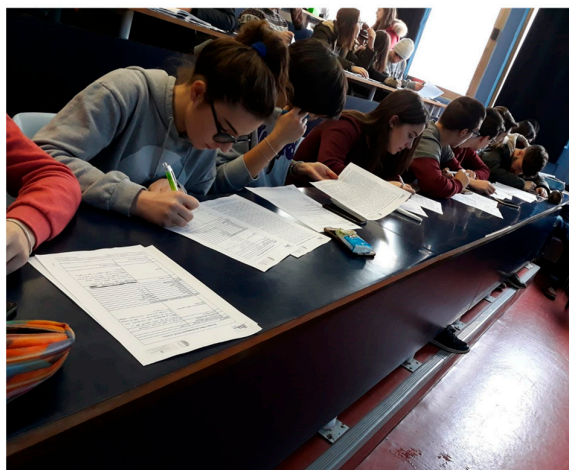


Figure 3. Simplified card (*Scheda A* of ICCD) to catalogue architectonic heritage (left). Students engaged in direct experience aimed at filling-in the simplified version of *Scheda A* (photo by HEI).

Using the cards and tools made available to the beginners, they learned to collect the information in an organized way, according to a path of knowledge, which guides the cataloguer, allowing them to check and code the data following specific criteria. This knowledge phase was preliminary to the development of all other activities (modules from 2 to 5). Through this approach, the students identified and analyzed around thirty archaeological and architectural assets in the municipal territory of Rionero in Vulture or in its neighboring territory. That cultural heritage covers a time span of about two thousand years, from the 2nd century B.C. to the 19th century. The Roman age is represented by several archaeological sites: a farm, a Christian basilica, and a necropolis in *Torre degli Embrici* site; the roman *Pietra dell'Olio* bridge (1st–2nd century) on Ofanto river; some remains of a Roman aqueduct and a necropolis with a wealth of grave goods. Another important archaeological site is the *Badia di Sant'Ippolito*, which dates back to the 10th century. It is located in the isthmus between the two lakes of Monticchio and it includes the remains of a monastery and a productive settlement. There are many architectural assets of medieval origin; the most important is the *Abbazia di San Michele*, consecrated in the 11th century. It incorporates the *Santuario di San Michele* and it is today a jubilee basilica. The various churches founded from the 12th and 13th centuries testify to an important religious, historical, artistic and architectural reality. Among the numerous noble palaces built between the 17th and 19th centuries is *Villa Granata*, a rural architectural complex that symbolizes a flourishing and active period for community life [39–43].

5.3.2. Development of a GIS to Catalogue and Manage Rionero Cultural Heritage

In the last fifty years, we have witnessed a huge development of ICTs with direct implications in cataloguing and managing heritage. Within this background, the key message transferred to the students was that GIS is a powerful technological tool that allows geographic and heterogeneous data to be put together to create a flow of information that can be visualized in the maps, and to build models useful for the study of phenomena and their changes.



Figure 4. Students involved in developing GIS for Rionero cultural heritage (photo by HEI).

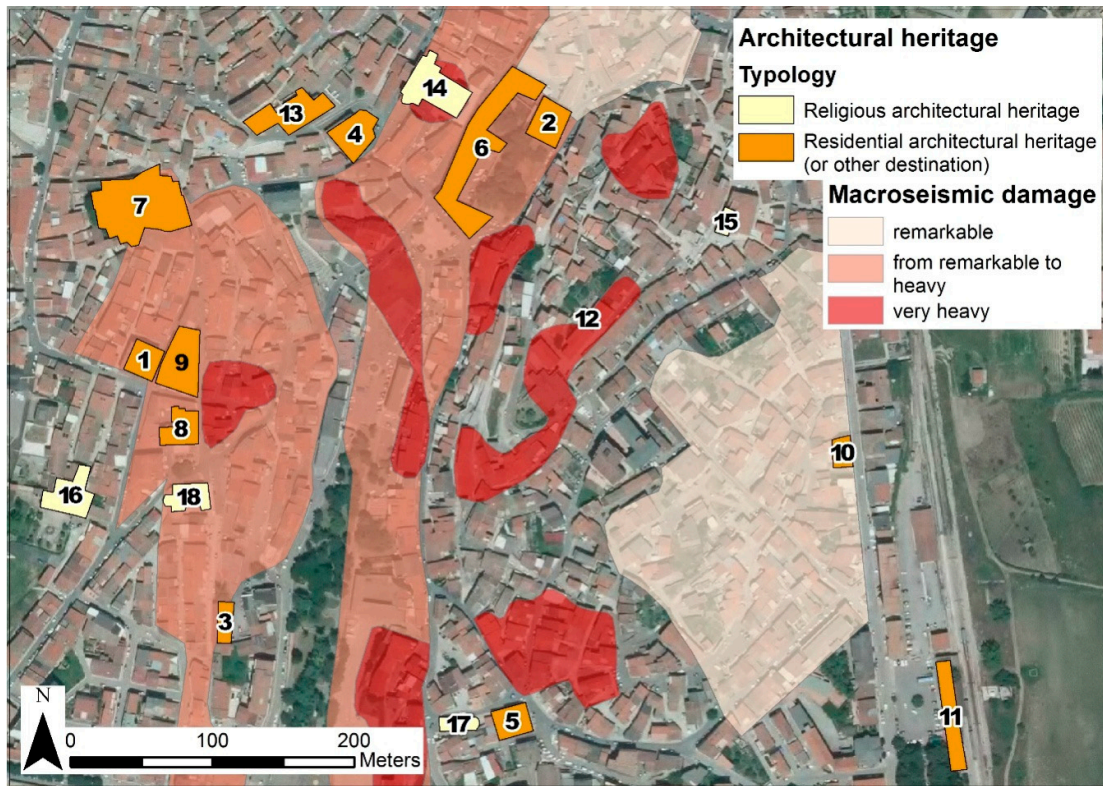
Actually, geographic information is a science in its own right that has its roots in many scientific fields, and it has the most varied field of application [44]. In particular, the combination of GIS and cultural heritage is important for the construction of virtual heritage catalogues [45], useful for facilitating the resolution of problems, such as those related to optimal management, effective and efficient allocation of funds, and more generally to enhance and protect heritage.

