Cultapp

Augmented Reality meets Cultural Heritage: Compendium of practices and applications

2019

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CultApp - Experiencing augmented reality on **cult**ural heritage **app**lications

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Programme: Erasmus+, Key Action 2: Strategic Partnerships in Vocational Education and Training

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Experience emotionally the augmented reality
applied to European cultural heritage
and take it further…

Preface

The Fachhochschule des Mittelstands in cooperation with six other partners from different European countries has been awarded European funding through the Erasmus + Programme, Key Action 2 (Cooperation for innovation and the exchange of good practices) to implement a Strategic Partnership project for Vocational Education and Training sector titled '*CultApp - Experiencing augmented reality on cultural heritage applications in iVET*[1]'.

The European Parliament and the Council of the European Union have designated the year 2018 as the European Year of Cultural Heritage (hereafter CH) with the purpose of "encouraging the sharing and appreciation of Europe's CH as a shared resource and reinforcing a sense of belonging to a common EU space"[2]. The European Year of Cultural Heritage shall highlight the best means to ensure the conservation and safeguarding of Europe's Cultural Heritage as well as the enjoyment thereof by a larger and more diversified audience, including heritage education. In this regard, the European Year shall also support the development of specialized skills and improve knowledge management and knowledge transfer in the CH sector, taking into account the implications of the digital shift.

In this scenario, CultApp project aims at building a challenging and creative vocational education and training environment which engages both school teachers and learners to promote cultural heritage and art education through the use of innovative digital applications, such as augmented reality (hereafter AR).

For this purpose, project partners already conducted a preliminary needs analysis that showed that one of the important ways of persuading all vocational education and training institutions, teachers and school staff to integrate the use of such pedagogical practices (e.g. AR) applied to CH in iVET programmes is to demonstrate the undoubted advantages and benefits these innovative technologies bring to education.

The first step foresees to involve partners in a more in-depth analysis in their respective countries (Germany, Italy, Bulgaria, Greece, the Netherlands, Poland). This, with the aim to identify the most relevant practices recognized as catalyst instruments for engaging iVET institutions and other key players in introducing AR applied to CH in their educational programs.

This publication is the result the first 7 months of work done by the project partners. They engaged in identifying and collecting examples of

[1] Initial Vocational Education and Training
[2] DECISION (EU) 2017/864 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 May 2017 on a European Year of Cultural Heritage (2018)

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AR technologies and good practices applied to cultural heritage (also integrated into iVET programs), including details regarding the methodologies applied and the results achieved.

It is a pleasure to be able to share this experience. We hope that the first intellectual output achieved concrete efforts towards addressing the areas highlighted by the project.

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Acknowledgements

The project partners would like to thank all the participants from the different countries, that voluntarily participated in the initial research phase of the project. Moreover, due acknowledgement is also given to third parties and relevant key institutions (e.g. iVET institutions, teachers, learners, parents, researchers, iVET staff, teachers training organisations, VET providers, professional experts in the field of AR and Europe's cultural heritage, Universities - departments of architecture, art, archeology, cultural heritage, ICT -, cultural private and public associations, cultural foundations, ICT foundations, museums, tourism sector, business sector, research institutes, public authorities, policy makers, NGOs etc.) that provided feedback and input on research tasks and interviews. Lastly, a special thanks goes to the German National Agency (Nationale Agentur Bildung für Europa beim Bundesinstitut für Berufsbildung – NA beim BiBB) for the guidance and support provided throughout the progress of this project.

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Partnership

The project brings together 7 organisations from 6 European countries (Germany, Italy, Bulgaria, the Netherlands, Greece, Poland) that form a transnational cooperation partnership with a balanced geographical representation of the Erasmus+ area. Partners were chosen paying attention to the necessity to guarantee a multi-expertise and multi-competence team with important experiences in the field of art and cultural heritage, as well as teacher training and ICT-based innovative methodologies and instruments.

Fachhochschule des Mittelstands (FHM) GmbH - University of Applied Science
(Lead partner)
https://www.fh-mittelstand.de/

Finance & Banking, Associazione per lo Sviluppo Organizzativo e delle Risorse Umane
https://www.asseffebi.eu/en/

PAIZ Konsulting Sp. z o.o.
https://www.paiz.com.pl/

Istituto Tecnico per Il Turismo "Marco Polo"
http://www.ittmarcopolo.gov.it/

National Association of Resource Teachers (NART)
http://www.narubg.org/

Niekée/Agora
http://www.niekee.nl/

CRYSTAL CLEAR SOFT
http://www.ccseducation.com/

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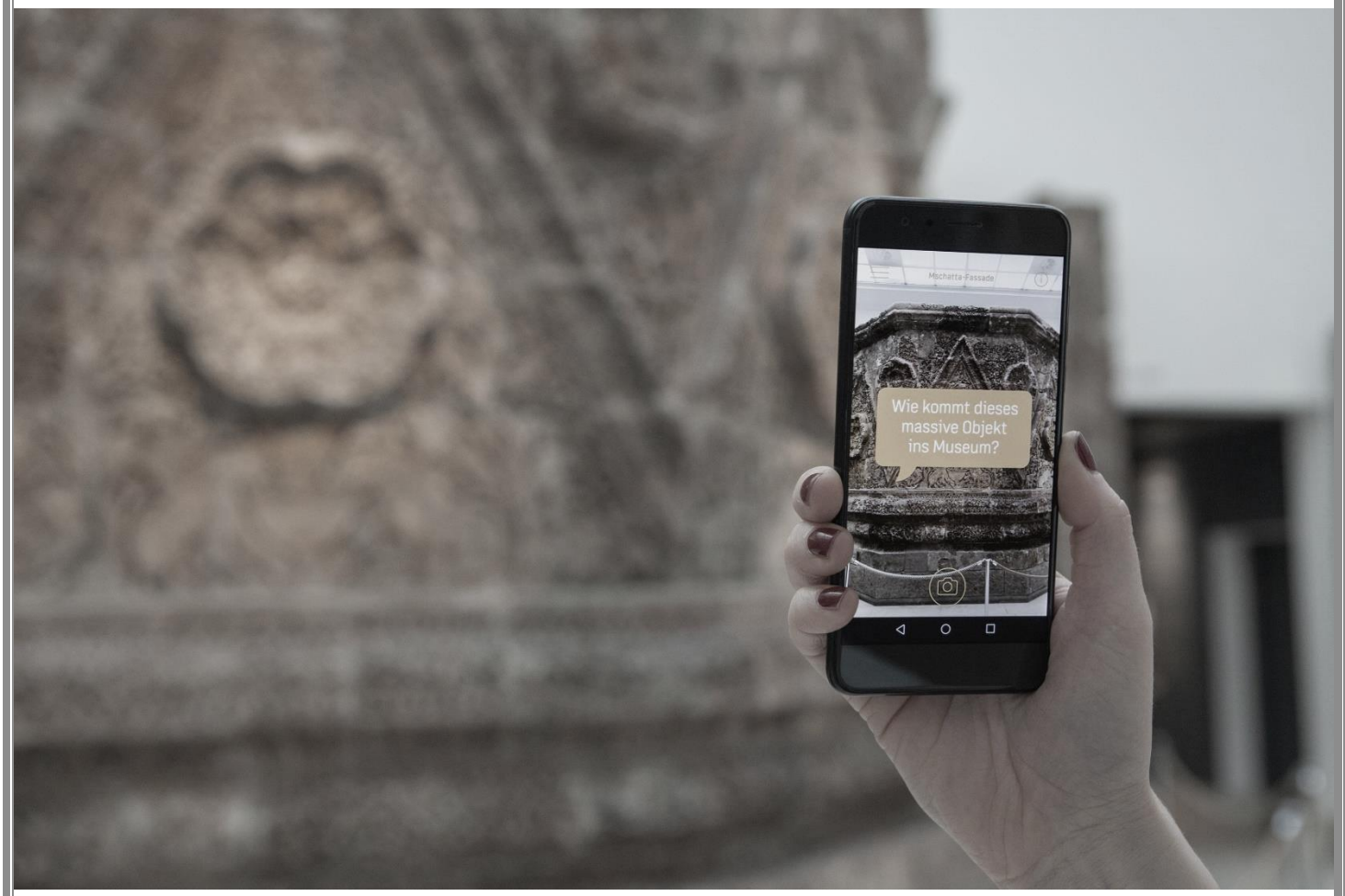

1.INTRODUCTION

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The project titled 'CultApp - Experiencing augmented reality on cultural heritage applications in iVET' is a thirty-months project funded through the Erasmus+ Programme.

The overall aim of the project is to raise awareness of protecting, safeguarding, reusing, enhancing, valorizing and promoting Europe's cultural heritage through education and lifelong learning, in particular, among young learners. This will lead to building a challenging and creative vocational education and training environment, which engages both school teachers and learners.

More specifically, the project aims at encouraging the modernization of the cultural heritage sector and at supporting the VET institutions in integrating innovative teaching practices within their art and cultural heritage programmes. Furthermore, in delivering their curricula through innovative and effective teaching approaches in order to get learners involved and enable them to ensure that Europe's cultural heritage is safeguarded and enhanced.

To this end, partners will set up an online teacher training programme to empower VET teachers to use AR when designing and developing learning sessions for better experience of cultural heritage objects. In addition, learners will engage in designing and developing an augmented learning project work.

The main project's objectives are:

- raising awareness of the importance of transmitting the value of Europe's CH within the education sector;
- enhancing the quality of the VET offer through the improved professional capacity of teachers;
- adopting innovative ways to transfer knowledge in education aiming at aligning technologies with learning objectives and to support learners in attaining 21st century skills such as communication, critical thinking, problem-solving, persistence, collaboration, and curiosity.

In this regard, the Project is expected to develop the following intellectual outputs:

Output 1: Compendium of augmented reality technologies and practices;

Output 2: Online Teacher Training Programme;

Output 3: Augmented learning virtual project work.

The first intellectual output of this project includes the design of the present Compendium of augmented reality technologies and practices (hereafter *Compendium*) in digital format. This book offers concrete examples of augmented reality technologies and practices applied to cultural heritage that were implemented in the selected European countries.

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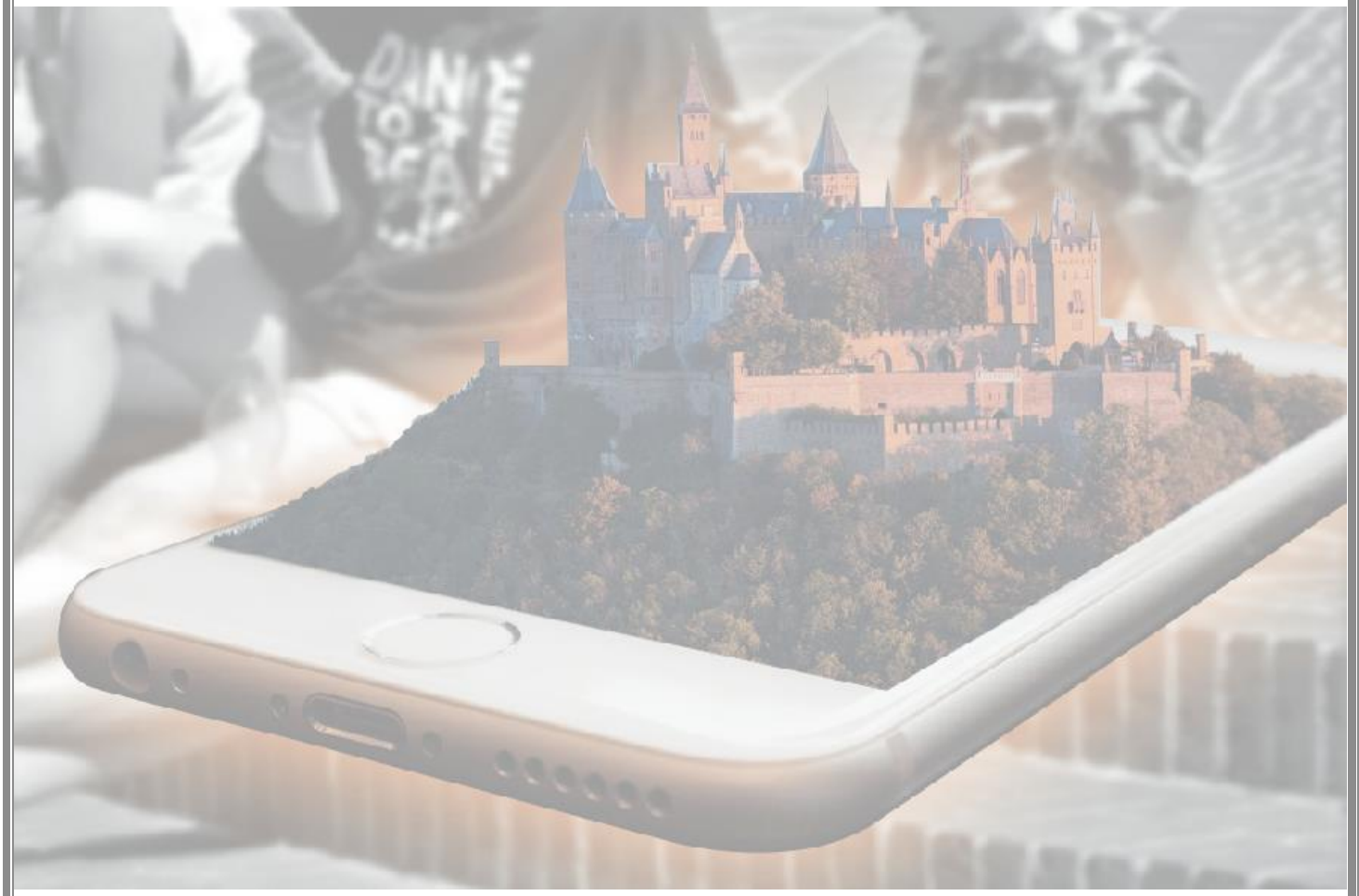

2. METHODOLOGY FOR SELECTING AUGMENTED REALITY PRACTICES APPLIED TO CULTURAL HERITAGE

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The methodology for the design of the *Compendium* required a joint effort by the project partners, third parties, and relevant key institutions and cultural actors (e.g. iVET institutions, teachers, learners, parents, researchers, iVET staff, teachers training organisations, VET providers, experts in the field of AR and Europe's cultural heritage, Universities - departments of architecture, art, archeology, cultural heritage, ICT -, cultural private and public associations, cultural foundations, ICT foundations, museums, tourism sector, business sector, research institutes, public authorities, policy makers, NGOs etc.).

The *Compendium* aims to demonstrate and disseminate the most attractive examples of augmented reality technologies and practices in the partner countries related to CH applications and, possibly, within vocational education and training.

Considering the existing experiences and the needs identified during the preliminary gap analysis which the project proposal is based on (i.e. studies of previous European projects in this field, desk research, discussions, workshops), Effebi Association provided project partners with the analysis methodology indicating selection methods and key criteria to use for collecting concrete augmented reality practices to encourage teachers and learners to approach Europe's cultural heritage.

Finally, partners adapted and translated their content and instructions in order to achieve wider access to the CH sector.

The selection process was based on the following key criteria defined on the basis of the needs analysis already conducted, on the input received during the preliminary workshops organized with relevant key institutions for this purpose as well as considering partners' expertise and interests:

- ✓ **End users:** AR technology and practices 'easy to use' for iVET teachers and learners (14-18 years old);
- ✓ **Field of application:** AR technologies and practices to 'augment' CH;
- ✓ **Area and context of implementation:** examples identified in Europe and abroad, but addressed to EU cultural heritage;
- ✓ **Impact/effect:** positive impact for vocational education and training environment

After the selection of existing AR technologies and practices, partners developed the following *Compendium*, which is designed in a practical fashion to allow for easy consultation by a wide range of key actors: Associated partners, iVET staff, teachers, learners, NGOs, iVET and cVET providers, universities, research institutes, public authorities, policy makers, etc.

The main challenge was to make the *Compendium* attractive and beneficial for the users, in particular, for the teachers involved in the training programme and for the learners engaged in the design and development of the augmented learning project work.

The use of the selected AR technologies and practices assured the outcome exploitation facilitating its transferability to other contexts and countries across Europe. Moreover, the practices included represent a starting point for adopting AR in teaching CH in iVET across Europe.

