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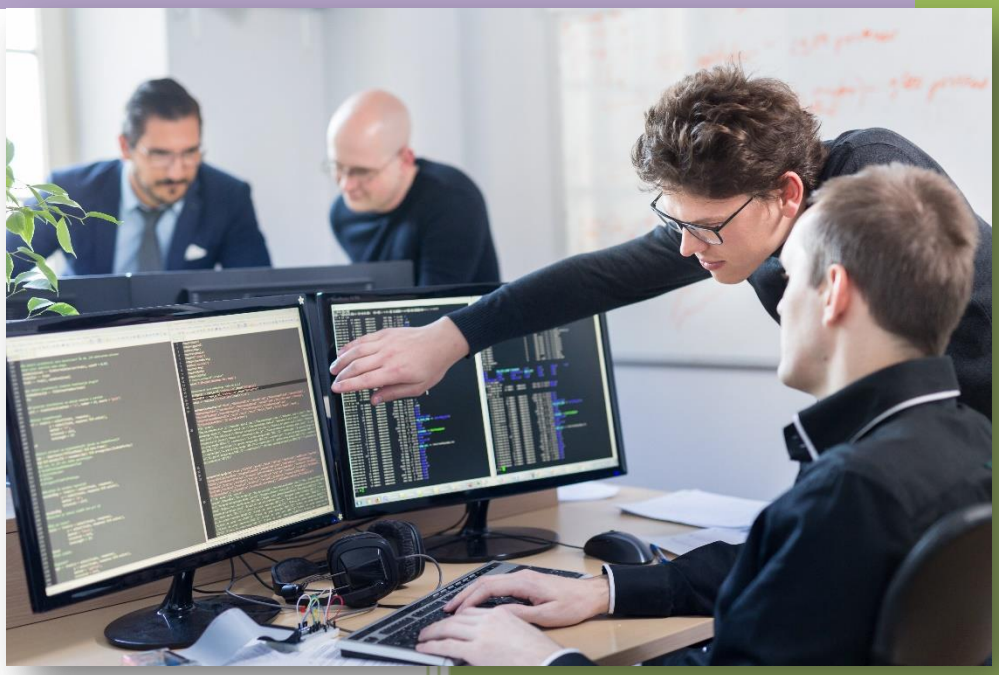
ROUTE TO SCIENCE CLASS

INTRODUCTION TO SMART CITY PROJECTS THROUGH BASIC WEB DEVELOPMENT TECHNOLOGIES



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DISCOVER PROJECT

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Introduction

HOW TO USE THIS RESOURCE

The Route to Science Class described in this document is designed so that it can be delivered by university staff and volunteering university students as extracurricular activity for secondary VET school students.

The activities consist of learning and career orientation experiences for high school students, combining an experiential path with an informative interactive talk on the impact of the smart city idea on the real world.

The approach builds upon the methodology of the Urenio laboratory, namely implementation of a Smart City project through the creation of an "intelligent city platform" with the help of basic Web Technologies.

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Activity concept and lesson plan

THEME OF THE CLASS

This is a learning program where participants are asked to imagine, research, design, and build the Smart Cities of the future.

They will have the opportunity to:

1) Understand the Smart City concept as a way to change their cities and to improve quality of living, efficiency and safety;

2) Integrate and apply the aforementioned knowledge to suggest innovative ways to realize Smart City ideas in the development of their home, school, community and city environment.

3) Learn to use two basic web technologies for the creation of an intelligent city platform:

- WordPress (https://wordpress.org/download/), the most widely distributed content management system (CMS) based on PHP and MySQL

- the open-source Appy Pie for the creation of the basic environment of an app.

LEVEL OF DIFFICULTY / AGE OF STUDENTS

This course is suitable for all students in upper secondary education.

REQUIRED PRIOR KNOWLEDGE

No previous knowledge is required, apart from some basic experience in programming and web surfing. Experience in programming will be an asset, as it would help students understand easily the basic tools of WordPress.

TIME REQUIRED FOR IMPLEMENTATION

The length of this activity should be at least 5 academic hours. However, the optimal length is 6 hours in order to allow sufficient time for discussion.

INSTRUCTORS

University teachers or advanced university students who have experience in the Smart City topic, in the use of IT platforms, and who can teach WordPress and Appy Pie.

KNOWLEDGE GAINED AND COMPETENCIES DEVELOPED - STUDENTS

Students will gain knowledge about the theory of Smart City and will grasp the benefits of the Smart City approach. At the same time, they will acquire basic practical skills for the implementation of their own idea for a Smarter City. Students will also acquire knowledge about the use of digital platforms as a citizen service.

A state of the art on Smart City Strategy will be illustrated:

- Digital and smart cities: concepts, examples, key technologies

- Applications for digital / smart cities (browsing ICOS and EU Smart Cities)

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The following technical skills will be developed:

- Content management systems – WordPress

- App development (basic skills) – Appy Pie.

KNOWLEDGE GAINED AND COMPETENCIES DEVELOPED – SCHOOL TEACHERS

If the accompanying teachers are experienced in programming, they would mostly gain knowledge and competencies related to the Smart City concept and its implementation.