After the preliminary phase oriented to explain what GIS is, how it works, and what it does, the students were trained in the basic concepts useful in building a GIS of Rionero cultural heritage (Figure 4). IBAM teacher made use of practical computer-based examples transferred to the students, involving them with direct interaction. The role of the teacher in that phase was crucial to engage the students in the GIS perspective, therefore preventing the student from losing the confidence in their possibilities. This was fundamental to the “learning by doing” approach, starting with easy tasks. The teacher gradually guided the students to gain autonomy in the basic steps to building GIS (georeferencing of maps, planning of a simple database, and performing basic operations using geographic and attribute data).

There were four main phases for GIS realization: (1) to acquire data about local cultural heritage, according to what is indicated in the previous section; (2) to plan a spatial relational database; (3) to populate the database with the descriptive elements of Rionero in Vulture heritage; (4) to carry out simple elaborations of data. The software used by the learners was QGIS, a free and open source professional GIS application (<https://www.qgis.org/>). As the cartographic base of the GIS, the students made use of an aerial photo from 2011 distributed free of charge through the geoportal of the Basilicata Region (<https://rsdi.regione.basilicata.it/>).

The students acquired basic skills in using GIS by the recognition of its use for the following purposes (Figure 5):

- (1) to have a synthetic tool for the places that you have chosen to map;
- (2) to have a tool that allows one to interactively query the map, thus accessing the information relating to the assets included in the developed GIS;
- (3) to carry out a thematic mapping of cultural heritage (e.g., Rionero heritage classified by typology or dating);
- (4) to have a tool that allows one to compare different data, such as cultural heritage and historical seismic damage data, through simple spatial overlay operations.



Id	Name	Typology	Period	Condition	X	Y
1	Catena Palace	Residential architectural heritage or with another destination	1700 - today	Existng, transformed	2576572	4530576
2	Catena Palace (Matteotti Road)	Residential architectural heritage or with another destination	Uncertain datation	Existng, transformed	2576857	4530744
3	Chiappa-Quarto Palace	Residential architectural heritage or with another destination	Uncertain datation	Existng, transformed	2576629	4530392
4	Ciasca Palace	Residential architectural heritage or with another destination	XVIII cent. - today	Existng, transformed	2576720	4530736
5	Former Grancia of the Santa Maria degli Angeli Convent	Residential architectural heritage or with another destination	XIV sec. - today	Existng, transformed	2576831	4530322
6	Fortunato Palace	Residential architectural heritage or with another destination	1728 - today	Existng, transformed	2576809	4530726
7	Giannattasio Palace	Residential architectural heritage or with another destination	XII cent. - today	Existng, transformed	2576569	4530685
8	Granata Palace	Residential architectural heritage or with another destination	XVIII cent. - today	Existng, transformed	2576598	4530528
9	Granata Palace (Umberto Road)	Residential architectural heritage or with another destination	XVIII cent. - today	Existng, transformed	2576598	4530575
10	Pompei Palace	Residential architectural heritage or with another destination	XIX - today	Existng, transformed	2577064	4530511
11	Railroad Station and Goods Yard	Residential architectural heritage or with another destination	1897 - today	Existng, transformed	2577141	4530325
12	Rione Costa Clock	Residential architectural heritage or with another destination	1888	Existing	2576884	4530606
13	Rotondo Palace	Residential architectural heritage or with another destination	XVIII cent. - today	Existng, transformed	2576675	4530751
14	San Marco Evangelista Church	Religious architectural heritage	1660 - today	Existng, transformed	2576776	4530769
15	San Nicola alla Costa Church	Religious architectural heritage	parish since 1774	Existng, transformed	2576982	4530674
16	San Pasquale Church	Religious architectural heritage	1773 - today	Existng, transformed	2576519	4530481
17	SS Annunziata Church	Religious architectural heritage	1700 - today	Existng, transformed	2576793	4530320
18	SS.mo Sacramento Church	Religious architectural heritage	XIII - today	Existng, transformed	2576603	4530480

Figure 5. One of the GIS outputs showing the Rionero in Vulture urban center cultural heritage. (Upper) The students used basic functionality of GIS to elaborate the geographic data, such as selecting heritage for typology and overlaying their spatial distribution on thematic representation of damage caused by the earthquake on Irpinia November 23, 1980 (Mw=6.8) in downtown Rionero [46]; (Lower) attribute table (portion) associated with individual assets.

5.3.3. Development of a Mobile Application to Enhance Local Cultural Heritage

The sector of applications for smartphones and tablets is in an unceasing state of evolution. There are more than one million applications available for download from the most important digital stores, with an estimated turnover of about eighty billion dollars.

More universities and masters programs offer training courses dedicated to the development of commercial and non-commercial applications, and forecasts for the future indicate an exponential growth in the market. For some years, applications have also been available in the cultural heritage sector. For example, many of applications are dedicated to tourism or enhancement of cultural heritage [7].

In this context, the students developed the *Rionero in VulTOUR* application (App), a digital guide to enhance the architectural and archaeological heritage of Rionero in Vulture.