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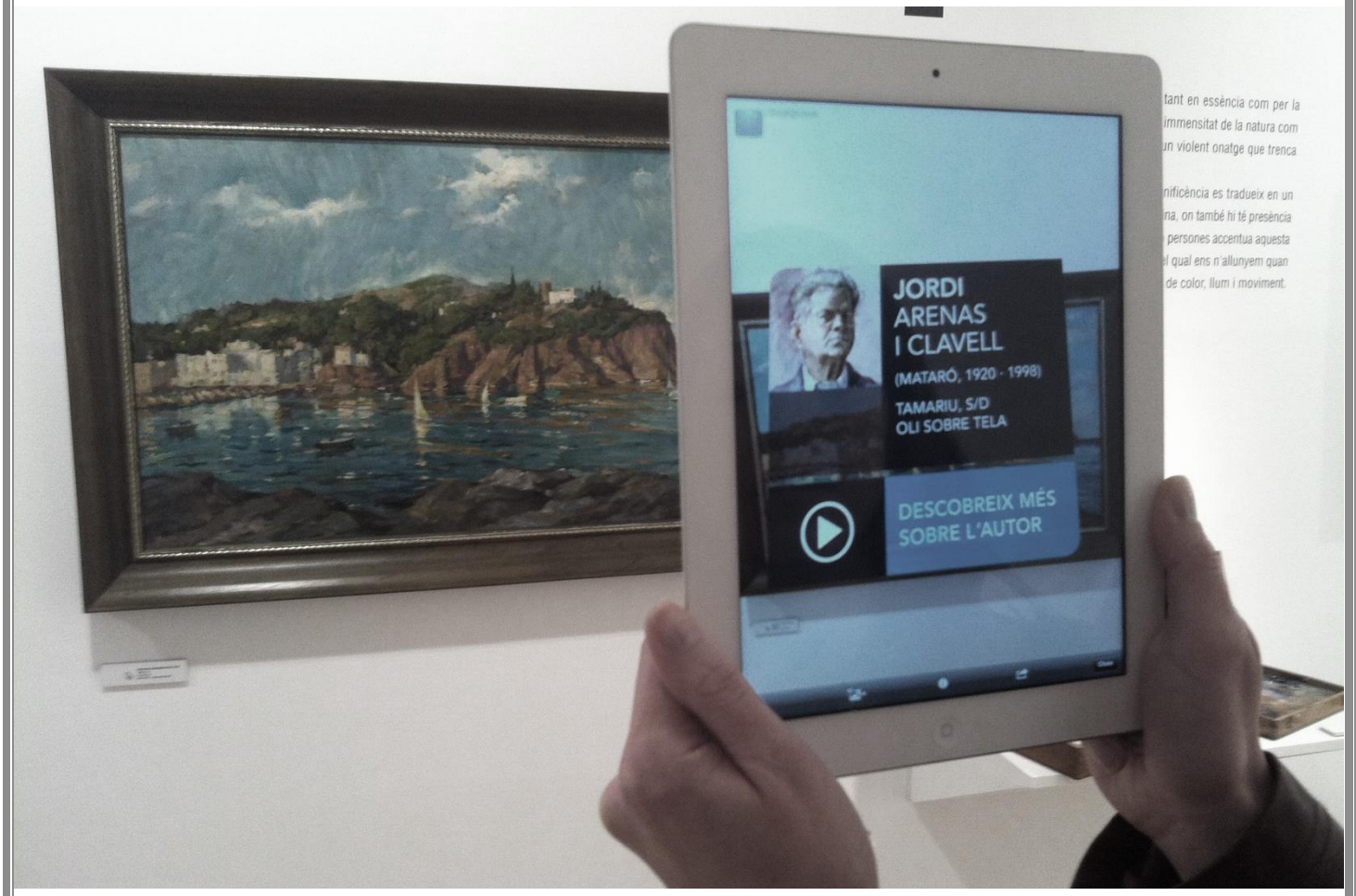

3. AUGMENTED REALITY PRACTICES APPLIED TO CULTURAL HERITAGE

3.1. Criteria for selection of Augmented Reality practices

Some of the main objectives of the selection and collection of augmented reality practices were:

- Raise awareness of the importance of promoting Europe's CH through education and lifelong learning;
- Encourage young learners to discover and engage with EU CH;
- Give an overview of teaching practices that are catalyst instruments for integrating CH subjects within educational programmes;
- Promote growth and job creation in the CH sector;
- Disseminate examples of AR practices applied to CH for introducing them in iVET programmes and curricula;
- Showcase the advantages and benefits these innovative pedagogical practices bring to education;
- Guide teachers and 'early-adopter learners' to develop the augmented learning project.

Here below some criteria to duly identify and select the AR technology or practice in partner countries:

- Be applied to cultural heritage and, preferably, integrated in iVET educational programmes;
- Be used for an educational or training purpose (e.g. teach subjects such art and cultural heritage);
- Be implemented in the partner country and/or abroad;
- Target teachers and learners from iVET institutes (14-18 years old);
- Be easily accessible from the technical point of view (e.g. free registration, user-guide available, etc.);
- Be effective and successful (the AR technology and practice has to be relevant for identifying cultural competences and digital skills that can be acquired through its usage);
- Demonstrate a positive impact for beneficiaries;
- Be transferable to other formative contexts and countries across Europe.

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3.2. Augmented Reality practices collected

Germany

1. AUGMENTED REALITY APP OF THE MUSEUM OF ISLAMIC ART

Headline	TAMAM – making alive millennia-old Islamic culture!
Title	Augmented Reality App of the Museum of Islamic Art
Timeframe	The app has been released in February 2019 as part of TAMAM project http://tamam-projekt.de/wer-ist-tamam/ .
Brief description	TAMAM AR app allows learning about the origins and purpose of artworks and cultural assets in the Museum of Islamic Art (German: Museum für Islamische Kunst) to be experienced on site in a new way, or delving into current research topics. Selected artworks of the Museum of Islamic Art can be scanned and augmented with the app. The free app is now available in the usual app stores for iOS and Android devices.
Tags	a. Education type: - Non-formal education b. Aim of the augmented reality technology or practice: - Teach/Learn cultural heritage and art subjects c. Accessibility and usage - Free access - Instructions/tutorial for use
Area and context of implementation	**Institution/Organization (e.g. museum, school, etc.):** The App has been developed in the frame of the educational project TAMAM coordinated by the Museum of Islamic Art, which is part of the Berlin State Museums, and supported by numerous Mosque communities. The app was implemented at the Museum for Islamic Art with the aim to learn more about the Museum's assets, which are considered tools for educational work. The App itself is part of the teaching materials and has therefore clear educational purpose. **Website:** https://www.smb.museum/en/whats-new/detail/the-museum-fuer-islamische-kunst-releases-an-augmented-reality-app-as-part-of-the-tamam-project/
Target group End users	Target groups of the App are numerous Museum's visitors of different age. Due to employing new multimedia approaches, also young people are expected to be inspired by the App and its functionality. Moreover, the App supports cultural education and social participation of Muslims living in Germany.
Technical AR framework	The App requires iOS 9.3 or newer versions and is compatible with iPhone, iPad or iPod touch. The App file size is 155,9 MB. Language of the App is German. The App is downloadable for free in the common app stores for iOS and Android devices (i.e. here:

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	https://apps.apple.com/de/app/tamam/id1444739233 The App makes use of the marker-based AR technology: when exploring the Museum's objects, the special attention has to be paid to the markings in the Museum. In addition, the orientation in the Museum is facilitated through the room plan on the app menu. TAMAM App features in a nutshell: - Clear list of all interactive objects; - Location of objects in the museum in the form of an interactive spatial plan; - Visual and/or sound background information about the objects; - Screenshot and sharing function.
Detailed description of the good practice	The TAMAM App is an educational project in which several mosques developed materials for cultural education together with the Museum of Islamic Art. For the time being, the TAMAM app allows experiencing of 16 objects from the collection of the Museum of Islamic Art employing AR. Users hold the camera of their mobile devices up to one of these objects to call up related animation and additional visual or sound background information, for instance, about the numerous design elements in the Aleppo Room, its inscriptions and pictorial motifs. Visitors are invited to experience figures dancing out of the frame, or complex patterns and structures putting together. The App has a clear educational purpose and is supposed to be used as teaching tool in the context of non-formal education.
Cultural competences and digital skills that the good practice is addressing	a. Cultural competences - Promote culture as a catalyst of creativity and growth through art education - Foster wider access to European Cultural Heritage b. Digital skills - Information and data literacy - Communication and collaboration
Results	AR app offered the Museum of Islamic Art unexpected opportunities to enter into a dialogue with visitors. In this manner, the Museum's offerings could be tailored to different target groups without overburdening the exhibitions with too much text and graphics. In addition, the Museum's services and interaction with the audience are kept up to date. Another positive outcome was increased networking of different education players who had so far very little cooperation with each other. Thanks to the participatory approach, the TAMAM multipliers were involved in the joint development process long-term.
Impact	The key message of the TAMAM app as well as of other teaching materials that have been created in the frame of the TAMAM project was: "Common past - common future". The artworks tell exciting stories of intercultural exchange and transregional references, which resulted into the emergence of these cultural assets. The history of art reveals that the mutual contacts and enrichment of different ethnic groups, cultures and religions have enabled artworks of this quality. Thus, the TAMAM app brings this

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	message into the present and combines it with the everyday experience of young Muslims in Germany. The objects of the Museum become relevant tools for educational work that accompany and explain current social processes in an artistic manner.
Challenges during implementation	No information available
Transferability	Depending on learning goals and pedagogical and digital skills of teachers, the App, which has been initially designed for non-formal education, can be surely used in the context of formal education: visiting Museum's exhibitions as part of History or Art course, learners group project work, class trips etc. The enthusiasm and creativity of teachers is highly needed!

2. "KARLSRUHE MAPTORY - EINE DIGITALE INSZENIERUNG IM STADTRAUM" („A DIGITAL ENACTMENT IN THE CITY")

Headline	Augment your senses in Karlsruhe!
Title	„Karlsruhe Maptory – Eine digitale Inszenierung im Stadtraum" (A digital enactment in the city)
Timeframe	The application was developed and implemented in 2015. About 2 years of preparation, production, development and deployment has been necessary.
Brief description	The Augmented Reality App Karlsruhe Maptory is a project developed in cooperation between multiple partners and headed by the ZKM, the Center for Art and Media technology based in Karlsruhe. The project seeks to explore the German town of Karlsruhe in a new way employing AR technology. With markers spreaded throughout the city, the user is able to spawn AR animations and learn about important historical personalities of the city and their context. The project´s final output was an app which could be downloaded from the iOS app store.
Tags	a. Education type: - Non-formal education b. Aim of the augmented reality technology or practice: - Teach/Learn cultural heritage and art subjects c. Accessibility and usage - Free access
Area and context of implementation	**Country:** Germany **City:** Karlsruhe **Institution/Organization (e.g. museum, school, etc.):** The project was coordinated by ZKM (Center for Art and Media Technology) based in Karlsruhe. Other partners were: Wissenschaftsfestival Effekte, Badisches Staatstheater Karlsruhe, South-West German broadcasting SWR2, EU – Culture Programme, Pipes-PROJECT who brought different expertise in the field of Arts, Media, and culture.

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	Website: https://maptory.zkm.de/ **Video:** https://www.youtube.com/watch?v=4uS5RrdoZxs
Target group **End users**	The target groups of the Maptory project were composed by locals and tourists who were fascinated by new applications of interactive and audiovisual media and were eager to experience historical and cultural topics of the city. They might want to dive into the AR technology or just want to know more about the city.
Technical **AR framework**	The app employs the inbuild sensors of iPhones to display a variety of different AR experiences, from faces coming out of a wall to the ability to play with the periodic table. Every attraction is linked to a person and is activated by a QR Code. Those are distributed around the town and can only be animated if the user is physically there. The app is distributed exclusively on iOS devices and it is freely downloadable from the Apple App Store and played on a private iPad or iPhone. It is also possible to book and borrow a tablet at the Loans station at the ZKM. The touchscreen of the app allows not only displaying images, but also receiving input from the user. The user is granted the ability to draw on walls but also to interact with the periodic table in AR. The app does not feature an export function and therefore does not support storing user-created content since the goal is to educate the public with pre-generated contents. There's no sign-up in the app, general public only needs an apple iD to download the app from the Apple App Store.
Detailed description of the good practice	The idea of the project was to give common people an innovative instrument to explore Karlsruhe in a more attractive and interactive way. In more than 30 different locations, one could experience scenic depictions in dollhouses or talking sculptures. Facades became interactive painting and playing surfaces and posters turned into cinema screens. The ZKM combined different genres of visual and performative arts with this app and made the city a stage for a new kind of music theatre. The contents were realized in scenic, graphic/ illustrative, acoustic or textual form. Team members were interdisciplinary partners coming from different sectors: theatre, video, audio design and programming. The pedagogical value of the app seems to be quite high. First of all, scholars, scientists, and artists from the past who were living and working in Karlsruhe came to life with their inventions, such as Ferdinand Braun, the inventor of the Braun tube (cathode ray tube), the architect Hermann Billing, who together with the sculptor Hermann Binz designed the "scandalous fountain" on the Stephansplatz, Fritz Haber, who developed the first method of synthesizing ammonia from nitrogen and hydrogen for which he received the Nobel Prize for chemistry. Secondly, the app contributed to fostering aesthetic and creative competences as it addressed different senses and perceptions.
Cultural	a. Cultural competences:

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competences and digital skills that the good practice is addressing	- Raise awareness and knowledge on the importance of promoting Europe's Cultural Heritage - Promote culture as a catalyst of creativity and growth through art education - Foster wider access to European Cultural Heritage - Other (*please, specify*): Aesthetic competence, creative competence. b. Digital skills: - Information and data literacy - Communication and collaboration
Results	The project gave the city of Karlsruhe a new attraction, especially for younger people, people interested in culture and history, and tech-enthusiasts. With this AR-experience, Karlsruhe has positioned itself as an open-minded innovative EU city with a versatile history and cultural background.
Impact	The implementation of the technology gave the local community, city and educators the ability to present the city to tourists and locals in a completely innovative and attractive way. While there were no quantifiable data on exactly how many tourists the project attracted, it was reasonable to assume that if the project was continued it would gain national or even international traction. This will return on boosting the gastronomy and hospitality sectors in the area. Besides, this city-wide implementation of diverse AR experience in culture and history was an innovative approach to both, formal and non-formal education. With the app, the education became mobile, entertaining and inspiring.
Challenges during implementation	The main difficulty encountered has been to exactly identify places where AR attractions can take place, and to design appealing storyboarding. To overcome these challenges, the creation of AR assets and clips was done in cooperation with the "Badisches Staatstheater Karlsruhe" while that of AR attractions was done in cooperation with the SWR and the Theatre of Karlsruhe.
Transferability	The concept of such an app can be transferred to any city with a reasonable high density of attractions. Since this project has to be unique for each city, it is an opportunity to bring together local cultural and educational organizations to their mutual benefit. Furthermore, the project can be implemented in universities and even schools to educate pupils in local history and culture and introduce them the world of AR. In addition, this type of AR project can be disseminated at EU level and even worldwide, as the didactic principle applies to almost any local context and its personalities. Notwithstanding any of the above, the project demonstrated that experiencing AR became possible and feasible also simply going around the city.

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Italy

1. AR - CIMUVE "AUGMENTED REALITY FOR THE WALLED CITIES OF VENETO": THE ROMANA VERONA MOBILE LEARNING

Headline	**Do you really know the ancient Verona walled city?**
Title	AR - CIMUVE "Augmented Reality for the Walled Cities of Veneto": The Romana Verona Mobile Learning[3]
Timeframe	This case study is related to the project Romana Verona Mobile Learning developed in 2015 by three organizations: University of Padua, "QuartiereAttivo" association and seven primary schools located in Verona.
Brief description	The main aim of the project is to enable young learners (primary school pupils) to learn more about Verona and its monuments (which are still an integral part of the city's landscape) at the time of the Romans, using augmented reality technology. The Verona Mobile Learning project intends to experience AR for learning purposes, especially in non-formal contexts. In fact, it also represents an important way to bridge the gap between formal and informal learning. Researchers believe that, in the near future, these non-formal learning environments will become increasingly important for learners and ordinary people. The App has been set-up in order to encourage an innovative approach to learn about the past. Its design results in a careful dialogue between educational technology experts of the FiSPPA Department (Philosophy, Sociology, Pedagogy, Applied Psychology) - University of Padua, cultural Heritage experts of the Italia Nostra association and the "Quartiere Attivo" association of Verona.
Tags	a. Education type: - iVET education b. Aim of the augmented reality technology or practice: - Teach/Learn cultural heritage and art subjects c. Accessibility and usage - Free access - Instructions/tutorial for use
Area and context of implementation	**Country:** Italy **City:** Verona **Institution/Organization (e.g. museum, school, etc.):** Primary schools of Verona, "The Quartiere Attivo" association and the University of Padua. **Website:** Not available
Target group End users	The Romana Verona Mobile Learning project addresses learners of primary schools (seven fifth-grade classes, 140 children in total) to recreate the most important features (hard to be recognized) of the

[3] Corrado Petrucco and Daniele Agostini (2016), Teaching our cultural heritage using mobile augmented reality, "Journal of e-learning and Knowledge Society", Vol 12, n. 3.

	Veneto's walled cities through a mobile AR application. The experience is closely linked to the school curriculum because in the fifth-grade classes' program the study of the phases of the Roman civilization (e.g. the Kingdom, the Republic and the Empire) is included.
Technical AR framework	Some of the technical characteristics implemented in the application are as follows: • Presence of a client-server model: it allows the application to download material and information from the server and to update it according to the GPS location. • It enables learners to visualize at the present day structures and places as they were at the time of their construction thanks to superimposed 3D models through AR technology. • Visualization of historical and actual Maps with POIs. • Indication of specifically geolocated and interactive AR tags. • Display of some 3D interactive models (e.g. siege machines). • Possibility to make interactive quizzes, discover treasure hunts and solve mazes. • Possibility to make connections between the various devices thanks to social functions which allow participants to share ideas and to promote teamwork. • Deployment of effective augmented reality through the Google Cardboard compatibility: better understanding thanks to immersive experience.
Detailed description of the good practice	The AR-CIMUVE "Walled Cities of Veneto" project aimed at recreating all the features of the Veneto's walled cities, which are either difficult to recognize or not easily distinguishable, through a mobile AR application. The main characteristics of the application in a nutshell are as follows: 1. The respect of pedagogical principles and educational objectives. 2. To stay within the pedagogical framework related to training activities about cultural heritage (Art History, Media and Communication, etc.). 3. The app is simple to use and encourages interaction with the user. 4. The content perfectly follows the tour of the site. 5. Learners can provide feedback. 6. A variety of practical activities to encourage the interaction between children and the cultural educator can be undertaken. The project is composed by different steps. The main one is represented by the "Verona Tour", the heart of the experience. During the visit of the city's landscape, half of the class uses the augmented reality tool to get explanations from the historian; the other half is supported by a textbook. The App is designed to be used independently by the learners, but it can also be complementary to a guided tour. The information provided on the screen are complementary and not substitutive to explanations and arguments presented by a tour guide. They are provided through AR technology: data, facts and figures are superimposed on the real vision of the artefact. Therefore, the visual content can

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	be better understood because it is accurately integrated into the original context. The web prototype has included additional instruments that enabled users to provide feedbacks. For example, the mobile application has been enriched with ***Google Forms*** that allow to integrate information and further suggestions at the windows interface. Therefore, it was used to collect feedback, make questions, show insights and other visual images. Moreover, it was decided to use augmented reality in an indirect way: the image on which the virtual layer is superimposed is already acquired and is taken from the memory of the device rather than real-time from the camera. The interface overturns the usual methods of accessing content that includes the departure from a structured text menu that refers to isolated interactive and multimedia content. In the Roman Verona Mobile Learning prototype, one begins from an immersive interface. Links to additional content and insights are distributed in the application's mixed reality space, thus making them more contextualized: their location in the virtual space is already an interpretive key of the content
Cultural competences and digital skills that the good practice is addressing	a. Cultural competences - Raise awareness and knowledge on the importance of promoting Europe's Cultural Heritage - Foster wider access to European Cultural Heritage - Promote growth and job creation in the CH sector b. Digital skills - Information and data literacy - Communication and collaboration - Digital content creation
Results	From a behavioral point of view, we can say that: • Children - usually considered by teachers the rowdiest - who used the device were capable to maintain a higher level of concentration during visits. • During the lecture in class, pupils that were using the devices were completely focused on the contents of the application. On the contrary, pupils with the booklets tended to lose their attention unless they were encouraged by the teacher. The opinions about the tour expressed by the pupils who have used the augmented reality technology enlighten that: • Most of them who used the devices during classroom were not stricken by the technology, but from discoveries and information regarding the history of the monuments and the landscape. • The vast majority of them who used the devices appreciated the way the App presents contents and calls for broader use of these technologies. • The technology that better engages pupils has been the most immersive one (using Google Cardboard) because it allowed them to see the places as they were in the past or to see places that you could not access.