The development of the App was obviously preceded by the proper arrangement of information gained as the first output of the Project. For each heritage site identified, students built an ad hoc file, including the geographical coordinates, informative-descriptive data, and photographic collections. However, in planning and developing the App, the heritage was classified into six different categories, the same as used to develop GIS: Defenses; Architectural religious heritage; Residential architectural heritage and architecture with different destinations; Rural architectural heritage; Archaeological heritage; and in addition, Museums and Libraries.

In order to develop the App, the learners used the open-source software App Inventor 2. The graphic interface of the software is very user-friendly, ideal for those who approach the design of an App without having expert knowledge of programming languages. Therefore, the use of App Inventor made the development of *Rionero in VulTOUR* easier than the traditional methods based on textual languages; to create the code, the students made use of a graphic language that uses a series of blocks similar to pieces of a puzzle.

After an introduction from the IBAM expert about the use of the App in cultural heritage fields, the students were involved in planning and developing the App. Actually, prior to the realization of the App, the students were engaged, by web search, in analyzing the current trends of both of the graphics and interface to be realized. After that phase, the beginners were guided to the development of the App, making particular use of the social interaction between students who proved to be particularly interested in developing the App, developing rather quickly a certain decision-making autonomy.

From the point of view of App features, the structure of the menu, card of the monuments, logo, and the banner were the result of a competition of ideas that saw each student as a protagonist and free to express their artistic inspiration.

The App is based on a very simple graphic interface and on a logical scheme of rapid intuition and use. Once installed on a smartphone or tablet and typed on the *Rionero in VulTOUR* icon, it displays the main menu, consisting of three buttons (Figure 6). These are related to the:

- (i) *list of heritage;*
- (ii) *general map of heritage,*
- (iii) *info.*

From the first one, the user can access the various tabs, from the second the interactive Google Maps, where one can see the locations of the various centers of interest, and from the third the user can access general information about the App. In each monument card, users can identify the current name with a brief description and photos of the property. Furthermore, users can geolocate the heritage on Google Maps by clicking on the banner at the bottom of the screen. The mobile App was a candidate for a regional competition called "Progetti Digitali" (Digital Projects), reserved for secondary schools of first and second degree. The competition was oriented to projects developed considering the use of new technologies for the enhancement of heritage. The App was ranked first in the merit ranking.

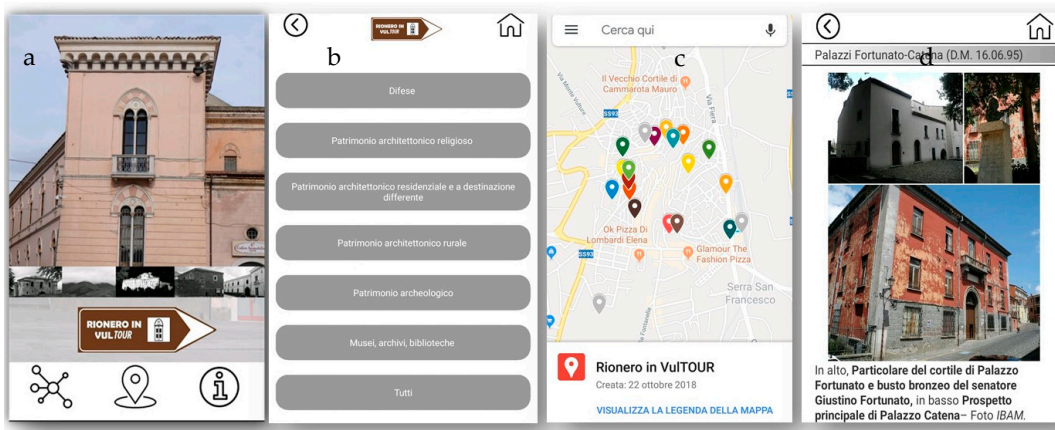


Figure 6. Screenshots from *Rionero in VulTOUR* application (App) developed by the students to enhance the cultural heritage of Rionero. (a) Main image at the start of the App (“Giustino Fortunato” Palace). At the lower portion of the image the three keys that report the user to a descriptive list (b) or map of local heritage (c) are evident. The “i” key takes users to general *info* about the App (e.g., the Project within which the App was developed and bibliographic references to the information included in each heritage card). (d) Example (partial screenshot) of the heritage card structure notifying the users of the historical information about the heritage. The App was a candidate for a regional competition called “Progetti Digitali” (Digital Projects), reserved for secondary schools of first and second degree. The App was the winner of the competition (<http://www.basilicata.istruzione.it/news/news19/news.shtml>). The App will be available on the Google Play Store in the coming weeks.

5.3.4. Architectonic Survey of a Building by Drone

The students were involved in field trip experiences to a heritage building located in the territory of Rionero in Vulture. As mentioned before, the building was the *Villa Granata*, an edifice that a candidate for restoration. *Villa Granata* (Figure 7) is an architectural complex that probably dates back to the 18th century, characterized by a rectangular plan, divided into two levels with circular towers at the four corners that give the building the aspects of a fortified structure. The main façade, characterized by an entrance portal with a round arch, looks to the north and faces Rionero township. The building appears as a “holiday resort”, or rather as a residence that wealthy residents had built in the countryside, near the town, to both escape the summer heat and control the production of their lands entrusted to the settlers. The building and the surrounding land belonged to a wealthy family who settled in Rionero. That family owned the entire complex until 1921, when it was the headquarters of an institute of viticulture, entitled to the senator Giustino Fortunato (1848-1832). The Institute had the aim of improving and increasing the cultivation of vines and other fruit trees in the Vulture area.