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Impact	The AR-CIMUVE wanted to exploit the role of AR technology in learning processes, especially in non-formal contexts. One must consider a setback which could limit its use and effectiveness: real learning contexts are still limited and the usage of AR tools is tied with sporadic non-formal activities; moreover, much of the teaching takes place in traditional classroom settings. With the aim of making the AR an effective mediator of the learning process, the school curriculum and learning settings should be reformed: informal experiences outside school using mobile devices, also with AR software applications, should be improved. This project, with the help of the teachers, could become a stimulus for further discussions in class so that learners do not consider learning experiences in informal learning spaces different from those that are held in school. In this sense teaching methods, which are oriented towards the Project-Based Learning in a "flipped classroom" approach could prefer this process, thus bridging the gap between formal and informal learning. The pilot project applied in Verona is designed to encourage and spread this kind of teaching practices. Thanks to the results and feedback that the project will receive it could be possible to fix and to further develop the application. Furthermore, the application developers are verifying the effectiveness of both teaching and learning, in the perspective of putting in place an adequate methodological model.
Challenges during implementation	Some interesting aspects emerged from the first couple of classes that used the application. Two critical issues were detected in the use of devices: • Children do not know how to use smartphones and tablets: contrary to what is commonly said, the majority of children do not have a good expertise in the use of the Android device. They ignore many of the interactions and basic functions of the operating system. • Pupils expect immediate feedback from the application. Where this is missing, they immediately think of a malfunction. • Teachers highlighted that they had not understood from the beginning the potential and implications of these technologies. Then, they were convinced of their effectiveness. Even thanks to the strong integration of the project into the school curriculum and also due to the massive activities that enabled them to share the project with other colleagues.
Transferability	The mobile APP can be easily transferable in iVET education and also at academic level. As regard to the upper secondary school, there are at the moment new methodological approaches for which this technology could be very beneficial, as for example the so called 'DADA': educational learning environments. This methodological approach, founded in the Scandinavian teaching context, is based on a learning landscape that serves as an educational tool and catalyst for learning. Within this model the use of technological devices like for example tablet, smartphones, gamified applications is considered a meaningful contribution to the development of several 'soft skills' such as *Self Awareness, Effective Communication, as well as Decision Making and Creative*

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	Thinking.

2. "SEEFORME: A SMART MOBILE AUDIO GUIDE"

Headline	**Let's have a smart experience in the museum!**
Title	"SeeforMe. A smart mobile audio guide"[4]
Timeframe	The mobile phone application has been designed and implemented in 2017 as part of a scientific research project developed by the Media Integrated and Communication Center (MICC) of the University of Florence, supported by the Tuscany Region within the "Social Museum and Smart Tourism" project.
Brief description	The mobile App "SeeforMe" is a smart audio guide backed by a computer vision system capable to work in real-time on a mobile device, coupled with audio and motion sensors. The goal of this application is to implement a real-time computer vision system that can run on wearable devices to perform object classification and artwork recognition and to improve the experience of a museum visit through the automatic detection of users' behavior. Artwork recognition allows to provide multimedia insights of the observed item automatically or to create a user profile containing information about what artworks a user is looking at and for how long. This mobile app has been implemented in order to enrich and to personalize the on-site museum visitor's experience. Nevertheless, it can be certainly replicated and it could find a diffusion among the iVET institutes, for example to teach Art History in upper secondary schools.
Tags	a. Education type: - Secondary education - Non-formal education b. Aim of the augmented reality technology or practice: - Teach/Learn cultural heritage and art subjects c. Accessibility and usage: - Free access - Instructions/tutorial for use
Area and context of implementation	**Country:** Italy **City:** Florence **Institution/Organization (e.g. museum, school, etc.):** University of Florence, Media Integration and Communication Centre (MICC); Application tested on the Bargello Museum, Florence **Website:** https://www.micc.unifi.it/projects/see-for-me/ **Video:** https://vimeo.com/187957085

[4] Lorenzo Seidenari, Claudio Baecchi, Tiberio Uricchio, Marco Bertini, Alberto Del Bimbo (2017), "Deep Artwork Detection And Retrieval For Automatic Context Aware Audio Guides", in ACM Trans. Multimedia Comput. Commun. Appl.

Target group **End users**	The SeeforMe app is mainly designed and implemented as a smart guide for enriching the museum's visit experience to tourists and visitors. The system creates personalized stories for each artwork and/or object the museum visitors want to observe while they are looking at them, even bringing up on the mobile phone display images, descriptions, information, etc. Moreover, at the end of the tour the user profile can be used to create a personalized exploration of multimedia content on an interactive table, providing more information on the items that most attracted the visitor, and suggesting additional museum itineraries. One of the main ideas behind the App is even to reduce the cognitive effort required to museum visitors. In fact, despite the rooms designed following different themes and the ubiquitous explanatory cards, users can still be overwhelmed by the great number of artworks into the museum. Labels can be very concise or, on the contrary, can be filled with very long explanation, often generic, not highlighting the main features of the individual paintings. By using this kind of mobile App, the visitor can take a picture of the artwork he is interested in. The App will automatically recognize the painting and provide related information. This is beneficial for the museums' curators who are against placing or attaching additional materials, such as QR codes, next to artworks. Furthermore, tourists and school groups are usually 'hit-and-run' visitors who tend to rapidly forget or do not have enough time to process the overload of information. This application could be commercialized to provide smart paradigms of interaction to ease the learning of the art history among teenagers (between 14 and 18 years old) - more familiar with digital technologies, open to technological innovation and to gamification - in upper secondary and iVET schools by exploiting gamification techniques with recreational and educational purposes. Moreover, the mobile APP could offer an incremental library of artworks that cab be expanded by museums curators, and also by the Art History teachers according to the school curriculum programs.
Technical **AR framework**	The SeeforMe App comprises several components that work together to enable a smart experience. The figure below shows an architectural diagram illustrating the main submodules of the system. From a higher-level view, two main sub-systems are identified: one to *recognize artworks* (providing Artwork id); one to *model the User status* which means to understand if the visitor is moving inside the museum hall or if he is talking with a friend.

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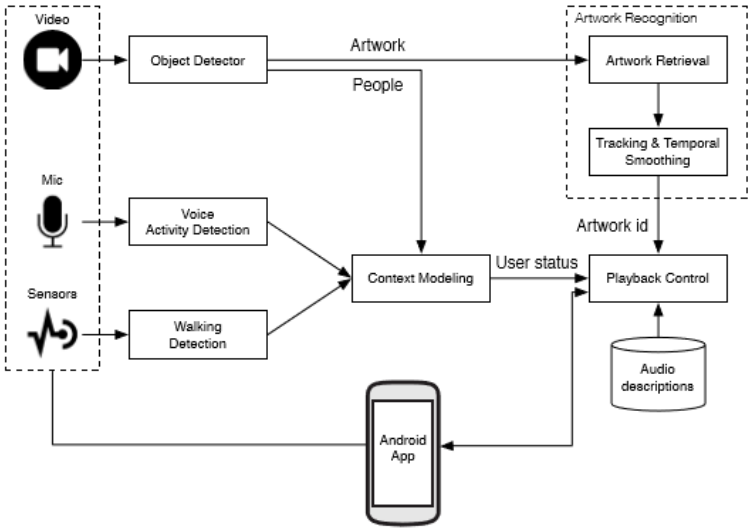
The sub-systems generate input signals for the Playback Control module which is responsible to display descriptions at appropriate time. The system senses the environment through three main channels. A *camera* understands what the user is looking at (Artwork Recognition); a *microphone* is used as a source for Voice Activity Detection, and *movement sensors* are necessary for



Walking Detection. The three sources are accessed through an Android App which is also responsible as a front-end of the whole system.

The mobile app has been developed using the Android SDK. The interface follows the guidelines of material design proposed by Google. SQLite is used to persist the information on the device local storage. Communication between the app and the YOLO[5] module is carried out using Java Native Interface (JNI) which enables the Java code running in the Java Virtual Machine (JVM) to call and be called by native applications. Data-interchange is performed through JSON messages. In particular, the YOLO module communicates with the mobile app passing data related to the current frame of the camera stream

The App is designed to handle three different user scenarios: (i) the user makes use of the application in a fully-automated way (placing the device in a front pocket with the camera facing forward, or

[5] YOLO (You-Only-Look-Once) is a real-time object detection algorithm developed to run on portable devices such as a laptop or cellphone lacking a Graphics Processing Unit (GPU).

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	hanging it on the chest using a special support as shown in the picture above). In this scenario, the system does not need any interaction and continuously monitors the surroundings using the camera, choosing when to start and when to stop the audio by analyzing the user's behavior; in this modality the user can still interact with the application by using voice commands that are elaborated by the operating system and translated in the form of actions such as start/stop the audio; (ii) the user makes use of the application actively in a semi-automated way: after pointing the device towards the artworks he is interested in, the system detects the artwork and provides the contextual audio guide, that can be started and stopped automatically or manually by the user; (iii) the user has completed the tour and wants to go over his experience: to this end, the application provides a visual history of the tour represented as a carousel of artworks in temporal order. Through the carousel, the user can select the artworks he visited, have multimedia insights and replay the audio guide.
Detailed description of the good practice	Digital and mobile technologies are becoming a key factor to enhance visitors' experiences during a museum visit, e.g. creating interactive and personalized visits. Personalization is viewed as a factor in enabling museums to change from the practice "talking to the visitor" to "talking with the visitors", turning a monologue to a dialogue. Through SeeforMe application the researchers of the University of Florence face the challenge of creating a personalized on-site museum experience using a non-intrusive computer vision algorithm that can be executed on board of an audio guide, which is in turn enriched with augmented reality contents. The content-based image retrieval (CBIR) technique has been applied to the domain of cultural heritage within the museum environment: the smart audio guide is based on an efficient computer vision pipeline that simultaneously performs artwork localization and recognition. It requires two main computer vision tasks to be solved: i) detection of relevant object categories: e.g. persons and artworks; and ii) for every detected artwork, reliable recognition of the specific artwork framed. Therefore, museums preserving cultural heritage were considered the most suitable places to apply this technology. The effective use of a smart audio guide can be considered an essential tool both for schools and for museums as well. Museums have recently been dealing with educational and pedagogical issues related to children and youngsters at school. Museums started being regarded as an extension and a follow-up of the learning process that starts in classroom. Therefore, school visits became increasingly important for the development of museum resources, especially if referring to the creation of learning resources dedicated to school groups, such as worksheets, treasure maps, activities oriented to draw and paint, games and quizzes, and so on. The smart guide is also an opportunity for museums to

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	(re)discover themselves by offering different and creative perspectives of and insights into their collections, objects or stories. Having said that, museums of the new era should have a number of requirements, e.g. receiving visitors in a more friendly and welcoming way, handing out brochures (with suggested different tours around the museum), providing advice and suggestions (e.g. the highlights of the museum), attracting and engaging their audiences. This aspect should be implemented through a cooperation strategy among local institutions, municipalities, schools, museum curators and managers. The University of Florence's research team has tested this App in the environment of the Bargello Museum of Florence. It has not been commercialized yet.
Cultural competences and digital skills that the good practice is addressing	a. Cultural competences - Raise awareness and knowledge on the importance of promoting Europe's Cultural Heritage - Promote culture as a catalyst of creativity and growth through art education b. Digital skills - Communication and collaboration - Digital content creation
Results	Users found the mobile app more useful than a traditional audio guide. The main differences between traditional audio guides and the SeeforMe system can be found in the interactive and social aspects of the provided experience. In traditional audio guides the content is most of the time passively exploited and the user has a low control on its reproduction. As regard to this, SeeForMe offers a more user-friendly experience giving the possibility to interrupt the audio playback manually and automatically, and start again from the point where it was interrupted. Playback control can be achieved also using voice commands. Furthermore, activation of contents in audio guides is cumbersome: locations or room numbers have to be identified and inserted manually reducing usability whilst SeeForMe allows automatic artwork recognition. This fact results in further differentiation of the Instrumental function, even in case of automatically triggered guides (e.g. those using RFID): an audio guide, being completely passive cannot guide the visitor within the museum, which is allowed by SeeForMe, highlighting the presence of other artworks. As for sociality, if it is true that social networking mechanisms are commonly provided in tourism apps for mobile phones, these functionalities are intended for virtual or remote users and not real companions. Indeed, audio-guides hinder communication between visitors (especially group visitors) and make people feel isolated, inducing them to stop using devices and applications in order to join their friends and/or other group's members to exchange opinions and remarks about the museum artworks. In this sense SeeForMe is more 'social' because it automatically understands the context detecting if the user loses attention or simply is speaking with someone else, adapting the

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	interaction with the system accordingly. In order to assess the whole experience offered by the system in a real environment, the research team conducted an evaluation of its usability. Most of the users agreed that the possibility to automatically start/stop the guide is the feature that makes the experience smoother. Regarding negative aspects of the system, most of the points made by users were about the need to access menus to change the language or other options.
Impact	The main impact of the mobile smart audio guide is the possibility to: - provide information to the museum's visitor at a proper time; - avoid intrusiveness and be aware of contexts; - offer augmented reality contents via audio descriptions (text-to-speech) in order to 'augment' the users' experience; - understand user's intentions and needs; - offer an incremental library of artworks to museum's curators; - provide complementary teaching tools for school professors; - offer a gamified learning experience to younger pupils.
Challenges during implementation	Despite the progressive development of the mobile AR application, there are some important difficulties that still hinder the full exploitation of its potential in the cultural heritage field. For example, the on-site Internet connection required to make use of the App is often malfunctioning in a museum. This aspect could limit the usability of an AR smart guide a lot. Moreover, the museum itself might be a limit: museums are delicate environments and the use of any technology should not disturb the visitor's experience. Furthermore, many art pieces might not permit to be enhanced with the new technology. Therefore, researchers tried to overcome these issues by developing a specific technological architecture that was embedded into the SeeforMe App.
Transferability	Even if the mobile App has been designed to enhance the tourist and/or visitor's museum experience, it could be also applicable in an educational context addressing both high school and University learners. The use of smartphones is particularly widespread among teenagers and young adults, in Italy as well. The smart phone has become a kind of 'hands extension' for many youngers. It could be useful and effective to teach some courses, such as for example Art History, with the aid of smartphones that provide augmented reality and gamification apps. Moreover, this technological approach is backed up by a pedagogical and educational point of view: indeed the 'social constructivism' philosophy, which pervades our views on learning these days, is particularly supported by the Web 4.0 tools which help learners to become active players of their cultural growth.

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Poland

1. "PRZEWODNIKI LUBLIN 2.0" ("TOUR GUIDES. LUBLIN 2.0")

Headline	**Discover the cultural heritage of Lublin!**
Title	„Przewodniki Lublin 2.0" ("Tour guides. Lublin 2.0") is part of "Lublin 2.0 – the interactive reconstruction of Lublin's history" project financially supported from the funds of the Ministry of Culture and National Heritage. Technology: Layar SDK and app. Owner/Promoter: "Grodzka Gate – NN Theatre" Centre.
Timeframe	The "Lublin 2.0" guides have been developed in 2012 and by the beginning of 2019 they were available through Layar SDK. From July 2019 onwards, support for the Layar application is no longer continued and the application will be phased out by its parent company Blippar.com Ltd. The "Grodzka Gate - NN Theatre" Centre, being the owner/promoter of the guides, is looking to implement new technologies and VR applications in order to be able to support and further develop their virtual Lublin guidebooks.
Brief description	The purpose of the guides was to present history and cultural heritage of the city in an attractive and intelligible way. "Lublin 2.0" guides allowed to sightsee the city of Lublin using a smartphone or tablet with GPS and Internet connection and the Layar app in which one or more from 14 routes can be chosen. Each route presented comprehensive knowledge about history and cultural heritage of the city in an attractive and intelligible way. The guides were available for free.
Tags	a. Education type: - Non-formal education b. Aim of the augmented reality technology or practice: - Teach/Learn cultural heritage and art subjects - Assess new competences and digital skills c. Accessibility and usage - Free access - Instructions/tutorial for use - On-line assistance
Area and context of implementation	**Country:** Poland **City:** Lublin **Institution/Organization (e.g. museum, school, etc.):** "Grodzka Gate – NN Theatre" Centre **Website:** http://teatrnn.pl/przewodniki/
Target group End users	This solution was addressed to all the users that can be identified as CultApp target groups. As the Layar app, which was necessary to use the guides, was available free of charge in Google Play (for Android) and AppStore (for iOS), anybody interested in the cultural heritage of Lublin could learn about it. This included learners, who are one of the main target groups of CultApp. On the other hand,

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	all the individuals and institutions interested in giving them such possibility (teachers, parents, iVET staff, VET providers, Universities, NGO's) could use this solution. Teacher training associations, as well as policy makers, could be interested in promoting it among teachers as an innovative and attractive way of teaching and learning about cultural heritage. This solution was also a good tool for promoting Lublin cultural heritage, which made it useful for cultural private and public associations, cultural foundations, museums and tourism sector. It could also be used by researchers, research institutes, universities and professional experts in the field of Europe's cultural heritage in their studies.
Technical AR framework	"Lublin 2.0." guides worked using Layar, a browser allowing its users to find various items based on augmented reality technology. Data in the form of website links, 3D models, films, audio, graphics and text files created layers added by a third party using Layar's API. Using smartphone's camera, accelerometer, compass and GPS it identified user's location and field of view and presented data assigned to a place. The app was free and did not require registration but the Layar SDK (including Developer API - application programming interface, which allowed developers to create new layers) was not free of charge. This did not create problems for using "Lublin 2.0" guides but anybody interested in developing a similar solution should be aware that some costs are connected with this.
Detailed description of the good practice	"Lublin 2.0" guides were a part of and used the contents created in the course of "Lublin 2.0 – the interactive reconstruction of Lublin's history". The project was implemented by "Grodzka Gate – NN Theatre" Centre, a local government cultural institution based in Lublin, which concentrates on the history of Lublin as a place of meeting of various cultures, traditions and religions and is an important institution in educating about Lublin's cultural heritage. "Lublin 2.0" guides allowed to sightsee Lublin to anybody who was equipped with a smartphone or tablet with GPS and Internet connection and the Layar app in which 14 routes could be chosen: the monuments of Lublin, the Jewish Lublin, Lublin from the Lublin Union till the European Union, Lublin in 1918, Lublin of Hartwig's, Lublin of Stefan Kiełsznia, the post-industrial architecture, the trail of the route in the "Poem about the city of Lublin" by Józef Czechowicz, the trail of 3D models, poems about Lublin, spoken stories about Lublin, Lublin of the Lublin Union, Lublin of the Lublin Renaissance, murals of the "City of Poetry" Festival. One or more trails could be chosen. Each route presented comprehensive knowledge about history and cultural heritage of the city in an attractive and intelligible way. The guides were available for free. The guides were used several times for events promoting cultural heritage of Lublin. As Layar allowed to connect a place with multimedia contents added in Layar, it could be applied to different types of cultural heritage, whether these would be monuments or the work of a specific artist connected with Lublin.
Cultural competences and	a. Cultural competences

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digital skills that the good practice is addressing	- Raise awareness and knowledge on the importance of promoting Europe's Cultural Heritage - Promote culture as a catalyst of creativity and growth through art education - Foster wider access to European Cultural Heritage b. Digital skills - Information and data literacy
Results	The main result of this study is presenting an example of how the AR can be used for creating a rich and organized experience on the subject of cultural heritage.
Impact	The practice described in this study is focused on cultural heritage although the technology (Layar) did not have such limitations. In other words, "Lublin 2.0" was a way of using Layar for educating about cultural heritage.
Challenges during implementation	This information is not available.
Transferability	As "Lublin 2.0" guides used widely available technology, free for the learner, there were no contraindications to transferring it to formal education.