Figure 7. The architectonic complex of the *Villa Granata* (in the foreground) in the urban context of Rionero. The *Villa* was considered as a didactic tool to perform the architectonic survey by drone.

Currently, *Villa Granata* is in a complete state of abandonment, which involves infiltration from the roof and failure to channel rainwater, which, together with capillary rising, contribute to the alteration and degradation of plaster, masonry, and bedding mortar. The building was also subject to vandalism, with the removal of portions or entire parts of shelves, architraves, and balconies, as well as frames. The lack of these elements, in addition to altering the aesthetic value of the property, has accelerated the hydrometeor actions due to water infiltration, both towards the inside of the building and through direct mechanical action on the wall surfaces. The eastern side of the building preserves the traces of red pigmentation in the façade, clearly visible in particular in the top portion facing south and above the tower located there. On the east, west, and north sides there are sub-vertical lesions of different extensions and widths.

That building was the subject of three on-site investigations. One of these was oriented to the architectonic survey by an Unmanned Aerial System (UAS) platform. UAS, commonly called "drones", are increasingly used for the analysis and study of structures and territories [47,48]. They allow precise, punctual, rapid, and economic acquisitions. The contemporary development of modern photogrammetry techniques, which allow the creation of 3D models using partially overlapping photos, has contributed enormously to the amazing success of drones. These tools and techniques, thanks to the enormous potential and their extraordinary versatility, have also made their entry into the field of cultural heritage in the last several years. For example, through UAS and modern photogrammetry techniques, it is possible to obtain high-precision surveys of monuments or archaeological sites and carry out analyses aimed at their knowledge, protection, and enhancement.

For the survey of the villa, a multi-rotor quadricopter drone, the Phantom Vision 2, plus the Chinese multinational DJI, was used. By this, a zenithal flight was performed at a constant height of 50 m. In this way, it was possible to take photos of the whole area around the building to examine the actual state of the roof and the land adjacent to the structure. Subsequently, through flights at progressively lower levels and at a shorter distance from the villa, it was possible to inspect the current state of affairs of the entire structure. With subsequent flights, the learners performed a photogrammetric survey of the area, taking oblique and zenithal sequential photos, with a certain degree of overlap.



Figure 8. The 3D model of the *Villa Granata*, performed by the students through the Agisoft Scan software that applies the “structure from motion” technique: (a) point cloud; (b) mesh; (c) 3D model.

Once the images were acquired, the students were taught about the processing of the data in the computer lab by using the Agisoft Photoscan, based on algorithms from Structure from Motion (SFM). The software makes it possible to recognize the points in common between several photos by producing a cloud of points (point cloud) (Figure 8a), and therefore a first virtual form of the object detected. From it, the software creates a mesh (Figure 8b), connecting the points with lines, on which the texture of the detected object is then placed, thus creating the 3D model (Figure 8c). The last operation by the students saw the insertion of fiducial points on the virtual model, which show the real metric values of the object.

5.3.5. Analysis of the Conservation State of the Villa by Direct and Indirect Surveys

The purpose of this output was the quick examination of the conservation state of the *Villa Granata*. For these objectives, starting from the introduction of other case studies, the students made use of both direct and “beyond the visible” surveys, the latter performed using the infrared thermographic technique. Regarding the former, once trained on-site, the students were subdivided into working groups (community of practice) for each façade to be surveyed. The interaction between the teacher and the individual groups was aimed at transmitting the method of recognition of the degradation forms and then directed the students towards autonomy and the comparison of ideas in the group. The learners mapped the degradation state by using a standard classification scheme as a reference (NorMaL 1/88 and UNI 11182: 2006) (Figures 9 and 10).



Figure 9. The students, after training on the recognition of the different types of degradation forms, independently surveyed and mapped the state of conservation of the villa. After the on-site phase, the students surveyed the data in digital form through the activity in the computer lab (photo by HEI).

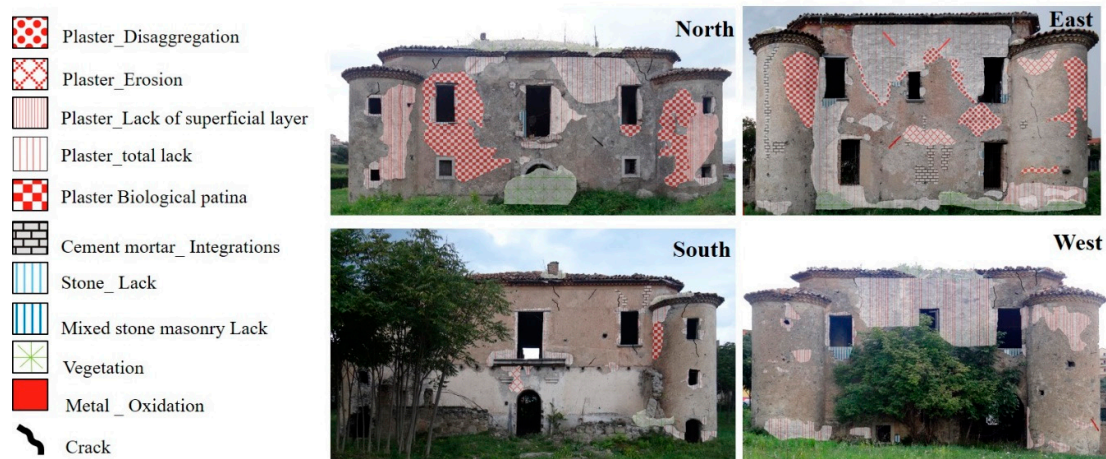


Figure 10. Quick analysis of the conservation state of the villa: the final elaborations performed by the students.