2. "CO PAMIĘTA MIASTO" ("WHAT DOES THE CITY REMEMBER")

Headline	Discover the history of Wola district in Warsaw!
Title	„Co pamięta miasto" ("What does the city remember") is a part of "Poland Lab" project financially supported from the funds of the Ministry of Culture and National Heritage. Technology: Aurasma (now HP Reveal). Owner/Promoter: Association of Creative Initiatives "ę" in cooperation with (and with financing from) Evens Foundation.
Timeframe	The development and implementation period of the practice was in 2014-2015 but the implementation of the practice understood as work with participants takes 4 days: 2 days of preparation and 2 days of the actual implementation.
Brief description	The aim of "Poland Lab" was to increase civic awareness and strengthen the influence of the young people to the space they live in by combing the potential of local NGO organizations working with young people, city activists, and experts in the field of new media and new technology. This practice uses photos put in places of cultural value for the local community as markers. After pointing a smartphone or tablet with the Aurasma app on such photo anybody can watch a film about the place.
Tags	a. Education type: - Non-formal education b. Aim of the augmented reality technology or practice: - Teach/Learn cultural heritage and art subjects

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	c. Accessibility and usage - Instructions/tutorial for use
Area and context of implementation	**Country:** Poland **City:** Warsaw **Institution/Organization (e.g. museum, school, etc.):** Association of Creative Initiatives "ę" in cooperation with Evens Foundation **Website:** http://polskalab.e.org.pl/eng/ (English version) http://polskalab.e.org.pl/portfolio/co-pamieta-miasto/ (Polish version) **Showcase – photos and films:** http://warszawalab.e.org.pl/category/punkty-na-mapie/co-pamieta-miasto/
Target group End users	This solution is addressed to all the users that can be identified as CultApp target groups. The Aurasma (HP Reveal) app, which is necessary to use the guides, is available free of charge in Google Play (for Android) and AppStore (for iOS) and the markers, initially located in different places in the Wola district are available at: http://warszawalab.e.org.pl/category/punkty-na-mapie/co-pamieta-miasto/. This enables anybody interested in the cultural heritage of Wola to learn about it. In addition, all the individuals and institutions interested in giving them such possibility (teachers, parents, iVET staff, VET providers, Universities, NGO's) can use it. The important part of this solution was contents creation by learners during workshops and then spotting the markers located across the district by its inhabitants. Thus, it can be used more as a source of inspiration and good practice, especially thanks to the manuals for implementing workshops published here: http://polskalab.e.org.pl/portfolio/co-pamieta-miasto/. Teacher training associations and policy makers could be interested in promoting it among teachers as an innovative and attractive way of teaching and learning about cultural heritage. This practice is also a good tool for promoting cultural heritage of any city, town or village, which makes it useful for cultural private and public associations, cultural foundations, museums and tourism sector.
Technical AR framework	Aurasma (currently known as HP Reveal) is an augmented reality platform. It is available as a software development kit or as a free app for iOS- and Android-based mobile devices. Aurasma's image recognition technology used a smartphone's or tablet's camera to recognize real world images and then overlay media on top of them in the form of animations, videos, 3D models and web pages.
Detailed description of the good practice	Poland Lab is an urban media citizenship laboratory, launched by Association of Creative Initiatives "ę" and Evens Foundation in medium-sized cities in Poland. The project combined the potential of local NGOs working with young people, city activists, and experts in the field of new media and new technology. Its main participants were local mid-high and high school youth. As part of "Warszawa Lab" a group of local animators together

	with local youth worked on using archives of Wola Museum (Wola is one of the districts of Warsaw), including documents, books, photos and films, to create short (2-4 minutes) films. These films presented information about: - one of the first free elections in Poland which took place in Wola, - factories located in Wola, - World War II and the ghetto, - the history of the "Dom Słowa Polskiego" Printing House and the history of the premises of Wola Museum. Films were created in Windows MovieMaker and uploaded to Vimeo.com. Participants used selected photos as markers and put them in places that were the topics of their films. Films were uploaded on the Internet. They included historical information enriched with archive films and photos, footage and a short animation made by project participants. When using Aurasma app on a smartphone or tablet, anybody could watch these films after pointing the smartphone on the marker and learn something about the place. The only condition is that one has to search for Wawalab in Aurasma search option and follow it. All the photo markers and films are available at http://warszawalab.e.org.pl/category/punkty-na-mapie/co-pamieta-miasto/. The project produced scenarios of the labs that included a similar practice and could be implemented for other cities, groups and integrated within teaching programmes.
Cultural competences and digital skills that the good practice is addressing	a. Cultural competences - Raise awareness and knowledge on the importance of promoting Europe's Cultural Heritage - Promote culture as a catalyst of creativity and growth through art education b. Digital skills - Information and data literacy - Communication and collaboration - Digital content creation
Results	The main result of this study is finding a practice that is an example of using AR in work with mid-high and high school youth, who can develop their own contents. This practice produced also a scenario/manual on which other technologies using AR can be based.
Impact	The practice has increased the level of young people's awareness of the cultural heritage located in their neighborhood.
Challenges during implementation	This information is not available.
Transferability	This practice can be transferred to formal education thanks to manuals it has produced, which are ready to be used for lesson scenarios.

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Bulgaria

1. "MOBILE APP FOR AUGMENTED REALITY IN MUSEUMS"

Headline	Come and see ancient and eternal city of Odessos (Varna)
Title	"Mobile app for augmented reality in museums"
Timeframe	The application was developed and implemented within 5 months in 2013.
Brief description	The application allows users to experience museum objects in their original condition and receive information about them using a low cost yet high-tech solution. Innovation combined with modern technology allows visitors and residents of Varna to keep an imprint of what they have seen, to enhance their knowledge, and to interact with content in an intuitive and exciting way. Using a free downloadable app, visitors can have a greatly enhanced experience of the Varna Museum of Archaeology while learning about ancient history.
Tags	a. Education type: - Non-formal education b. Aim of the augmented reality technology or practice: - Teach/Learn cultural heritage and art subjects c. Accessibility and usage - Instructions/tutorial for use
Area and context of implementation	**Country:** Bulgaria **City:** Varna **Institution/Organization (e.g. museum, school, etc.):** Museum of Archaeology **Purpose:** To improve visitors' museum experience, expand engagement and deliver information about the artefacts through mobile devices and AR technology. **Website:** http://www.sim-on.org/AR_and_3D.htm
Target group End users	The project is beneficial to the museum sector as a whole, as well as every museum goer (tourists, students with teachers on school trips, school staff, researchers etc.) Among museums' beneficiaries are also people and organizations from the cultural sector, private and public associations, cultural foundations as well as representatives from the business sector. Sometimes, history classes are organized within the premises of the museum so the students of those classes can also benefit from the solution.
Technical AR framework	The application uses beacon-based location technology via Bluetooth enabled devices to determine the user's location within the museum exhibition. It then makes use of the phone or tablet camera and 3D markers located in the real world to display a 3D image of the artefacts which the AR software superimposes on the markers. Users are also provided with workspace to manipulate the markers. The model can be rotated and explored from any direction. Missing objects, loaned to other museums can be

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	displayed on guests' phone/tablet. Augmented reality marker technology allows objects to be viewed in their original, authentic state. The app also displays relevant information via text, video and images.
Detailed description of the good practice	The idea to implement marker and beacon technology in Bulgarian museums started in 2013 when the development process began. It was inspired by existing applications in the same field used in other countries. The main goal was to improve the cultural heritage experience in the education sector but also in Bulgarian museums as a whole, to create added value for wider audience, and to address as many people as possible. The idea was to use this innovative approach to attract people to museums and reinvent the cultural heritage from a new perspective. The parties involved were the developer and the Varna Museum of Archaeology. The application mainly targets school-age museum visitors. Among the benefits, an increased engagement in the exhibitions and easier access to background information can be named. The app has enabled visitors to explore items and see information about them in a way that wasn't previously possible. This practice can be integrated in schools' museum visits as well as to create a virtual museum based on real life markers and 3D content in school environment. Therefore, it can be applied to cultural heritage education.
Cultural competences and digital skills that the good practice is addressing	a. Cultural competences - Foster wider access to European Cultural Heritage - Promote growth and job creation in the CH sector b. Digital skills - Information and data literacy - Communication and collaboration - Digital content creation
Results	The application was very well received by visitors from Varna region and is still in use to this day. Young people and learners were interested how the technology was developed. They learn easily and no longer face challenges of boring and traditional way of serving the information in the museums. After the application launch, much more visitors from all over the country and abroad started to come to the Varna museum.
Impact	Statistics showed that more young people up to age of 30 were visiting the museum, so the application raised interest of the young generation in cultural heritage, when presented in an interactive way. Furthermore, similar projects were initiated, so it has helped to improve the museum experience in several other Bulgarian towns.
Challenges during implementation	In 2013 when the application was introduced, mobile device cameras were of much lower quality making harder to use the application. Nowadays even low-range devices are equipped with good quality cameras which have eliminated this issue. The other main challenge was the creation of AR content which is a time-consuming process. The whole process took longer than planned, but in the end it was successful.

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Transferability	This technology is applicable for non-formal education as both a virtual museum experience and an enhancement to visiting a real museum, for example in a day trip. It can be applied in a wide variety of settings as it requires only a mobile device with the app installed and the physical markers in the real-world environment.

2. "ANCIENT THEATRE IN PLOVDIV"

Headline	Preserve the past, protect the future of Plovdiv
Title	"Ancient theatre in Plovdiv"
Timeframe	The application was developed during 3 years. It is constantly being updated and upgraded.
Brief description	The app has been implemented in partnership with the "Ancient Plovdiv" Municipal Institute, which works to preserve and manage cultural heritage sites in the area. Its purpose is to bring the ancient structure of the theatre back to life and make it a more interactive, innovative and educational experience for visitors with all kinds of background. The app is owned by the developer, professor Jordan Detev, and promoted through the Institute, which distributes a leaflet that also works with the app. The app works in the theatre itself or with a leaflet which is sold by Municipal Institute "Ancient Plovdiv". Its aim is to help modernize the tourism and cultural heritage sector by making use of modern technologies. Visitors of the ancient theatre have a greatly enhanced experience being provided with images and video at every step, revealing what the site looked like back when it was built, and being shown information about different artefacts on site and the history of its use.
Tags	a. Education type: - Non-formal education b. Aim of the augmented reality technology or practice: -Teach/Learn cultural heritage and art subjects - Assess new competences and digital skills c. Accessibility and usage: - Free access
Area and context of implementation	**Country:** Bulgaria **City:** Plovdiv **Institution/Organization (e.g. museum, school, etc.):** "Ancient Plovdiv" Municipal Institute, Institute for Virtual Culture **Purpose:** To improve visitors' experience, expand engagement and deliver information about the site and artifacts through mobile devices and AR technology. **Website:** http://www.visitplovdiv.com/en/node/522
Target group	The project was developed without having a concrete, specific

End users	target group in mind. Instead, it chose the technology precisely because it is universally accessible. That being said, the most relevant users are visitors of the cultural heritage site, which includes learners, teachers, tourists and so on. The users of the app vary from kids and learners to pensioners, who seek to learn about new technologies and cultural heritage. Plovdiv, which is the European Capital of Culture for 2019 (https://plovdiv2019.eu/en), is visited by a huge number of tourists from all over the world. The app helps them to explore the ancient Roman ruins and history of the area.
Technical AR framework	The app works with image recognition. When the camera of mobile device rests on an image present in the graphical data base of the application, the real-world images trigger related media from the database to appear on top of them on the mobile device screen. By pointing the camera at a leaflet, which is distributed by the "Ancient Plovdiv" Municipal Institute and contains photographs of the real-world trigger images, users can have a similar experience without visiting the actual location. The library database has an impressive size – up to 100 images can trigger up to 100 different images related up to 100 videos. The videos can be played at an angle depending on the location of the user. Application works using GPS to determine location. There are two different modes of operation – the first freely triggers events as the user and their device move across the area, while the other requires them to press a play button once a marker is encountered to display the AR content. Users can export and share content on the app. Data about the most popular user activity points is collected to improve the service.
Detailed description of the good practice	The app is run by experts who have dedicated their careers to cultural heritage. The team combines technical innovation with cultural knowledge and includes leading-edge technologists, substantive specialists in art, archaeology, architecture and landscapes, and entrepreneurs experienced in public engagement at museums and historic sites. The App "Ancient theatre in Plovdiv" is owned by the developer, professor Jordan Detev, and promoted through the Institute which distributes a leaflet that also works with the app. Professor Detev is the head of the "Institute for Virtual Culture" which has worked since the release of "Ancient Theatre Plovdiv" in partnership with 10 different museums, libraries and cultural institutions to develop a network to promote augmented reality in the cultural sector. Professor Detev is a professional computer artist and artware developer. He also has a long teaching career in a number of higher education institutions around the world. Over the years, he created an interactive software program called "COMPUSER" for automatic and interactive music composing. He also created MUSIC VISION INCARNATION (MVI) - a programming environment for sound painting compositions. Both artware won many awards and worldwide recognition. COMPUSER has a gold medal from Expo 91 - A worldwide innovation exposition. Using MVI he created mixed media compositions (Double Dreams, Palm Sunday and Let

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	it be), which have travelled the world and festivals. He was a guest professor at Illinois University in Urbana Champagn, in London, Milano and other cities. When the Google Glass commercial came out in 2014, professor Detev sought contact with a company called "Ateer lab" which offers a cheaper alternative. Together they created a product called "World Heritage Maker", which he presented at international archaeology conference in Illinois University in May 2014. When Google cancelled the Glass project, professor Detev reoriented his efforts towards mobile devices. He believes they are ideal for AR technology, and cultural heritage is a huge topic, the development of which is yet to come thanks to new technologies. The app is freely available for anyone on the Google Play store.
Cultural competences and digital skills that the good practice is addressing	a. Cultural competences - Foster wider access to European Cultural Heritage - Promote growth and job creation in the CH sector b. Digital skills - Information and data literacy - Communication and collaboration - Digital content creation
Results	The project increased tourists' interest in the site and kick-started a number of other projects involving augmented reality and cultural heritage in Bulgaria. The most significant result of the project is that it managed to make the visitors return to the historic site and museum. Over 86% of the users of the app express overall satisfaction about it. The following positive results can be noted: • Increasing attention • Making learning attractive and effective • Providing motivation • Creating contextual awareness • Ensuring permanent learning • Triggering creativity • Developing imagination • Saving time and space • Providing flexibility
Impact	The project positively impacted cultural tourism not only in the area, but also on the national level. Following the release of the application, The Institute for Virtual Culture has realized over 25 augmented reality projects related to cultural heritage. The Ancient Theatre project is known all over the world; it is available in over 144 countries around the world. Regarding the long-term impact, reported advantages of AR in this setting include learning gains, higher motivation, facilitated interaction, better collaboration, lower costs, better user experiences, just-in-time information, enabling of situated learning

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	and learner-centred approaches, increase of learners' attention, enjoyment, exploration, increased capacity for innovation, creation of positive attitudes, more awareness, anticipation, and authenticity.
Challenges during implementation	Challenges imposed by AR are usability issues and frequent technical problems. Some of the difficulties can be summarized as follows: - How to maintain superimposed information, - learners pay too much attention to the virtual information, - evaluation is focused on short-term instead of long-term learning, - AR can be perceived as an intrusive technology. Light and image recognition are the most common issues which are frequently updated by the developer.
Transferability	The application can be used in both formal and non-formal contexts. AR is a promising technology that has the potential to encourage learners to explore learning materials from a totally new perspective. Besides, the advancements made in information technology further broaden the scope for educational AR applications. It can display augmentations using both a real-time capture of the location, and a paper substitute.