The direct investigation was flanked by the instrumental one, based on the use of infrared thermography (IRT). This analysis is useful both to support the evaluation of the state of conservation and to examine architectural and construction aspects of the property.

Thermography offers answers to several questions [49–53]:

- to examine the history of a building;
- to “read” building features (e.g., to identify non-visible elements hidden under the plaster, to study wall textures, to recognize rear-end collisions of existing openings, mapping of previous restoration interventions);
- to carry out diagnosis and monitoring of the conservation state (e.g., presence of moisture due to infiltration or capillary rising, identification of cracks, detachment of plaster).

From a technical point of view, the thermographic analysis allows one to highlight the different temperature responses caused by inequalities in the thermal properties between materials placed within the first few centimeters inside the wall. In general, the variation of the environmental conditions determines phenomena of thermal variations in the wall structure that can be captured through the infrared thermographic analysis of its surface. The differences in “response” to the thermal stress of materials, such as wood, bricks, stone, and mortar between ashlars, can therefore

easily be visualized by the impression that they throw on the layer of plaster that hides the view. Changes can also be highlighted between layers of plaster laid at different times, and therefore with different thermal properties related to different surface morphology, degradation, porosity, etc.

FLIR SC660 was the thermal imaging camera used by students to perform the surveys. That camera detects the radiation in the infrared spectral range between 7.5 and 13 μm (long-wave infrared spectral band) and it is characterized by a sensor with a resolution of 640 \times 480 pixels. Regarding the acquisition system, the sensor is equipped with a matrix of sensitive elements of dimensions of 640 (H) \times 480 (V) with a visual field (35mm lens) of 24 $^\circ$ (H) \times 18 $^\circ$ (V), and it is capable of producing a thermal sensitivity of 30 mK at 30 $^\circ\text{C}$. The thermographic recordings were carried out in the afternoon of Monday September 24, 2018, under conditions of partially cloudy sky and with a temperature ranging between 22 and 24 $^\circ\text{C}$. From a technical point of view, the solar source was the thermal stimulus used to take the shots.

The students, once trained in the use of the camera (Figure 11), acquired the thermograms for each façade and in a successive phase performed in the computer lab, processed the data using a proprietary software (Flir Tools). In this last phase, the goal was to train the learners on how to recognize and interpret the different thermal responses of the building materials in terms of both structure features and the conservation state of the architecture (Figure 12).



Figure 11. Students during the training activity on the use of FLIR SC660 infrared camera (photo by HEI).