The Netherlands

1. De Archeo Route Limburg App and ArcheoGo-game

Headline	Experience the story of the history!
Title	De Archeo Route Limburg App and ArcheoGo-game
Timeframe	The AR technology was developed between 2017 and 2018. The scaling up the content of the app has been planned for 2019.
Brief description	The purpose of the ArcheoRoute is to make archaeological sites in Limburg (province in the south of the Netherlands) more visible and to tell the stories that lie behind these sites. Making use of ArcheoRoute Limburg app directly on a pre-selected site, one can discover the related stories of antiquity whose background is available on the website. Moreover, one will experience the story in a modern way through going back in time. This will bring users face-to-face with archaeologists, while taking them to the stories behind the findings at the selected location. These stories are also shown in English, German and Dutch. At the moment, there are 12 locations to discover.
Tags	a. Education type: - iVET education - cVET education

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	- Secondary education - HEIs - Adult education - Non-formal education b. Aim of the augmented reality technology or practice: - Teach/Learn cultural heritage and art subjects c. Accessibility and usage - Free access
Area and context of implementation	• **Country:** the Netherlands **Cities:** Eijsden (1)Apply Eijsden filter • Apply Gennep filter Gennep (2)Apply Gennep filter • Apply Haler filterHaler (1)Apply Haler filter • Apply Herkenbosch filterHerkenbosch (1)Apply Herkenbosch filter • Apply Melick filterMelick (1)Apply Melick filter • Apply Nederweert filterNederweert (1)Apply Nederweert filter • Apply Neer filterNeer (1)Apply Neer filter • Apply Reuver filterReuver (1)Apply Reuver filter • Apply Roermond filterRoermond (1)Apply Roermond filter • Apply Wanssum filterWanssum (1)Apply Wanssum filter • Apply Weert filterWeert (1) **Cities and related Cultural Heritage** Eijsden - Fort Navagne Gennep - De Franken van Gennep Gennep - Het Genneperhuys Melick - Romeins villaterrein Melick - Rur Stellung Nederweert - Het cachot Neer - Het zwaard van Neer Neeritter/Haler - De Galgenberg Reuver - Oppe Brik Roermond - Roermond vestingstad Wanssum - De danser van Wanssum Weert - Van Horne Dynastie **Limburg Marketing:** https://limburg.marketing/en **Provincie Limburg:** https://www.limburg.nl/

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	Website: https://archeoroutelimburg.nl/en The app can be downloaded for free from the Apple App and Google Play store, as follows. On the contrary, the content needs to be directly provided by the app-developer: QR code AppStore app Scan above the QR code for your I-phone QR code Google Play app Scan above the QR code for your Android smartphone
Target group **End users**	Target group/end users are not only learners, but also tourists and locals. Teachers can use this app to support their learners' imagination about the history of the local area of Limburg.
Technical **AR framework**	The app is very basic. The augmented reality is based on a technology that allows to recognize an object and to create a hologram next to it. Interaction between the end user and the app happens by changing the position of the camera to the object. The app gives the end user the option to see how the local environment was in the past.
Detailed description of the good practice	The idea is to discover the stories behind archaeological finds in Limburg. It comes from the local governments (Province Limburg and Dutch municipalities) and tourism organizations who are also the main actors. The objective of ArcheoApp is to create awareness about the cultural heritage and history in the region Limburg by using mobile devices and Augmented Reality. The tool provides a story teller who explains the situation of the location in the past. At the same time, the user (learner) can look around and see the history on the screen of the mobile device by pointing to the Archeo object. The up to now hidden story will come to life: What happened here and what do we learn about the past with this finding. Right now, these are the two main features of the app.

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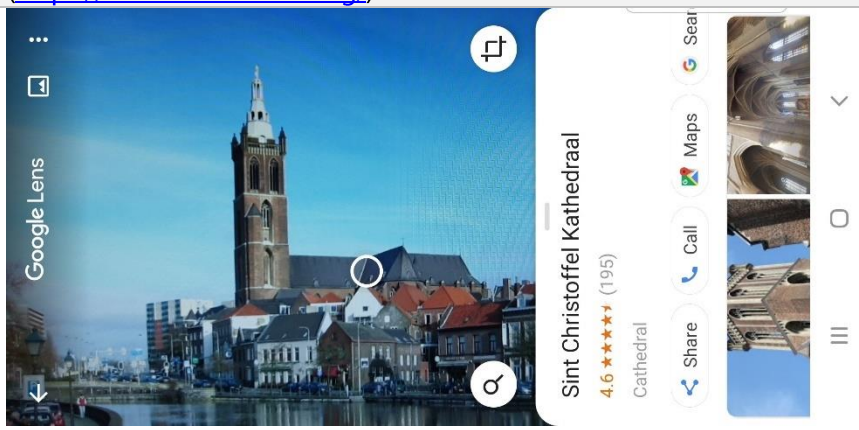
	Collaboration, making notes, and sharing options are not (yet) implemented.
Cultural competences and digital skills that the good practice is addressing	a. Cultural competences - Raise awareness and knowledge on the importance of promoting Europe's Cultural Heritage - Foster wider access to European Cultural Heritage b. Digital skills - Information and data literacy
Results	The app is very easy to use and the interaction with the end user is basic as well. At the moment, it has only a few locations.
Impact	More municipalities and educational institutions are expected to use this app in the future to unlock the history in the local area. The app can show how people lived in the past, how they built their buildings, how did they use their own land. All information about technics, living, social, science, politics etc. are available.
Challenges during implementation	The exact position of the places in which the app gives them "life" is not very easy to find. Only coordinates are given. This means one needs extra skills to find it.
Transferability	The archaeological content of the app can be transferred in iVET programmes in order to aware learners about the history of their own local environment. By now, the content of the app is directly provided by the app builder.

2. GOOGLE LENS

Headline	Search what you see!
Title	Google Lens[6]
Timeframe	The AR technology was developed in 2017.
Brief description	Google Lens allows users to identify an object by pointing the camera of the phone in the direction of the object. Google Lens uses a rich database through which objects can be recognized. By using the neural network, the Lens app will be searching in an online database for an object with description that is probably the object in real. This can also be used to recognize pictures and translate text. Finally, it is also part of Google Photos and Translate. The Google Lens is not directly related to iVET programmes, but could be useful as tool to unlock "hidden" information behind a physical object.
Tags	a. Education type: - iVET education - cVET education - Secondary education - HEIs - Adult education

[6] "©2018 Google LLC, used with permission. Google and the Google logo are registered trademarks of Google LLC."

	- Non-formal education b. Aim of the augmented reality technology or practice: - Teach/Learn cultural heritage and art subjects - Assess new competences and digital skills c. Accessibility and usage - Free access.
Area and context of implementation	Everything that is available and published on the Internet is usable. This means that the area is open, not limited. Google Lens uses a neural network of data which is growing everyday by adding data in to the Internet. **Institution/Organization:** Google **Website:** http://lens.google.com Google Lens can be downloaded for free from the open source TensorFlow machine learning framework. (https://www.tensorflow.org/).
Target group End users	 Everyone who wants to know additional information about objects around him, can use Google Lens. Not only cultural heritage objects can be scanned, but almost everything. Above a screenshot of the App is displayed showing how to recognize the Cathedral of Roermond (NL) by taking a picture.
Technical AR framework	The app recognizes objects pointing a camera. During its deployment, the user can not make annotations.
Detailed description of the good practice	The idea is to make a guided augmented tour around the city. Pupils grouped together can take pictures of any Cultural Heritage object and gain additional information on it by using Google Lens. Moreover, they can find more information about the object by searching on the internet once they are back at school. The focus of the guided tour is to discover how things were made, at what time, by whom and with what purpose.
Cultural competences and digital skills that	a. Cultural competences - Raise awareness and knowledge on the importance of

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the good practice is addressing	promoting Europe's Cultural Heritage - Foster wider access to European Cultural Heritage b. Digital skills - Information and data literacy - Communication and collaboration.
Results	The app is just an app to "augment" objects. However, the user also needs some literacy skills to find out more information.
Impact	The app by itself has no big impact, but the technique of linking data is very powerful.
Challenges during implementation	The implementation of the app is very easy. But one needs additional tools to make it useful in the education sector. Google Lens helps the user to find information about an object. This can also be a cultural heritage object. What you want to know, is not relevant for Google Lens. Google Lens displays general information about the object. The links behind the information can give you more details. Google Lens should use in the wonder moment phase of the learning process. It's a part of a set of apps you can use, like Google Photos, Google Translate.
Transferability	The technology is not only useful for objects, but also for recognizing text. Words in different languages can be translated in real time by the app. There is no limitation of using the tool outside the Netherlands. The tool is international and can be translated in different languages. It's up to the teacher to design a case how to use this app. The app could be part of collecting information, or unlock hidden information. Learners and teachers have to learn to select the information which they need. Skills like Media literacy are necessary.

Greece

1. "MOBILE AUGMENTED REALITY APP"[7]

Headline	Restoring the historic paths of Chania!
Title	Placeholder Title MAR (mobile augmented reality) It is under development by the Technical University of Crete.
Timeframe	This information is not available.
Brief description	A complete mobile tourist guide for cultural heritage sites located in the old town of Chania, Crete. The focus of the AR feature is to superimpose 3d models of historical buildings in their past state onto the real world, while users explore the Venetian part of Chania's city, searching historical information in the form of texts and images.
Tags	a. Education type: - Non-formal education

[7] The case study does not have an official title yet since the app is still under development.

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	b. Aim of the augmented reality technology or practice: - Teach/Learn cultural heritage and art subjects c. Accessibility and usage - It is not yet defined.
Area and context of implementation	**Country:** Greece **City:** Chania **Institution/Organization:** Technical university of Crete **Website:** Not created yet The app is not available yet. It is supposed to be available in android app store, according to the creators.
Target group End users	Since the aim of this work is to virtually restore partially or fully damaged buildings and structures on historic sites and help visitors interact with some of Chania's monuments and document their visits, people of all ages can benefit from the implementation, from learners and teachers to kids and parents. The goal, according to the creators, is to provide a complete operational AR experience to the end user by tackling significant AR technical challenges related to the accurate registration and positioning of the 3D content integrated into the mobile application. Researchers, universities, museums, experts in the field of AR and Europe's cultural heritage are also relevant beneficiaries.
Technical AR framework	The application presented features a database that holds records of historical monuments on-site. The database stores users' documentation of their visit and interactions in the areas of interest, available to each user that signs in. The system features geo-location and sensor approach, which compared with optical tracking techniques, allows for free user movement throughout the site, independent of changes in the buildings' structure. Furthermore, they combined this implementation with a hybrid registration technique (sensor-based and vision-based), in order to showcase the capabilities of future AR technologies. In order to accurately record the geo-location of the monument and provide real-time tracking, the standard sensors of a mobile phone are used. No markers or patches are placed on the monument and the implementation of the software does not require any physical contact with the monument.
Detailed description of the good practice	There is no single best solution to AR tracking and registration. Vision-based approaches are best suited for controlled and small environments, but their performance decreases in wide and outdoor areas, where the sensor-based approaches provide the best results. The future seems to lie in within hybrid implementations, which are currently in their initial state, and most often require additional hardware components. The geo-location approach and the instant tracking option of the Wikitude Javascript API was selected. Although a case can be made for the registration difficulties of the geo-location approach due to sensor filtering and low GPS accuracy, these implementations require fewer actions by the users and ensure that the AR experience will be delivered independent of external conditions.

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	On the contrary, the instant tracking option provides greater registration accuracy and eliminates the inactive period, but it is susceptible to occlusions (real world objects can interfere with the virtual objects) and requires additional actions by users. The decision to include both implementations was taken in order to provide users who are unaccustomed with AR applications and intuitive way of visualizing the 3D models based on geo-location, while also being able to provide a more sophisticated AR experience with instant tracking. The Wikitude Javascript API was selected because of its robust tracking, educational licensing option, documentation, large community and efficient customer service. The main screen of the proposed application is the map indicating the location of the user, the available POIs, as well as the main navigation buttons. The aim of the map is to help the user navigate the city. This navigation can also be accomplished via the camera view where the POIs are displayed in 3D space on the camera's surface. In its initial state, the user is shown the available monuments that can be augmented by 3D models as markers on the map. Upon visiting the monuments, the user has access to the 3D reconstructions through the AR camera. The initial monuments act as an introduction to the application's main features. After users visit a specific monument, they are awarded points whilst the interest areas of the system pop out as question marks on the map. The user is urged to visit all the interest areas and unlock them to earn more points. In order to unlock an interest area, the user has to correctly classify it according to its perspective historical period. Information concerning historical periods relevant to specific monuments can be acquired from the application. When a user correctly unlocks a monument, access to its historical information is available. The aim of this approach is to urge the user to closely observe the monuments, consult the information already unlocked, or even interact with the locals to get as much information as possible. The user is transformed into an active participant of the sightseeing experience instead of a passive spectator.
Cultural competences and digital skills that the good practice is addressing	a. Cultural competences - Raise awareness and knowledge on the importance of promoting Europe's Cultural Heritage - Promote culture as a catalyst of creativity and growth through art education - Foster wider access to European Cultural Heritage b. Digital skills - Information and data literacy - Communication and collaboration
Results	The MAR application for mobile phones is designed with the goal of increasing the synergy between visitors and cultural heritage sites. In addition to exploring standard web and application content, the platform offers a novel approach for visualizing

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	historical information on-site. By applying 3D models of the historical monuments through AR, user experience is enhanced, connecting the digital content and the real-world environment. Moreover, gamification features offered such as user-related rankings and leader boards can further motivate the users as they allow new means of interacting with cultural heritage information. Finally, the MAR application can easily encompass additional historical sites requiring little preparation and enable future experts to display their digitized collections using varied forms of data presentation.
Impact	The representation of monuments in their past state with the use of superimposed 3D models and gamified elements of the learning procedure can increase users' interest in heritage sites and enhance motivation to learn in a more fun way and engage with culture. Upon completion it is clearly deduced that the application will greatly benefit the visitors at the city of Chania and the city's populace. Although it is developed as a non-formal education tool, it can be helpful to all stages of education, but especially for teachers and learners of relative university departments such as architecture, art, archeology. Creators have put forward an expandable platform that can easily include additional historical sites and as result be useful to the academic sector, as experts, researchers and museums can create and add more digital representations of monuments. In its present version, the application does not support social interactions between users, apart from the posted overall rankings. In the long term, developing further the platform to include comments, shares, likes and even more actions by including a communication layer would lead to even wider expansion of interested audience. Gamification around heritage sites and applications in general is gaining a growing value, as it allows for new ways of interacting with the monuments and their relative information. Adding treasure hunts and storytelling could improve visitor involvement and create a more immersive experience associated with cultural heritance.
Challenges during implementation	One of the main challenges of Mobile AR (MAR) is the lack of established guidelines in the application and integration of AR technologies in outdoor heritage sites. The overall design of the system consists of two main parts, the mobile client and the server. The server facilitates a database developed in MySQL, which holds the monument records (name, description, latitude, longitude, etc. and user specific information). Circles centered on latitude and longitude points make calculations easier in defining and differentiating the areas of interest than with polygon geometry. The information is delivered to the mobile unit on location request basis. The database is exposed to the users via a REST web service. A basic registration to the system is required. The functions available to the users consist of storing data about visits, marked places and the overall progress in an area, whereas all the monument information is delivered to the mobile device's views. A well-known issue during technical evaluation concerning the instant tracking method is the inconsistency between their

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	calculation of the device's orientation and the respective orientation calculated by the API. This measurement has been observed to vary by up to five degrees when the geo-magnetic sensor reports low accuracy values. This error is minimized by recalibrating the sensor while moving the device in an 'eight' figure motion. The user is informed when the sensor accuracy is low. Another issue during the user evaluation, this time round, is the rapid battery consumption when AR camera is used in conjunction with the constant usage of the GPS for extended periods of time. Addressing such issues, the AR camera view was defined as a standalone activity instead of a replacement to the map in the main activity.
Transferability	As it is already mentioned the MAR tourist guide is developed by the Technological University of Crete to satisfy a certain need, the presentation of cultural heritage sites located in the old town of Chania, Crete, applying AR visualization features combined with gamified elements to increase the engagement of town visitors and allow new means of interacting with cultural heritage information. This application operates as a non-formal type of education but according to its creators can also serve other purposes. For example, it will enable future experts to display their collections of digital 3D models of other cultural heritage sites.

2. CHESS APPLICATION IN ACROPOLIS MUSEUM

Headline	A personal tour guide on your phone
Title	The CHESS application in Acropolis Museum.
Timeframe	Approximately 2 years to develop both the scientific background and the application.
Brief description	Having an AR application as one of its outputs, CHESS (Cultural Heritage Experiences through Socio-personal interactions and Storytelling) was a project, co-funded by the European Commission, aiming to integrate interdisciplinary research in personalization and adaptivity, digital storytelling, interaction methodologies, and narrative-oriented mobile and mixed reality technologies, with a sound theoretical basis in museological, cognitive, and learning sciences. The main objective of CHESS is to research, implement and evaluate both the experiencing of personalized interactive stories for visitors of cultural sites and their authoring by the cultural content experts. The application exploits the use of personalized interactive storytelling experiences related to the exhibits of the museum and accessible through mobile devices. The storytelling content is personalized, providing several filters (different themes, information depth, language style, visiting style, activities). The AR application comprises various multimedia features (audio narration, images, 3D reconstructions, video games) that are tailored according to each visitor's profile.