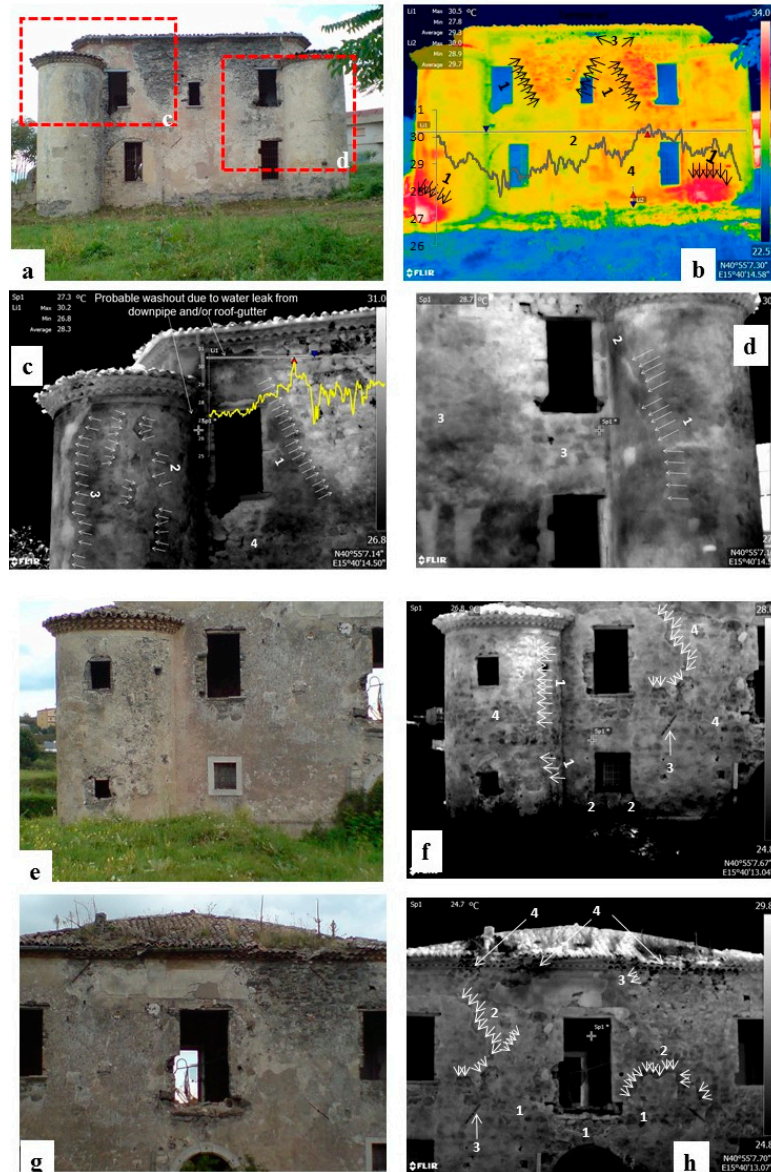


Figure 12. Thermographic interpretations performed by the students. Images in the visible field: (a) façade east; (e) façade north, detail; (g) façade north, detail. Thermograms and their elaborations: (b) thermogram of façade east (a) in false color; (c,d) detailed thermograms of façade east corresponding to the red boxes (a); (f) thermogram of façade north (e) in gray tones; (h) thermogram of façade north (g) in gray tones. Students identified possible water infiltration zones due to disconnection of roof tiles or water leakage from gutters and downspouts. Furthermore, discontinuity of plaster, masonry ashlar, area of capillarity rise, and elements hidden under the plaster (the head of the chains placed to reinforce the building) were identified. Details of thermal image (b): (1) limit of the “thermic anomaly”, identifying the shift between the plastered wall and stone not covered with plaster; (2) thermal trend along the façade; (3) probable water leakage from the roof-gutter; (4) thermal trend due to water capillarity rise. Details of thermal image (c): (1) limit of the “thermic anomaly” identifying the shift between plastered walls and stones not covered with plaster; (2) boundary between plaster layers changing in thickness; (3) repaired crack; (4) wall texture. Details of thermal image (d): (1) repaired crack; (2) probable water leakage from down-pipe; (3) wall texture. Details of thermal image (f): (1) repaired crack and probable prosecution at the foot of the tower; (2) capillarity rise; (3) head of the tie (masked by plaster); (4) wall texture. Details of thermal image (h): (1) wall texture; (2) limit of the “thermic anomaly” identifying the shift between the plastered wall and stone not covered with plaster; (3) head of the tie, as in image (f); (4) probable water leakage from roof-gutter.

6. Discussion

One of the main purposes of the school-work alternation is to encourage the orientation of young people, so as to identify their talents, strengths, and weaknesses. However, the goal of SWA is also to guarantee the development of both *hard* and *life* (or *soft* or *transversal*) skills. The former are the technical and professional skills related to a specific job, while the latter are those typically considered as not specifically connected to a particular job or area of knowledge and that can be used in a broad range of situations and work settings [17].

The SWA Project aimed mainly to link and consolidate the disciplinary contents acquired in the formal curricular paths to the training route, as well as developing new technical-professional skills that the students will be able to use in the world of work. Considering the main disciplines involved in the Project (arts, computer science and technology, geography, geological sciences, history, mathematics, and physics), the estimated outcomes, in terms of both technical-professional and deepening of formal curricular paths, can be listed as follows:

- 1) *Arts*: to make the students conscious of what the heritage represents for society and what values and significance the heritage symbolizes; to learn about different typologies of cultural heritage, both material and immaterial, with the latter being no less important than the former; to be more confident about the phases to be engaged in order to gain knowledge of heritage; to increase the learners' knowledge of their own heritage, so as to be aware of promoters of the territory where they live; to be conscious that heritage has suffered changes over time due to natural as well as human factors; to build up awareness about the necessity to perform preventive heritage actions to assure the posterity of heritage, leaving restoration as the last resort; to be more able to observe and describe heritage, also improving the vocabulary of technical terms; to learn how to catalogue heritage;
- 2) *Computer science and technology*: to transfer to the students the skills need in the market place related to: (i) developing a basic Geographic Information System to catalogue and manage heritage; (ii) programming, using block-based language, simple mobile applications to enhance cultural heritage; (iii) using low-cost technologies (drones) and related elaboration software to survey territories and buildings and obtain 3D model of them; (iv) learning about main non-destructive and destructive diagnostic technologies to be used to investigate heritage and works of arts; (v) using the infrared thermography technique in the field of archaeology of architecture and analyzing heritage conservation states; (vi) to be confident in knowing the main digital technologies for the enhancing, safeguarding, and for fruition of heritage, and the main trends of the related marketplaces; (vii) to be capable in the drafting of activity reports with dedicate software; (viii) to be confident in building diagrams and charts to represent the experimental data;
- 3) *History*: to make the students more confident about the use and limits of different typologies of historical sources; to allow the connections of historical fact and events to the birth, transformation, and restoration of cultural heritage; to learn about time windows, embracing the heritage of the local territory; to be able to fill in an informative card with the selection of the main elements to be considered in the description, also with a view to enhancing heritage;
- 4) *Geography*: to learn about the concept of geographic reference systems, cartographic projections, geographic coordinates, georeferentiation, differences between basic and thematic maps and their correct reading and interpretation, and the meaning of inhabited centers and municipal territories; to learn about the main web resources that can be used to search for maps and aerial photos;
- 5) *Geological sciences*: to learn about the main typologies of rock used as building materials in local heritage; to raise the general awareness about the geological hazards of the Italian territory and the risk associated with the built structures considering, for example, the effects caused by strong historical earthquakes on heritage;
- 6) *Mathematics*: to make the students able to calculate composite surfaces and compare dimensions and shapes; to stimulate the need to represent data graphically in order to interpret them in the correct way; to learn about the proportion and symmetry concepts (e.g., "Golden number" or "Fidia number") on which basis some monuments or works of art were built;

- 7) *Physics and chemistry*: to distinguish between the main degradation forms affecting built structures, understanding how the chemical and physical actions influence the conservation state of materials; to learn about the usefulness of other electromagnetic waves beyond those visible as indirect tools for the knowledge of heritage; to strengthen the curricular contents regarding the basic laws of infrared emission, using everyday life as a means of experience; to correlate the properties of simple objects (e.g., a pendulum) to specific features of buildings (e.g., resonance frequency). The building of skills in conservation with the requirements of the Council of Europe Granada Convention (1985) [54], which states, “Each Party undertakes promotion of training in the various occupations and craft trades involved in the conservation of the architectural heritage.”

However, especially nowadays, hard skills are only a part of the skills necessary in young people. Soft skills (also known as transversal skills, higher-order skills, non-academic skills, and generic skills) include a range of cognitive (critical and creative thinking, and responsible decision-making), personal (awareness, drive, self-management), and interpersonal skills (communication, negotiation, cooperation and teamwork, inclusion, empathy and advocacy). Soft skills are becoming as important as hard skills when looking for a job [55,56]. These skills will help young people to manage their future with greater resilience as: “The era of a job for life is now gone” and, therefore, “the ability to learn and adapt (skills intelligence) is a skill that will increasingly become essential” [56]. The increase of some of transversal skills is expected as a result of the SWA Project. For example, creativity among students was involved during the competition aimed at selecting the banner, logo, and user interface of the Rionero in VulTOUR App. Furthermore, learners developed the output of the Project through a teamwork approach that forced them to respect timing, tasks, and collaborate in defining shared goals. The dissemination of the Project results performed by the students was a further field to improve attitudes in managing emotions, acquiring self-control, and improving expressive and technical vocabulary, thus increasing confidence in communication (Figure 13).



Figure 13. Students, with the SWA Project coordinator acting in the role of chairperson, engaged as speakers during the dissemination of the Project results (June 4, 2019, seat of the High Education Institute “Giustino Fortunato”, Rionero in Vulture; photos by HEI).

Beyond these, SWA also focused on empowering some of the eight key competences that the European Commission indicates as useful to contribute to a successful life in a knowledge society [55]. They are: (i) literacy competence; (ii) languages competence; (iii) science, technological,

engineering, and mathematical competence; (iv) digital competence; (v) personal, social, and learning competence (soft skills); (vi) civic competences; (vii) entrepreneurship competence; (viii) cultural awareness and expression competence (Figure 14). From the activities of the SWA Project, the increase in science, technological, engineering, and mathematical competences (iii) is predictable. Furthermore, the growth of digital competences (iv), civic competences, and cultural awareness (vi and viii) are also expected. Actually, heritage helps to reinforce the cultural dimension of the individual, with positive repercussions in the social sphere. This determines the consolidation of a sense identity, as well as physical and mental well-being, the growth of tolerance, mutual respect, peaceful relations, social integration, and the construction of safer and stronger communities; ultimately, heritage allows building of active citizenship [6,57,58]. Looking at the fifth key point, this also includes the learning of competences. From this point of view, the situated learning approach enabled the students to gain a progressive increase in autonomy in the development of the tasks. Teachers' support in the early stages was crucial as the students faced the first activities aimed at producing concrete outputs in fields not familiar to them. After a first phase of methodology addressing the individual activities to be carried out, the beginners acquired a progressively stronger adaptation to the needs of the tasks that led them to prepare the five tangible outputs.

The adoption of self-governing operating paths by the students was observed to be more relevant for the elaboration of the technological and ICT outputs (App and GIS). This observation seems accommodating of Prensky's idea [59,60] that the younger generation are "digital natives" that are innately or inherently technologically shrewd and that they behave and think in a different way because of their use of technology.

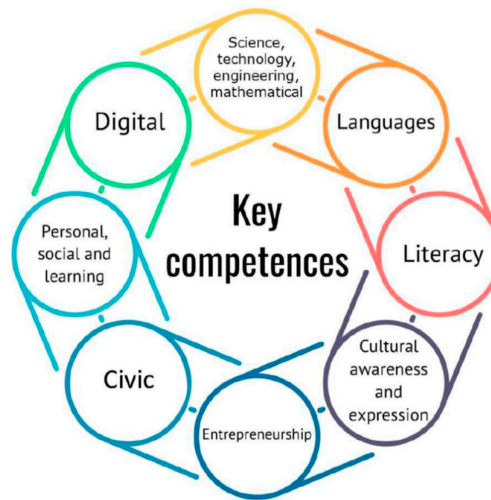


Figure 14. Key competences for lifelong learning according to the European Commission [55]. As a consequence of the SWA activities, the reinforcement of some of these can be expected.

However, if on one hand the acquisition of some technical and professional skills can be supported to a certain extent by the realization of the five main scientific products, the deepening of formal curricular paths, as well as the acquisition and improvement of other expertise, cannot be demonstrated by the results included in this paper. The evaluation of these aspects will be the subject of specific research by involving the students and schoolteachers. This further phase will also allow evaluating, through ad hoc questionnaires to be given to the students, the strengths and weaknesses of the alternation pathway to increasingly improve the planning and development of future SWA projects.

7. Conclusions

This paper has discussed an experience developed within the framework of the school-work alternation, a training modality envisaged in the Italian school system to link schools closer to the world of work. The authors have paid attention to the outcomes of the Project and growth of curricular, technical-professional, and transversal skills.

However, the management and development of the Project activities allow the authors to make three main remarks about the outlooks of SWA in the cultural heritage field. The first considers the role that SWA can play in raising young people's awareness of preserving cultural heritage, also taking advantage of ICTs. The second regards the advisability of a link between SWA and regional development policies. The third looks at the potential benefits that SWA can gain from a close synergy between different actors operating in the heritage sector.