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	The AR activities are displayed in different versions, which are injected into the storytelling content based on the users' profiles.
Tags	a. Education type: - Non-formal education b. Aim of the augmented reality technology or practice: - Teach cultural heritage through personalized learning c. Accessibility and usage - Free access – An authorization account is required - Downloadable app in mobiles and tablets through the project website (an account is required)
Area and context of implementation	**Country:** Greece **City:** Athens Institution/Organization: Museum of Acropolis **Website:** http://www.chessexperience.eu/ **Museum's site:** https://www.theacropolismuseum.gr/ It is installed in portable devices used in the museum program.
Target group End users	- Teachers working on cultural-related subjects - Cultural Heritage Researchers and organizations - Visitors of the museum are mainly tourists (children, young individuals, adults) or school groups (teachers, learners 6-17 years old) - Industrial organizations - Museum curators The above groups will be the end users of the AR application.
Technical AR framework	The technical setup is based on a server-client architecture supported by wireless networks, where smartphones act as clients being in constant communication with the back-end that uses a Storytelling Engine to provide the story-related activities according to visitors' profiles. For some of the AR activities, 3D assets and core data (mostly feature maps) are used in order to monitor loading times. Once the users start their experience, the delivered story plot triggers related activities with the help of an activity management component. For mobile devices, the development team used instant AR, which is a single AR application. For iOS, the technical framework includes a web-based browser component, an X3D render engine, a tracking engine and a video preview feature. The AR activities as well as the user interface are using an HTML5 engine, CSS and JavaScript. Finally, all the elements of the application are responsive in order to be displayed properly on different screen sizes and devices. In order to ensure a user-friendly interface, the AR activities are supported by 3D-feature maps and 2D reference-contours based on Simultaneous Localization and Mapping (SLAM). Once the maps are acquired, they are matched with a 3D model of the physical object.
Detailed description of the good practice	CHESS project promotes the design of handheld AR experiences incorporated into interactive museum narratives. Those experiences start by defining a visitor's profile that later adapts the

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	AR activities based on the user's behavior. In this narrative context, those activities provide four ways of having a digital look at the exhibits: - Virtual reconstruction of the original exhibit - Placement in the original location - Visual highlighting of details and annotations - Recreation of mythological beings The CHESS application explores the use of personalized interactive storytelling experiences related to the exhibits of the museum and delivered through mobile devices and tablets. To this end, several stories have been designed, where AR has been integrated. The first story is related to a horse acting as the main narrator and pointing out the importance of ancient Greek civilization from different aspects (war, sports, mythology, daily life). The personalization of this story lies in the creation of two different personas: one plot for a child that has to help the friends of the horse get back to their time while listening about mythological creatures; and the second one for an adult that gets a glimpse of the ancient Greek society. The first example plot is linked to the mythological creature called Medusa, that turned mortals into stone at their gaze. The AR activity provides a different version of the two profiles and it is integrated in the plot as part of a transmedia environment. In one profile, the narrator will interrupt the path warning the visitor about Medusa standing behind him. The user is guided to use the device as protection and this way, he will see Medusa's eyes glowing until the screen 'cracks' by her power. In the other profile, the exhibit is reconstructed with 2D sketches and placed in its initial position on top of a big temple located where the Parthenon is today. The second example is linked to a Kore statue. In this case, the AR activity serves as a mediation channel. Narration integrated into AR connects the activity with interactions as a medium to control information delivery through motions. With such techniques, when users raise their device, they are able to see the statue with bright colors. Annotations and audio narrations are also embedded and start playing according to the visitor's movements. Content and language styles also change for the two different personas.
Cultural competences and digital skills that the good practice is addressing	a. Cultural competences - Promote cultural heritage as part of personalized learning paths based on tailored scenarios b. Digital skills - Mediation level
Results	CHESS project aims to enhance the personalized attribute of the experiences that every visitor of the Acropolis museum gains. Towards that purpose, CHESS application is custom-developed to create tailored experience based on the user's preferences,

	hobbies, interests and general background. By guiding the visitor to the artefacts of his/her interest and offering appealing content which includes interactive objects such as quizzes or games that enhance user experience. This approach was designed, implemented and tested in one of the most popular cultural settings of the Acropolis Museum of Athens (Greece), which is the Archaic Gallery. The Gallery displays archaeological exhibits in thematic and chronological clusters found on the Acropolis hill together with discreet mediators. However, considering that AR cannot be seen as a stand-alone application replacing the entire landscape of existing mediators, a coherent framework founded upon personalized interactive non-linear storytelling is integrated. Within this context, based on a web-app approach, the project uses inherent values to add an emotional character with a digital touch to cultural heritage. The outcome is an AR authoring tool that develops multi-path dynamic storylines supported by advanced multimedia content.
Impact	The main advantage that mobile technologies offer to museums is that they provide them the opportunity to connect in real time information appeared in a digital way to a physical object and thus broaden the margins of information spaces related to this object. However, different approaches have proven that these extensions may break the flow of an exhibition discourse, while it might be confusing for visitors to concentrate their attention in both physical exhibits and information displayed in their mobiles. AR technologies appear to be the most suitable solution to combine digital environments with reality, since they visually superimpose information directly over the exhibit and thus the user only pays attention on the screen. Moreover, AR does not rely only on an object-oriented approach, but is integrated into interactive storytelling content that includes various activities based on a user's background. This implies that AR activities are depicted as story units of a general plot. After the launch of CHESS application, the Vice President of the European Commission stated that: "*Europe has the world's best cultural heritage. New digital tools aren't just about sharing that heritage, but about opening up our culture for all. To remain relevant, museums need to be a digital breeding ground for innovation and the app economy*". (Neelie Kroes, 2016)
Challenges during implementation	From a technical point of view, the web-app facilitates the integration of storytelling in augmented reality in both cases that AR is part of the story plot or AR becoming the channel that supports narration. Nevertheless, incorporating AR into different profiles appeared to be time consuming since multimedia content and assets needed to be produced. To this end, the development team is working on the provision of unified templates, where the activity concept and the graphical assets are predefined. Regarding user experience, it seems that visitors are keen on learning information that are more related to exhibits. The challenge for the AR tool is to have a balance between descriptive annotations and the main storytelling feature. The solution that

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	CHESS offers is leveraging personalization, obtaining more in-depth information or keeping it for later through stop/pause buttons. Finally, the AR technologies used for the application require visitors to move around the exhibits in specific distances, which may disrupt others' contemplation of the object, especially on crowded days. The challenge here is the co-existence of different visiting behaviors around objects. Towards facing this challenge, the tracking system's working distance needs to be increased, providing more flexibility regarding the environmental conditions.
Transferability	The application is targeting both learners and teachers due to its educational character and its personalized learning paths that consider any visitors background. On their effort to integrate such technologies into non-formal education, the project team is currently working on the wider framework and benefits of the storytelling experience, aiming at evaluating the added value of AR storytelling in museum and galleries visits, exploiting its usability in other environments that aim in enhancing their educational aspect and promoting new learning techniques.

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4. MAPPING OF KEY INSTITUTIONS

One of the project objectives was to identify institutions, which are actively engaged in preserving and promoting CH to demonstrate the catalytic power of multiplayer collaboration among iVET institutions, teachers and school staff across Europe.

To this end, CultApp partners conducted a detailed desk research and identified the most relevant key players (about 10 per country) that could have a significant impact on the promotion and valorisation of the cultural and historical area of the 6 participating countries (DE, IT, NL, PL, BG, EL). Related challenges, impact and benefits encountered have been also specified.

The profile of the institutions identified is rather heterogeneous. This is mainly due to the different professional expertise and the field of activity of partners involved (e.g. educational, academic, industry and ICT sectors).

Germany

1. *Kulturstiftung der Länder (the Cultural Foundation of the German Federal States)*
   https://www.kulturstiftung.de/

Profile: The foundation has dedicated itself to many tasks related to the promotion, maintenance, preservation, and presentation of Germany's cultural heritage and the acquisition of important artworks and other cultural assets.

Challenges: losses of cultural assets; preservation of significant cultural assets in Germany and making them accessible to the public in museums, libraries and archives in the future; promotion of the cultural education in schools.

Benefits: access to the German cultural heritage.

Impact: raising awareness of aesthetic education among youth and adults; raising awareness of the German cultural heritage diversity at regional, national, and international level.

2. *Lippe Tourism & Marketing GmbH*
   https://www.land-des-hermann.de/natur-aktiv/ueber-uns/

Profile: Lippe Tourism & Marketing GmbH is the service agency in the region East Westphalia-Lippe that is specialized in promoting regional touristic attractions.

Challenges: creating innovative approaches to increase the visibility and attractiveness of the region East Westphalia-Lippe.

Benefits: promotion of employability within the regional tourism branch.

Impact: boosting competitiveness of the tourist destinations of the region.

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3. *Allianz Kulturstiftung (Allianz Cultural Foundation)*
https://kulturstiftung.allianz.de/de_DE.htm/

Profile: The non-profit Allianz Cultural Foundation initiates and promotes multilateral arts, cultural and educational projects in Europe and the Mediterranean. The focus is on transdisciplinary and contemporary projects that implement innovative approaches to art, culture and education.
One focus is on exchange, meeting and digital programs that inspire and connect young people across Europe.

Challenges: fostering culture and arts within the crisis areas.

Benefits: contribution to mutual understanding and cross-border dialogue.

Impact: promotion of the European integration through cultural projects; raising awareness of young people for Europe's cultural diversity.

4. *Förderverein Welterbe Schwerin (Promotion Association World Heritage Schwerin)*
https://www.welterbe-schwerin.de/

Profile: The Association World Heritage Schwerin promotes awareness and enthusiasm among the citizens of Schwerin and beyond for their residency ensemble and its recognition as UNESCO WORLD HERITAGE.

Challenges: Commitment, creativity, and innovative ideas for citizens and other relevant actors towards designing a competitive UNESCO proposal.

Benefits and impact: promotion and preservation of the cultural heritage of the city of Schwerin, increasing the visibility of the destination of Schwerin inside and outside the region and country; involvement of citizens into the promotion of Schwerin's cultural tourism.

5. *Kulturstiftung des Bundes (The German Federal Cultural Foundation)*
https://www.kulturstiftung-des-bundes.de/en

Profile: The German Federal Cultural Foundation promotes art and culture within the scope of federal competence. One of its main priorities is to support innovative programmes and projects at international level. The Foundation also promotes projects that develop new methods of fostering cultural heritage.

Challenges: promoting cultural exchange and cross-border cooperation.

Benefits: fostering cultural and artistic potential of knowledge to address social issues.

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Impact: support of all areas of art and cultural activities (upon application) without any barriers in terms of topic or subject.

6. *Kultur & Arbeit e.V. (Culture & work e. V.)*
   http://kultur-und-arbeit.de/english

Profile: Culture and work e.v. is an association that promotes culture through professional development and qualification of cultural workers for the labour market.

The Association acts as a coordinator of no-profit cultural projects, offers the preparation of studies and research papers for cultural industry and cultural tourism, and provides public relations services on the topics of cultural labour market, cultural economy, and regional development.

Challenges: mastering interdisciplinary tasks, for example, at the interface of the energy sector and the preservation of cultural heritage, of culture tourism and new information technologies, or of education and culture.

Benefits for the society: boosting creativity and innovation skills of cultural workers, facilitating easier access to the culture industry, promotion of employability, establishment of networks in the cultural sector.

Impact: fostering city and regional development and culture tourism (especially in rural areas), preservation of the Europe's cultural heritage.

7. *Zentrum für Kunst und Medien ZKM (Center for Art and Media Technology Karlsruhe)*
   https://zkm.de/en

Profile: The ZKM is a unique cultural institution worldwide that expands the original tasks of the museum. It is understood as house of all media and genres, of both spatial arts such as painting, photography and sculpture and time-based arts such as film, video, media art, music, dance, theatre and performance.

Challenges: to bring into question established concepts and to develop new ones; to bring alive persons, artefacts and findings that were ignored in the past; to understand the functioning of the digital world and of disruptive technologies.

Benefits: people from all over the world are enabled to profit from the scientific research findings and cultural education. In this manner, the ZKM bridges the gap between the specific expert knowledge and wider audience.

Impact: increasing the visibility of knowledge and culture; bringing together Art, Science, Literature, Performing Arts, Politics, Economics; fostering social development at large.

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8. *Kulturerbe-digital.de*
   https://kulturerbe-digital.de/

Profile: Kulturerbe-digital.de is a portal of the EUBAM Working Group (Federal Working Group on European Affairs for Libraries, Archives, Museums and Historic Preservation) aiming at informing about the digitization of the cultural heritage in Germany.

Challenge: building up international cooperation in digitizing cultural heritage and corresponding projects.

Benefits/impact: increasing visibility of and access to current and finished digitization projects in the field of cultural heritage, fostering networking of cultural actors; opportunity to share cultural projects via the portal.

9. *Akademie der kulturellen Bildung des Bundes und des Landes NRW (Academy of Arts Education of the German Government and State of North Rhine-Westphalia*
   https://en.kulturellebildung.de/

Profile: The Academy is the only institution in Germany that provides multifaceted further and continuing education services to teachers all around aesthetical education, such as music, rhythm, dance, theatre, play, literature, fine arts, media, general arts education and social psychology and consulting.

Challenges: appreciating diversity, inclusion, sustainability of educational offerings.

Benefits: holistic approach to the aesthetical education of children and youth through combining cultural education and innovative pedagogical concepts with focus on personal development.

Impact: contribution to the extracurricular arts education landscape; promotion of new and innovative job profiles and qualifications within the cultural sector.

10. *Deutsche Stiftung Denkmalschutz (German Foundation for Monument protection)*
    https://www.denkmalschutz.de

Profile: The German Foundation for Monument Protection is a private non-commercial institution engaged in preserving this unique cultural asset and promoting public awareness of monuments of all kinds across Germany.

Challenges: to support civic heritage engagement, to raise awareness of the historical value of monuments, and to provide balanced support in all regions of Germany.

Impact/benefits: promoting creative power and regional diversity in Germany; connecting people across borders; retaining the cultural identity of villages, towns and cultural landscapes.

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11. *Europäische Bewegung Deutschland (Europe's movement Germany)*

https://www.netzwerk-ebd.de/

Profile: The main objective of the Movement is to promote European integration in Germany as well as cross-border cooperation between citizens and European civil society. This has to be accomplished, among others, through fostering Europe's cultural heritage and education.

Challenges: identifying suitable ways and channels for inspiring youth for common Europe; chances and threats of the digital era.

Impact/benefits: fostering creativity, digital skills, and civic commitment of youth; contribution to the common European spirit through the idea of common Europe's cultural heritage.

Italy

1. *University of Florence - Department of Architecture (DIDA) - Cultural Heritage Management Lab*

https://www.dida.unifi.it/changelang-eng.html

Profile: The Laboratory operates for the enhancement and management of cultural heritage through:

- the collection of the documentation of architectural and landscape heritage;
- the development and implementation of integrated projects for the enhancement and management of the city and the landscape;
- the management of architectural and landscape assets maintenance plans.

Challenges, impact and benefits encountered: The Laboratory is a department of Florence University involved in basic research. The main challenges are to transform basic research into to technical research and to implement a new augmented reality application.

The institution conducts research, on its own and on behalf of third parties, on the issues of documentation, enhancement and management of cultural heritage.

The laboratory operates to:

- develop research programs on the subjects of cultural heritage documentation;
- identify the most suitable design solutions for safeguarding and protecting the cultural heritage;
- promote cultural heritage.

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2. *Region Toscana – General Directorate for Training Policies and Cultural Heritage*
http://www301.regione.toscana.it/bancadati/uffici/Strutture.xml?cmu=50124

Profile: On behalf of the Ministry of Cultural Heritage, this Institution takes care of the planning, coordination and promotion of national tourism policies. It maintains national and local relations with Regions, the community and Trade Associations and international relations in the field of tourism. In addition, it develops projects in the field.

The main activities carried out by the General Directorate for Training Policies and Cultural Heritage are:

- Promoting the Cultural heritage as a factor in the sustainable development of tourism (how to enhance the use of cultural heritage through the construction of an integrated and organized network of partners);
- Enhancing the Sustainability of destinations (relationship between cities of art and tourist flows);
- Valorising the Regional Territory (tourism development towards the hidden and still unknown heritage);
- Investing on the New Travel Economy (new, sustainable way of experiencing tourism);
- Increasing Smart Innovation - the new professions (relationship between tourism and digital innovation).

Impact and benefits: For the local government, it is of high relevance to be partner and also enabler for the diffusion of CH knowledge among the community. With this aim it should:

- put in place a coherent cross-departmental approach within the Region administration;
- facilitate partnership with other local actors, including schools, museums and the business sector (craftsmanship, SMEs, ICT companies, etc.);
- coordinate local cultural institutions and tourism offices with museums in order to offer an integrated cultural supply attractive to citizens and visitors;
- supporting local museums with public funds;
- facilitate legal and long-term funding eligibility;
- remove constraints and tackle management issues that may prevent the involvement of museums in enhancing CH promotion.

3. *Tuscan Regional School Office - Department of Digital Innovation*
http://www.toscana.istruzione.it/aree_tematiche/scuola_digitale.shtml?active=2&page=277

Profile: The Regional School Office of Tuscany is a local department of the central Ministry of Education, University and Research. It is focused on:

- compliance with general rules on education and essential levels of performance;
- monitoring the implementation of school regulations;
- monitoring the effectiveness of the training action and the compliance with the programmed standards;

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- providing administrative, accounting and management support to the school administration at regional level;
- taking care of the integrated training offer, adult education, higher technical education and training and work-based learning;
- assigning financial and human resources to educational institutions;
- evaluating the degree of implementation of the plan for the training offer.

It is articulated with several offices with different roles. One among these offices is responsible for implementing the European policy on digital innovation.
The Tuscan Regional School Office – Department of Digital Innovation, is making a huge investment in order to speed up the use of ICT in lower and upper schools' classrooms and to foster digital innovation in schools' organization and teaching.

Challenges: The main challenge for the Regional School Office - as for many other policy makers involved in teachers' training - is the improvement of teachers' skills (related to digital capabilities and pedagogical and social issues). There are some barriers to the implementation of this training process such as the lack of a modern technological infrastructure in the Italian Schools, along with the resistance to change among 'veteran' teachers, which slows the implementation of the actual educational reform.

4. *Fiesole Museums*
   https://www.museidifiesole.it/en/

Profile: The Fiesole Museums include the Archaeological Civic Museum and the Archaeological Area. The Fiesole Museums constitute an integrated management system that incorporates other museum's structures, even if not owned by the Municipality. They represent a cultural institution, at the service of the community, open to the participation of all citizens, whose purpose is the conservation and enhancement of historical-archaeological assets, with particular regard to the City of Fiesole and its territory.

Beside the main activity of preserving and exhibiting art works, the museum is also involved in the field of Educational Services. Special attention is paid to direct educational provision to schools of all levels. The aim is to approach young people to archaeology, history, art and the cultural and landscape richness of Fiesole, through traditional visits, educational workshops, thematic itineraries and educational games.

Challenges, impact and benefits encountered: The most important challenge for each museum or foundation (they are also described below) is the lack of ICT expertise within Museums organizations, along with insufficient financial resources. This makes more difficult the accessibility to CH for citizens. A possible solution to overcome this barrier might be the development of a network of collaborations amongst Museums at different levels – foundations, private/public bodies. Moreover, a partnership with ICT companies might help to facilitate the accessibility to CH – through digitisation – for the local community and at global level.

5. *National Museum of Bargello*
   http://www.bargellomusei.beniculturali.it/

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Profile: Dedicated to Medieval and Renaissance art, the 'Museo Nazionale del Bargello' is located in Florence's historic Palazzo del Podestà. It was established by royal decree on June 22, 1865 as the Italy's first national museum. With the recent reforms of the Ministero dei Beni e delle Attività Culturali e del Turismo, started in 2014, the Bargello Museum became an autonomous entity, as well as the leading institution of a consortium that includes four other Florentine museums: the Medici Chapels, Palazzo Davanzati, Orsanmichele, and Casa Martelli.

6. *Frederick Stibbert Museum*
   http://www.museostibbert.it/

Profile: The museum was funded by Frederick Stibbert (1838-1906). He started to collect immediately upon his coming of age and ended up transforming his house in a real museum that he declared: "has cost me a great deal of money and much care and effort". When Frederick died, he left the museum to the Municipality of Florence. Today the museum is a Foundation.

Impact and benefits: Its mission is to improve the knowledge of history for benefitting future generations.

7. *Casa Museo Rodolfo Siviero Foundation*
   http://www.museocasasiviero.it/ww4_siviero/casasiviero.page?country=ENG

Profile: The museum is located at the ground floor of the fine Neo-Renaissance building on the banks of the river Arno, where Rodolfo Siviero lived from 1944 until his death in 1983. The house and furnishings were left to the Tuscany Region by Rodolfo Siviero in 1983. It exhibits the private collection of the so-called 'James Bond of the world art', renown for his work in recovering a great number of masterpieces stolen from Italy during the Second World War.

Challenges, impact and benefits encountered: Among its main activities, the Foundation Casa Museo Rodolfo Siviero has the promotion of the artistic and cultural heritage included in the collection gathered by its founder. To this end, the Foundation periodically organizes events, art exhibitions, conferences, involving citizens and tourists. It has also recently started an intense educational activity for families and schools in the Florentine area, with educational and gamified workshops. The Foundation is open to the use of new technologies in order to enrich the visitor experience, but also in the process of enhancing edutainment activities.

8. *Marino Marini Foundation*
   http://www.fondazionemarinomarini.it/eng/

Profile: The foundation was established on July 11th 1988 by the City of Florence and the Marino Marini Foundation of Pistoia. The Foundation's man aim is to manage and maintain the value of the Museo Marino Marini, and promoting cultural events and

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expositions dedicated to artists and themes from the twentieth century to the contemporary work of the present day.

Challenges, impact and benefits encountered: Along with its main function of preserving, promoting and enhancing its art works collection and in general contemporary arts, it is investing in an intensive program of conferences and public presentations with the purpose of attracting a larger audience. The educational path has been strengthened as well, with the implementation of educational activities not only for schools, but also for adults and families.

9. *Municipality of Florence – UNESCO Office*
http://www.firenzepatrimoniomondiale.it/en/

Profile: The UNESCO Office was created in order to meet the primary need of creating an official document, the Management Plan, to protect and enhance the UNESCO World Heritage site "Historic Centre of Florence" and to fulfil the provisions of the UNESCO Convention 1972 concerning the protection of the World Cultural and Natural Heritage.

Challenges, impact and benefits encountered:

- Promoting the preservation, valorisation, and sustainable management of the Historic Centre of Florence;
- Organizing cultural initiatives and the celebration of centennials related to the historical identity of the City of Florence;
- Promoting, implementing and coordinating studies and research about the history and the conservation of the city, the territory, and its monumental heritage;
- Strengthening, through specific projects, the transnational cooperation and collaborations between UNESCO World Heritage properties and Florence's twin cities.

10. *Polo Museale della Toscana*
http://www.polomusealetoscana.beniculturali.it/

Profile: Established in March 2015 (DPCM 171/2014), the Polo Museale della Toscana is in charge of managing, protecting and boosting 49 state-owned Tuscan museums and other cultural places, some of which are included within the UNESCO World Heritage List.

Challenges, impact and benefits encountered: It carries out activities with the aim of enhancing the Tuscan cultural assets. It also carries out activities of Lifelong Education and awareness about Cultural Heritage.

Poland

1. *The International Cultural Centre in Krakow*
http://mck.krakow.pl/en

Profile: The International Cultural Centre in Krakow is a national institution of culture.

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Challenges, impact and benefits encountered: The Centre is specialized in the issues of culture and heritage of Central Europe. It offers classes on cultural heritage for school groups.

2. *The National Heritage Board of Poland*
   https://www.nid.pl/en/

Profile: The National Heritage Board of Poland is a state agency.

Challenges, impact and benefits encountered: The Agency gathers and disseminates information on heritage, sets standards for its protection and conservation and raises social awareness of cultural heritage of Poland in order to save it for future generations.

3. *National Centre for Culture Poland (NCC)*
   https://nck.pl/en

Profile: The National Centre for Culture is a cultural institution.

Challenges, impact and benefits encountered: The Centre is focused on raising the qualifications and skills of managers, animators and other professionals working in cultural sector and, at the same time, maintaining and promoting national and state traditions along with Polish cultural heritage and fostering cultural education.

4. *The National Institute for Museums and Public Collections*
   https://www.nimoz.pl/en

Profile: The Institute is a state agency responsible for national policy for museums.

Challenges, impact and benefits encountered: It assists museums in their promotion and development.

5. *Adam Mickiewicz Institute*
   https://iam.pl/en

Profile: The Adam Mickiewicz Institute is a national cultural institute.

Challenges, impact and benefits encountered: Its mission is to build and communicate the cultural dimension of the Poland brand through active participation in the international cultural exchange.

6. *Association of Creative Initiatives "ę"*
   http://e.org.pl/about-us/?lang=en

Profile: Association of Creative Initiatives "ę" carries out social projects all around Poland.

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Challenges, impact and benefits encountered: The Association implements projects on cultural heritage. Its key method of youth involvement is based on education and activation achieved through art.

7. *Workshops of Culture*
   https://en.warsztatykultury.pl/

Profile: Workshops of Culture focus on promoting the practice of "active culture".

Challenges, impact and benefits encountered: Workshops consist of artists and institutions from Poland and abroad. They concern the field of cultural education, management, and animation, as well as everyday application of modern technologies in cultural education and in the promotion of cultural heritage. The Workshops organize four largest festivals in Lublin: Night of Culture, East of Culture – Different Sounds, Carnaval Sztukmistrzów and the Jagiellonian Fair.

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8. *The "Grodzka Gate – NN Theatre" Centre*
http://teatrnn.pl/en/

Profile: The "Grodzka Gate – NN Theatre" Centre is a local government cultural institution based in Lublin.

Challenges, impact and benefits encountered: Within the scope of its activities, the Centre draws on the symbolic and historical significance of its residence, the Grodzka Gate, also known as the Jewish Gate. The Gate used to be a passage from the Christian to the Jewish part of the city, a meeting place of various cultures, traditions and religions. The Centre also offers classes on cultural heritage for school groups.

9. *The Lublin Museum*
https://www.muzeumlubelskie.pl

Profile: Established in 1906, the Lublin Museum presently boasts one of Poland's richest multi-faceted collections. The Museum's main location inside the Royal Castle collects and displays archaeological, ethnographical, military, numismatic and art exhibits.

Challenges, impact and benefits encountered: The museum offer classes on cultural heritage for school groups.

10. *The Open-Air Village Museum in Lublin*
https://skansen.lublin.pl/en/

Profile: The Open-Air Village Museum in Lublin is a public institution specialized in creating, preserving and sharing both material and intangible cultural heritage and social background.

Challenges, impact and benefits encountered: The Museum recreates historical forms of settlements, habitations, buildings of public services of villages and small towns with their interiors as well as with traditional forms of the rural landscape. The Museum shows the cultural diversity of the province, gathering items related to the former life in the village, in the manor and in the small town. It also preserves knowledge about customs, rituals, traditions and everyday work of people living in the past. The Museum also offers classes on cultural heritage for school groups.

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Bulgaria

1. *Regional centre for the support of the process of inclusive education - Vratsa*
   www.rc-vr.com

Profile: The Regional Center for Support of the Inclusive Education Process is a specialized service unit of the Ministry of Education and Science for the implementation of the state policy for inclusive education in Vratsa District.

The Center carries out activities related to the implementation of the state policy for supporting the process of inclusive education in the Vratsa district, organizational and methodological support of kindergartens and schools for the personal development of children and students with special educational needs.

Challenges: Potential difficulties in explaining AR technology to teachers and professionals in the field of special education, because on a local level AR and VR technologies are not very developed and popular.

Impact/benefits: Impact on children with special educational needs and their parents, opportunity to approach AR technology and investigate cultural historical heritage from a new, more creative perspective.

2. *Institute "Ancient Plovdiv"*
   www.oldplovdiv.com

Profile: The Ancient Plovdiv Municipal Institute was established with Municipal Council decision of 02.07.2004 for the purpose of managing, protecting, preserving and using the immovable cultural assets in the Ancient Plovdiv architectural heritage.

It implements the municipal policy for the protection and development of cultural heritage in line with the principles of national cultural policy and local traditions.

Challenges: Evaluation focused on short-term instead of long-term learning; AR can be perceived as an intrusive technology because everything around is progressing quickly so that a balance should be established as well as emotions and senses should be stopped taking for granted.

Impact/Benefits: attracting more tourists and visitors; promoting discoveries in combination with new technologies; contributing to a better understanding of the common past in order to valorise, conserve, protect and preserve the European cultural heritage.

3. *Historical Museum Perushtica*
   www.museumperushtica.com

Profile: The Perushtitsa Historical Museum presents not only the history of the city, but its main aim is to popularize artefacts, legends and documents from the millennial past of the region between the legendary Thracian Besapara of the northwest and the

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mighty megalithic rock sanctuaries on the slopes of the Rhodope Mountains to the south.

Challenges: A major challenge is the lack of ontologies and standard vocabularies. Open access culture is thus very limited in the field of cultural heritage, as is the reuse of data. The use of digitized data is important: common challenges are the approaches, how to develop these data, how to store and to handle it. Copyrights and IPR could be a challenge to the relevant actors due to limited knowledge of what is actually possible or not. Limitations due to regulations and museological approaches that can be seen as obsolete can also be a challenge. Open access to some specific data, for example in the archaeological sector, also raises legal and ethical issues.

Impact/benefits: learning gains, higher motivation, facilitated interaction, better collaboration, lower costs, better user experiences, just-in-time information, increased capacity for innovation, creation of positive attitudes, more awareness, anticipation, and authenticity.

4. "119 School Acad. Mihail Arnaudov" Sofia

https://119su.bg/bg

Profile: The school was established in 1960 as a primary school. Today, it is an established metropolitan secondary school with innovative and modern appearance and style of work. It receives around 1100 students from the first to the twelfth-grade study in the school. Some classes provide an intensive teaching of natural sciences and IT.

Challenges: not all learners show interest and motivation to work on cultural heritage topics.

Impact/benefits:

- Increased Motivation: Users being more eager, interested, and engaged in dealing with new technology as well as teaching and learning content compared to non-AR methods;
- Increased Attention: The attention users pay to the technology becomes the attention paid to the teaching and learning content;
- Increased Satisfaction: It means that users experience the learning process or their educational progress with higher satisfaction. Learners have more fun running through a library and solving tasks directed by an AR application than by a librarian;
- Increased Interactivity: This benefit is about new ways of interaction with the learning tool, through concepts such as context-aware information on the device;
- Increased Information Accessibility: AR applications can improve and facilitate the access to information regarding teaching and learning content;
- Improved Development of Spatial Abilities: With the help of AR, learners are able to acquire a new level of spatial abilities;
- Improved Memory: It refers to the retention of knowledge acquired during the use of an AR application.

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5. Regional center for support of the process of inclusive education – Sofia

www.rcsf.bg

Profile: The Regional Center for Support of the process of Inclusive Education is a specialized service unit of the Ministry of Education and Science for the implementation of the state policy for inclusive education in Sofia-city district. The Center provides methodological assistance to school teams to support personal development and teams in kindergartens on the territory of Sofia Municipality.

The institution guarantees for the state policy in the field of equal access to education on the territory of the city of Sofia. The Center has the following state-defined functions:

- Assessment of special needs,
- Provide support from a resource teacher, speech therapist, psychologist, social worker or other specialist,
- Approval of assessment.

Challenges: Inclusive education is still a process of transition in Bulgaria. Teachers and professionals in the field meet difficulties with the new technologies and methods in their work with kids with special need. The adaptation to the rapidly changing environment is something they go through, so definitely they would need time and additional efforts to include AR applications in the educational process.

Impact/benefits: The involvement in the project can have a beneficial social impact as it can contribute to the integration of kids with special needs and increase cultural and historical knowledge by innovative methods.

6.Regional center for support of the process of inclusive education - Stara Zagora

www.rcsz.org

Profile: The Regional Center for Support of the process of Inclusive Education is a specialized service unit of the Ministry of Education and Science for the implementation of the state policy for inclusive education in Stara Zagora District.

The Regional Center provides methodological assistance to school teams to support personal development and teams in kindergartens throughout the municipalities of Stara Zagora.

Challenges: A new law for special education was accepted in Bulgaria and there are much changes in this sphere. On the other hand, big number of teachers and professionals in the provincial cities are from the old generation and meet difficulties with the new technologies and methods in their work. The resources in the cities out of the capital are limited and this might cause lack of motivation and desire to explore new and innovative applications.

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Impact/benefits: The AR technologies could be interesting and much more attractive for students with special educational needs, rather than conventional ways and approaches of studying. Augmented reality application could keep their attention fixed and help being more concentrated. Therefore, the work of the teachers would be easier and less stressful.

7. Museum "Experimentariumin" Techpark Sofia

https://sofiatech.bg/museum/

Profile: Sofia Tech Park is the first science and technology park in Bulgaria, created with the aim to be established as a platform for exchange of knowledge and ideas between the academic field, the business, the government and the society.

The first interactive children's center TechnoMagicLand has been established due to the partnership between Sofia Tech Park and the leading Bulgarian software company "Technologica" EAD. A number of scientists, experts, specialists and mythologists in the respective scientific fields have participated in the development of more than 35 exhibition experiments. TechnoMagicLand provides interesting, entertaining and useful activities targeted for children 7 to 14 years of age, as well as students from technical high-schools.

Challenges: The focus of the activities does not lay on cultural heritage.

Impact and benefits: High level of technological development and reaching out a large audience are significant benefits. Thus, the ambition of Sofia Tech Park is advancing the interactive children's center to the European Network of Science Centers and Museums.

8. Sofia University - St. Kliment Ohridski

www.uni-sofia.bg

Profile: Sofia University is the first Bulgarian University. It is a model of research and teaching of broad cultural and social importance. The University plays an active role in the design and implementation of policies at national, regional and international level.

Sofia University is the country's leader in the number of participants in student and teacher mobility and the promotion of the European Higher Education Area.

Challenges: limited time and the large workload of the University; barriers such as the lack of a modern technological infrastructure and proactive teachers; some bureaucracy barriers.

Impact/benefits: The university has a large experience in the field of education as well as technology. Sharing their experience could be highly beneficial for the project. The project's outputs can be helpful tools to improve the university's teaching methods and learning practices.

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9. Muzeiko

http://www.muzeiko.bg

Profile: Muzeiko is the first children's science center in Bulgaria and a modernized educational institution providing children with a place that provokes their curiosity and interest in science, technology, ecology, and the arts. Muzeiko is established, based on the model of children's museums in the US, taking into account the results of the latest studies on children's brain development and learning of children of different ages.

Muzeiko works in partnership with museums and schools all over the country. The Children's Science Center team develops materials and programs that teachers can use at different times when working with children. A variety of scientific demonstrations and workshops are organized periodically at the Muzeiko. There are specialized Art Studio and Technical Studio

Challenges: Difficulties in identifying suitable ways and channels for inspiring youth to be involved and interested; lack of time.

Impact and benefits: The staff will develop their digital skills and gain knowledge in the field of cultural heritage. In this way, they will benefit both professionally and personally. The kids who visit Muzeiko or other places related to its programs and activities, will have the chance to learn more about cultural heritage in a fun and innovative fashion.

10. Museum of Archaeology - Varna

https://www.archaeo.museumvarna.com/

Profile: On 12 December 1901, a group of socially active figures and teachers established the Varna Archaeological Society that for decades has been the basic motivating power for interest in and study of the history of Varna, Varna Region, and Northeast Bulgaria.

Varna Educational museum is situated on the ground floor of the Archaeological museum. It has been created in 1986 by archaeologists and museum curators Dimiter Dimitrov S.R. and Ivan Ivanov R.S. This is the first Bulgarian museum for children that has its own exposition and a hall for educational purposes. Its goal is to expand kids' knowledge of the past and important historical heritage; to provoke greater interest towards history and archaeology by creating a non-traditional, attractive and at the same time accessible expositional area, where visitors (small and grown-up) can enjoy direct contact with museum exhibits.

Challenges: insufficient financial resources make difficult the accessibility to AR in CH for citizens.

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Impact and benefits: The museum is open to new technologies in order to enrich the visitors' experience and attract more people of different ages, which will gain knowledge in a more creative and easy-to-learn way.

The Netherlands

1. *Bibliotheek Roermond*
   https://bibliorura.nl/

Profile: Bibliorura Library is the link between reading and education. In this way, it forms the foundation for the citizen to be able to fully participate in society.

Challenges: The Netherlands is one of the countries with the largest number of internet accounts per capita. "Googling" to find information has become a common verb. The Bibliorura Library therefore does not see itself as a competitor in this (digital) information provision.