Regarding the first point, a preliminary reflection on the meaning of the term "cultural" for contemporary society is required. In the past, the term was anchored to the paths of education and social transmission or to the concept of aesthetics. The contemporary society, being technologically advanced and globalized, has informally disconnected the term from the influences and perceptions of the past. Places and objects have lost or diluted their symbolic meaning for the communities to which they belong. In these terms, raising consciousness about cultural heritage significance to allow it to be safeguarded and transmitted means: (1) to reunite communities with places and objects that belong to them; (2) to return the value of the relationship between the site and its surroundings; (3) to informally learn about the object and its symbolic meaning that characterizes it within the history of that community (a role traditionally entrusted to the family and society); (4) to identify the methods and tools capable of repairing that link between the individual and the social value of the cultural good. It is the recognition of this symbolism, or value, which attributes an identity to the heritage. These processes help the individual citizen to be active and proactive, even in preserving and handing down cultural heritage to posterity [61]. Applied technologies, especially ICTs, are an important means of offering a closer view of cultural heritage, as well as facilitating its access. The use of ICTs for cultural heritage, thanks to the appeal and ease of use for generations of "digital natives", has a significant pedagogical impact through a: (i) a multidimensional perspective that allows the distinction of the "good" from the "general" (two-dimensional and three-dimensional) in detail; (ii) a "localized" perspective that allows, virtually or physically, a relocation of the good in its original or creation context; (iii) a "perceptive" perspective that allows, virtually or physically, to live the experience related to the good; (iv) a "globalized" perspective thanks to the use of the network and technology for the digitization of heritage. The contribution of ICTs is revealed through the knowledge, development, and use of tools, such as GIS, 3D reconstructions, and applications for mobile devices, all activities developed within the above-discussed SWA Project. Despite their diversity, all ICT tools require an interaction, being more or less explicit, on the part of the individual and all contribute to the achievement of various aims. ICTs act to facilitate the learning, to allow a conscious approach to heritage, to grow the ability to "recreate" lost contexts and "create" new contexts of use and enhancement, and to enable the acquisition and exchange of information. In this sense, ICTs overcome their initial condition as a tool for the cultural heritage to move towards the acquisition of their own social and cultural identity, owing to the role and the social task they assume in mending the "unstable" relationship between goods and individual. From this perspective, ICTs put at a community's disposal many tools that can facilitate the way in which the heritage is safeguarded. Therefore, the use of ICTs can stimulate younger generations to take on an active role in protecting cultural heritage by using, for example, ad hoc applications to support agencies and local authorities, reporting critical situations relating to heritage. Actually, mass cooperation and active citizenship can be a cost-effective and pervasive way of contributing to heritage safeguarding, particularly in a period in which funds are increasingly diminishing and no perspective of turnaround can be predicted. The approach followed in the SWA Project is in line with this perspective, as the potentiality of ICTs were placed at the center of the activities. Indeed, even if the Rionero in the VulTOUR mobile application was planned for local heritage enhancement, the students independently suggested the development of an additional App module for reporting

events that threaten cultural heritage. This highlights the students' awareness that protection of assets needs a close cooperation between all actors, including citizens, whose active and proactive role is pivotal. In this manner, an update of the App will be performed by the students in the coming months.

The second point considers the relationship between school-work alternation and regional development policies. The activities developed in the SWA Project are in line with the adoption of the smart specialization strategy (also known as S3) by the Basilicata Region for 2014–2020. S3 is a key developing model settled by the Europa 2020 plan to stimulate each region to build on its own strengths in order to guide priority-setting in national and regional innovation strategies, identifying unique opportunities for development and growth [62] (<http://s3platform.jrc.ec.europa.eu/what-is-smart-specialisation->). Following this approach, the Basilicata Region considers the Cultural and Creative Industries, which include those related to cultural heritage, among their own five smart specialization strategies, with each of these supported by a cluster, which is an association of companies and public and private research organizations [63]. What is more, the cultural and creative sector will grow in significance in the coming years, benefiting from the policy that Europe is going to put into the field. Indeed, the “Creative Europe Program”, aimed at supporting the European Cultural and Creative Sector for 2021–2027, will increase its budget by 17% with respect to the current program (2014–2020) [64]. In this context, within the Cultural and Creative Specialization (CCS) of Basilicata, some specific intervention policies fit well with the activities developed in the SWA Project. We refer to those related to ICTs for acquisition, fruition, cataloguing, and enhancement of cultural heritage (Technological Line 1 of CCS), the use of GIS technologies (Line 2), and the application of non-invasive technologies for monitoring degradation phenomena (Line 3) [63]. In these perspectives, where the training actions are carried out looking at the regional development policies, the school-work alternation can play an important role in fulfilling the task of guiding students towards future choices in both study and work scenarios, helping them to recognize the strengths, vocations, and opportunities that territories where they live offer, within a wider European landscape of actions.

Regarding the third point, it is interesting to note that the school-work alternation can be considered as a platform of convergence between the needs of both school systems and specialists of cultural heritage, in particular those working in universities and research centers. Indeed, the times when researchers lived in “ivory towers”, isolated from society, has now passed. University and public research centers are requested to “outsource” their activities more to generate knowledge outside the academic and research environments to the benefit of social, cultural, and economic development. Therefore, universities as well as other public research centers must rearrange their internal resources, dedicating part of their efforts to strengthen what is called the “Third Mission” [65]. The convergence of interests and needs between the school system and universities and research centers can make SWA a non-negligible tool to put into the field actions aimed at the knowledge, enhancement, and protection of local cultural heritage, relying on: (a) human resources (students and professional trainers), (b) economic funds (albeit limited) made available for the SWA activities, and (c) a close partnership between schools and heritage stakeholders (e.g., superintendents, municipalities) to properly orientate the SWA activities towards the needs requested for actions concerning local heritage.

Finally, in order to increasingly improve the benefits to cultural heritage, school-work alternation projects should preferably follow a reinforcement of heritage education paths implemented in the school curricula, so as to support a gradual transition and not a strict distinction between education and training activities.

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Appendix

Appendix to Table 1

Piano Nazionale di Informazione su "Istruzione e Formazione 2010: https://archivio.pubblica.istruzione.it/buongiorno_europa/news/2006/presentazione_100306.shtml (accessed on March 26, 2019, in Italian).

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