Impact and benefits: the strength of the library lies in facilitating users to access the information and in providing support for their understanding. The ability to read is important for this. The library is pre-eminently the institution to promote reading based on a good collection of physical and digital media, and thereby to contribute to the development of all residents of the working area. This enables the citizens to correctly incorporate knowledge and information and to participate fully in the current knowledge society. This goal is not only restricted to information in (digital) books, but also about enclose information by using new media like AR in daily life and learning situations.

2. *Qeske*
   www.qeske.nl

Profile: Qeske offers a platform for all, for people who give and receive. Sharing ideas and competences is the source for successful and innovative collaborations.

The facilities offer space for initiatives in every sense of the word. Whether you just need a flexible workplace, but still want to be part of this guiding community, or you have a larger organisation looking for flexible accommodation in an agile environment that can be used as a field lab, think tank or incubator space. Qeske offers all this and more.

Benefits: Education does not happen in an isolated school building, but through an active involvement of experts from companies and organisations, which have successfully tried out innovative concepts.

Challenges: A challenge for education is adaptation to a rapidly changing environment and being proactive in designing and shaping the world of today and tomorrow. This is only

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possible in an environment that is close to reality and in the midst of society. Qeske is connected to the society and also to develops of AR applications for education.

Impact and benefits: Education in all forms finds a flexible learning workplace in the Qeske facilities allowing to work actively with the experts on an agile and dynamic curriculum. This is possible in the form of minors, internships and graduation projects.

3. *Ixperium Roermond*
   https://ixperium.nl/

Profile: The iXperium Roermond was established in 2018 in collaboration with iXperium / Center of Expertise Learning with ICT, the Swalm & Roer Foundation, the Nieuwste Pabo and the municipality of Roermond.

Challenges, impact and benefits encountered: iXperium Roermond focuses on teachers of primary education and learners of the Pabo (Teacher trainer academy). Also teachers with their class come to the iXperium where they can get to know and experiment with ICT applications for education.

4. *Welten Instituut- Seamless Learning*
   https://www.ou.nl/welten-seamless-learning-design

Profile: The Welten Institute is the research centre for learning, teaching and technology of the Open Universiteit of the Netherlands. It focuses on improving the quality of education by educational research that is scientifically of excellent quality and at the same time practically oriented.
The institute aims to help to bridge the gap between theory and practice; become partner for (higher) education; be an (inter)national high-quality research institute.

Impact and benefits: The Welten Institute contributed to the digital education with the Mobile Seamless Learning project. People increasingly learn in different physical and social settings with less effort than 50 years ago, as both technological as well as physical infrastructures allow them to do so. Learners easily move from one place to another and create their own learning places, e.g. by using mobile devices and cloud technology. Learners' mobility and control on what, when, where and how they want to learn is still increasing every day, allowing them to choose from a wide variety of formal (e.g. schools, universities) as well as non-formal (e.g. museums, 'on the job', MOOC's) learning experiences. Seamless Learning (Wong, Milrad, & Specht, 2015) looks at the gaps that currently exist between these varied learning settings and how learning across these different settings can be fostered by making transitions as smooth as possible (Looi et al., 2010) with innovative technology and pedagogy, in order to make learning more meaningful, transferable, effective, continuous and fun for learners. The Welten Institute can deliver input from scientific side to our project and provide us with examples of their own projects.

5. *Stichting Historisch Egmond – SHE*
   http://www.historischegmond.nl/

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Profile: SHE is a foundation with the main objective to trace and record the history of the Egmond family and their environment from the earliest beginnings to the present, and to generate interest in it. Historical Egmond tries to make the connection between past and present wherever possible. SHE is also looking for common ground with regional, national or general history.

Challenges, impact and benefits encountered: Volunteers from the foundation interview fellow villagers and others who can tell about Egmond and do research among other things in archives. Working groups deal with specific topics and others work individually. The foundation disseminates this knowledge through the magazine Geestgronds that appears three times a year, through other publications and articles in the newspaper, and through its website. There are also lectures, circular walks and guided bicycle tours, excursions, exhibitions and markets. The foundation collects old photos, books, family or business histories, documents, engravings, maps, etc. of the Egmonds and copies of Geestgrond that have become redundant.

6. *Rijksdienst voor het Cultureel erfgoed*
   https://www.cultureelerfgoed.nl/

Profile: The National Service for Cultural Heritage (RCE) is part of the Ministry of Education, Culture and Science. They work under the direct responsibility of the minister and implement laws, regulations and heritage policy that the ministry and the service perform together. They also develop practically applicable knowledge and provide advice on national monuments, landscape and living environment, archaeology and movable heritage.

Challenges, impact and benefits encountered: Rijksdienst Cultureel Erfgoed has the overview of the Dutch collection of cultural heritage objects. Most every object is described by the RCE. The RCE has resources that can be settled for the CultApp project.

7. *National Knowledge Institute for Cultural Education Amateur Art (LKCA)*
   https://www.lkca.nl/

Profile: The National Knowledge Institute for Cultural Education Amateur Art (LKCA) wants to ensure that everyone receives good cultural education (at school and during leisure time) and that everyone can participate in cultural activities. With this aim they support professionals and administrators working in cultural education or cultural participation.

Challenges, impact and benefits encountered: LKCA shares news, practical examples and research, organize expert meetings and publish advise. They support people in the following:

- increase cultural education promoting participation through the municipality or the province,
- develop political plans,
- follow national and international cultural developments.

8. *Province Limburg*
   https://www.limburg.nl/

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Profile: The province Limburg is one of the twelve provinces in the Netherlands. It is located between two other countries, Germany and Belgium.
The focus of Province Limburg regarding Cultural Heritage can be described as a triptych: archaeology, monuments and intangible Limburg heritage.

Challenges, impact and benefits encountered: The Province has written three separate policy notes: for archaeology, monuments and the intangible Limburg heritage. The common threads in these three documents are the same. They aim at:

- gaining more visibility,
- reaching out a larger audience,
- getting a greater social impact,
- manifesting more coherence between initiatives and therefore "more value for money".

9. *Rijckheyt - Centrum voor regionale geschiedenis*

http://www.rijckheyt.nl/

Profile: Rijckheyt that means "treasure, treasure home" in Middle Dutch is the center where the historical archives and collections of the municipalities of Brunssum, Gulpen-Wittem, Heerlen, Nuth, Simpelveld and Voerendaal are managed and made available. These municipalities are located in the south of the Netherlands. The cultural-historical heritage, the collective public memory is therefore available in one central location.

Challenges, impact and benefits encountered: Rijckheyt stands for the partnerships that exist with municipalities and other cultural institutions. It is committed to the enrichment with historical knowledge that customers/ visitors gain from the regions, and returns it to the society in the form of studies and publications.

10. *Coöperatie Erfgoed Limburg U.A*

https://www.limburgserfgoed.nl/

Profile: The Limburg heritage cooperative was established to achieve concrete goals for its members, but especially with the ambition to provide information about Limburg's heritage centrally accessible to the public. This is the reason why work is being done on the establishment of a joint information service point, the development of a story and collection website, on joint public-oriented projects and on the development of heritage management. Each member contributes to the development of the cooperative based on their own specific capacities.

Challenges, impact and benefits encountered: The cooperative includes a network of players in the field of cultural heritage that might be very valuable for the CultApp project. They are:

- Centre Céramique, Kumulus en Natuurhistorisch Museum Maastricht;
- De Domijnen Sittard;
- Erfgoedvereniging Heemschut commissie Limburg;
- Huis voor de Kunsten Limburg;
- Koninklijk Limburgs Geschied- en Oudheidkundig Genootschap;
- Maastricht Centre for Arts and Culture, Conservation and Heritage;
- Monumentenwacht Limburg;

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- Molenstichting Limburg;
- Regionaal Historisch Centrum Limburg;
- Sociaal Historisch Centrum voor Limburg;
- Stichting het Limburgs Landschap;
- Stichting Limburgse Kastelen;
- Stichting het Limburgs Museum;
- Stichting IKL;
- Stichting Kruisen en Kapellen in Limburg;
- Stichting Restauratie Atelier Limburg;
- Stichting Werkgroep Industrieel Erfgoed Limburg;
- Federatie Musea Limburg;
- Federatie Historie Sittard-Geleen-Born;
- Stichting Cultuur- en Grensgeschiedenis Sittard;
- Stichting Directeurenoverleg Centra voor de Kunsten Limburg;
- Stichting Limburgs genealogisch en geschiedkundig informatiecentrum, Sittard;
- Stichting Menno van Coehoorn;
- Stichting 'Past for Present' Sittard;
- Stichting Soleur Sittard;
- Stichting VVV Zuid-Limburg;
- Vereniging Limburgse Bibliotheken;
- Vereniging Limburgs Particulier Grondbezit.

11. *Kasteel Hoensbroek*

https://www.kasteelhoensbroek.nl/

Profile: Hoensbroek Castle is one of the most beautiful, best preserved and easily accessible castles in Europe.

Challenges, impact and benefits encountered: At the moment, visitors can be engaged in several activities, most based on paper or with a guide. AR would be an attractive way of visiting the castle and showing the history of the castle in a different, more realistic and attractive way.

Greece

1. *Asserted Knowledge (Aknow)*

http://aknow.eu/

Profile: A technical consulting and staff sourcing company providing highly skilled ICT services and staff to organisations. Aknow's main activities are the provision of highly specialised staff sourcing, strategy-oriented custom business development, and hands-on technical consulting.

Challenges and impact: A potential challenge identified is the lack of specific knowledge of the cultural heritage field. However, educating key institutions on the issue will reinforce the impact.

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Benefits: The company can share the project outcomes with their clients significantly multiplying the project's outreach. Participation in the project will give them the chance to broaden their professional horizons and improve their services.

2. *Cosmic Innovation*
   http://mycoin.eu/

Profile: A very dynamic company bridging the gap between commercial and public/EU funding ecosystems. Its activities include innovative training methods, personalised training, and informal learning among others.

Challenges, impact and benefits encountered: Boosting EU cultural heritage can help the company expand their field of expertise. This will give them the opportunity to improve their trainings and thus provide their trainees with more useful tools for personal and professional development.

3. *Civic LTD*
   https://www.civicuk.com/

Profile: An award-winning digital solutions provider. Civic helps businesses succeed through effective, usable technology by combining their expertise in user experience design, development and hosting to provide digital solutions that work.

Challenges: Civic does not have knowledge of the cultural heritage field. However, educating them will contribute to the project's impact.

Impact and benefits: Civic can contribute to increasing significantly the projects outreach through their large and diverse professional network. Additionally, their expertise in digital solutions can be highly beneficial for the project implementation.

4. *Ellinogermaniki Agogi*
   https://www.ea.gr/ea/intro/highres.html

Profile: A private Greek-German school covering all educational stages from the Kindergarten all the way to Senior High School. The focal point is gradually shifted from the rich educational activities to the purely academic learning, so that, upon completing Senior High School, the students will have fulfilled all the necessary requirements in order to successfully continue their studies in Greek, German, or English universities.

Challenges, impact and benefits encountered: The involvement in the project can have a highly beneficial impact on the school's learners. Additionally, the school's teachers will develop new skills and gain knowledge that they can use to improve their teaching methods. Lastly, the school will share with us their expertise on the field of education in order to improve the project's implementation.

5. *Kmop*
   https://kmop.gr/

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Profile: A non-profit organisation supporting disadvantaged groups. Its main areas of expertise include social welfare and health, employability and human rights protection, scientific research and development of know-how in social policy and social protection issues. It works with the public and private sectors, as well as with civil society to drive solution-oriented, knowledge-based interventions that are crucial to fostering resilience and making the world a better place to live.

Challenges: More effort might need to be given in educating the organisation in digital technologies.

Impact and benefits: Participation in the project can have a significant impact on the organisation's staff as well as on its beneficiaries. The former will develop their digital skills and gain knowledge on the field of cultural heritage, this way they will benefit both professionally and personally. The beneficiaries will have the chance to learn more about cultural heritage through a fun and innovative way.

6. *Civic plus*

http://civisplus.gr/

Profile: A non-governmental and non-profit organisation with the aim of fighting against social exclusion, poverty, social inequality, as well as protecting the natural and social environment, thus contributing to the endeavours of Civil Society towards social prosperity and sustainability.

Impact and benefits: As above, we believe that Civic Plus's involvement in the project can bring a strong benefit to the organisation and its beneficiaries. Additionally, they will share with us their expertise in the field of education and social inclusion, enriching this way the project implementation.

7. *University of Thessaly - School of Engineering*

http://uth.gr/

Profile: The University of Thessaly is a public university in Thessaly, Greece. The school of Engineering offers 5 degrees in diverse engineering disciplines.

Challenges: Due to the large amount of workload and the limited amount of time the collaboration might be hard sometimes.

Impact and benefits: The university has a large experience in the field of education as well as technology. Sharing their experience could be highly beneficial for the project. Also, we believe that CultApp will benefit the university and its learners. The project's outputs can be helpful tools to improve the university's teaching methods and learning practices.

8. *Idec*

https://idec.gr/

Profile: An Education and ICT Training Centre, offering training courses to professionals, adults, young people and learners thus promoting digital skills. More specifically, it

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offers specialized courses for professional development, validated courses for the acquisition of professional qualifications, as well as courses for learners aiming to enter higher education institutions (universities) in the UK, Greece and Cyprus.

Impact and benefits: Participation in the CultApp project will promote the development of new competences and digital skills of the Centre's trainers and trainees. We believe that it will help the trainers stimulate the interest of young trainees and encourage them to develop new skills and explore new fields of knowledge.

9. *National Technical University of Athens (NTUA)*

https://www.ntua.gr/en/

Profile: A public engineering school and one of the oldest higher education institutions of Greece. NTUA's main activities are research and education. Research is conducted by administrative and education personnel as well as graduate students.

Challenges: Potential challenges could be the limited amount of time and the large workload of the University.

Impact and benefits: Involvement in CultApp could contribute to the professional development of the teaching staff of the Institution. Additionally, it can reinforce the learner's professional and personal growth.

10. *Cyprus Neuroscience & Technology Institute (CNTI)*

http://www.cnti.org.cy/new/index.php/9-uncategorised/101-homepage-2.html

Profile: A non-profit non-Governmental Organization active in programs with future orientation in areas related to human brain-modern technology-social transformation and the repercussions of relevant research for humanity. CNTI's projects are clustered within three different units: The New Media lab, the Global Education Unit and the Humanitarian Affairs Unit. The Global Education Unit projects focus on equipping youth and educators with knowledge, skills and tools to increase awareness about global issues and use new technologies to promote the Millennium Development Goals.

Challenges: Potential challenges could be the limited amount of time and the large workload of the institute as well as their lack of specific knowledge in the field of cultural heritage.

Impact and benefits: CNTI is a relevant strategic partner towards promoting project findings to young people and teachers. Involvement in the project will be highly beneficial the professional and personal development of the organisation's staff, teachers, and learners.

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5. CONCLUSIONS AND RECOMMENDATIONS

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The present Compendium has been conceived and completed thanks to the active contribution and productive collaboration of all project partners.

It confirms the need for iVET and other key institutions to work in closer collaboration to put forward concrete initiatives for promoting, preserving and valorising the cultural and historical heritage of the territory, thus providing wider access to it.

Such wider access can be achieved by getting the whole education system – in particular, teachers and learners - more interested and involved when approaching subjects such as art and cultural heritage. In this regard, the integration of new and attractive ways of teaching and learning is highly recommended.

Moreover, to foster employability and professional development adequate access to innovative digital technologies is required. In this regard, education and training institutions are invited to implement effective and stimulating teaching practices and instruments to deliver their curricula in a more attractive way, encouraging the development of new competences and digital skills.

Augmented reality (AR) was detected as the most suitable technology to transfer knowledge in education, in particular, among young learners.

Experiencing AR in the field of cultural heritage will enable the shift from a "teaching-listening" method to a more active, participatory, and engaging study method that promotes team work, collaboration between classes in the same school or even between schools in different countries enhancing a learner-centred approach.

Therefore, integrating augmented reality technology for teaching art and cultural heritage related topics within iVET programmes and curricula will be beneficial for both, teachers and learners.

This Compendium is expected to support teachers when introducing these new teaching practices in their educational trails in order to facilitate learning experience in Europe's cultural heritage of their learners. In turn, learners can be easily involved in artistic and cultural activities using innovative digital educational tools (AR applications) enjoying themselves.

Last but not least: common Europe's Cultural Heritage is increasingly becoming an enabler of social cohesion within the European Union. Thus, promotion of Europe's cultural assets is considered a relevant factor towards raising awareness of a common European identity among young learners who will co-design the future of Europe.

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CultApp slideshow's sources:

- Fig.1-2: https://www.smb.museum/en/whats-new/detail/museum-fuer-islamische-kunst-veroeffentlicht-augmented-reality-app-des-tamam-projekts.html
- Fig.3: https://maptory.zkm.de/
- Fig.4: Corrado Petrucco and Daniele Agostini (2016), Teaching our cultural heritage using mobile augmented reality, *"Journal of e-learning and Knowledge Society"*, Vol 12, n. 3.
- Fig.5: https://www.micc.unifi.it/projects/see-for-me/
- Fig.6: https://pixabay.com/photos/lublin-panorama-city-lubelskie-184211/
- Fig.7: https://pixabay.com/photos/smartphone-digital-camera-camera-381237/
- Fig.8: https://varnacitycard.com/place/archaeological-museum/
- Fig.9: https://varnacitycard.com/place/archaeological-museum/
- Fig.10: https://varnacitycard.com/place/archaeological-museum/
- Fig.11: https://archeoroutelimburg.nl/en
- Fig.12: *mobile screenshot*
- Fig.13: https://commons.wikimedia.org/wiki/%CE%A7%CE%B1%CE%BD%CE%B9%CE%AC#/media/File:Archaeological_Museum_of_Chania.jpg
- Fig.14: http://www.chessexperience.eu/

CultApp slideshow's webography:

- https://pixabay.com/photos/pokemon-pokemongo-friends-school-1548194/
- https://www.smb.museum/en/whats-new/detail/museum-fuer-islamische-kunst-veroeffentlicht-augmented-reality-app-des-tamam-projekts.html
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- http://lens.google.com
- http://www.chessexperience.eu/

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Learn more about CultApp project:

www.cultapp.eu