They will gain skills to develop a bottom-up idea, present it through a web blog and use it through the development of an App, as well as to teach their students how to do this.

KNOWLEDGE GAINED AND COMPETENCIES DEVELOPED - UNIVERSITY STAFF OR UNIVERSITY STUDENTS

The competencies that will be developed by the university staff and students participating in the activity include the capacity to encourage citizen co-creation in the development of online citizen-centred services.

MATERIALS NEEDED FOR IMPLEMENTATION OF THE ACTIVITY

The teaching staff (university staff or students) will need a projector and a computer with Internet connection for the lecture.

Professors will need a whiteboard to draw strategic diagrams during the lecture. Students will need notebooks, pens or colour pencils, and possibly also sticky notes in each group in order to organize ideas.

Computers with Internet connection will be necessary for the hands-on activity in order to allow students to work in groups.

The students will use WordPress platform and Appy Pie, so this software needs to be installed on the computers that will be used prior to the activity. During the WordPress hands-on activity, the students will need to work on an existing hosting web that the school should provide. The instructor will need to have already downloaded WordPress (https://wordpress.org/) before the activity, and to provide access to students. Students will work on the WordPress dashboard in order to learn the basic functions of this specific web technology.

At the end of this course, the instructor will present how to convert the website created into an app https://www.appypie.com/convert-website-to-mobile-apps./. The basic tools of APPY PIE are open-source and free.

BREAKDOWN OF ACTIVITIES

The Route to Science Class is divided in 3 parts:

1. Lecture

The lecture consists of two main blocks.

Firstly, theoretical training will presents the concept of Smart Cities

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and the benefits of the Smart City. The objective of this first part is to facilitate students in understanding the current landscape of the Smart City.

Secondly, the instructor will present a number of key Smart City applications that all cities need to develop to address key global challenges. This block will help students build connection with their own environment. The case-study based analysis will create possibilities for student engagement and help students connect the acquired knowledge with specific problems in their homes, schools, and city.

2. Hands-on activity /Lab work

This part aims at teaching how broadband networks and digital services support Smart City operations. In view of this objective, instructors will:

a) teach students WordPress (https://wordpress.org/download/), the most widely distributed content management system (CMS) based on PHP and MySQL. PHP and MySQL are the most common technologies used in the design and development of digital city applications.

b) teach students how to build an app without coding. For this step, the instructors will use the open source https://www.appypie.com/# . This is a mobile app creator that allows its users to create and monetize different types of mobile apps. Its features include image recognition and tracking as well as a panoramic and 360 video viewer.

These two activities will introduce students to the creation of an intelligent city platform (Urenio) and understand how building a Smart City will benefit people, cities and economy.

3. Self-reflection on the part of students

In this phase, the students will be invited to reflect on how they understood and used the acquired knowledge to imagine other possible Smart City solutions.

USEFUL LINKS TO RESOURCES

Examples of Intelligent City Platforms are available from:

- http://icos.urenio.org

-https://ec.europa.eu/info/eu-regional-and-urban-development/topics/cities_en

Additional information for the use of WordPress:

https://academy.lifterlms.com/course/the-complete-wordpress-for-beginners-masterclass/.

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SUGGESTED FURTHER READING	http://eu-smartcities.eu/solution-proposals
SOURCES USED TO DEVELOP THE RESOURCE	http://icos.urenio.org

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Background knowledge sheet

EDITORS

Vasiliki Geropanta (Guglielmo Marconi University, Italy)

INTRODUCTION TO THE TOPIC

This Route to Science Class looks at the latest trends in city regeneration: the 'Smart City'.

Over the last two decades, thousands of places in the world have been entitled "smart" as a result of using different types of electronic data collection to supply information that ameliorate the city function. The concept describes urban areas that use web technology and/or sensors to collect, manage and use data and information that transforms the urban performance and efficiency (Bellone, Ranucci, and Geropanta, 2019).

Generally, the Smart City is a project based on top-down or bottom-up strategies that use Information and Communication Technologies (ICT) to ameliorate modern urban production factors. While its focus seems to be on ICT infrastructure, in reality it expresses a new system of innovation, based on the creativity of citizens and users living in the city. Smart Cities focus on providing resources that empower citizens to contribute to urban change and live in a better, more effective way.

Financially, politically and socially, these evolutions have resulted in new possibilities, collaborations and problem-solving strategies for cities. Many scholars, organizations, corporations and large global cities have adopted the Smart City Strategy. The European Union and other international institutions believe in a wired, ICT- driven form of development, promoted through large investments in research and development.

Consequently, many education departments have included the Smart City as a topic in their curricula. Some focus on the use of electronics, some on the use of robots and sensors, some on web development. The Smart City methodology is gaining popularity because of: a) the impact it has at an individual level (the methodology is citizen-centric, bringing therefore a latent transformation of citizens into smart citizens) and b) because of its use in many other disciplines, which promotes a culture of multidisciplinarity.

IMPORTANCE TO DAILY LIFE/ ECONOMY /SOCIETY

This course raises awareness of collective benefit. The creation of an intelligent platform can lead not only to identifying and solving local challenges, but also to an economic boost of the locality. Furthermore, understanding the use of basic tools to build Smart Cities falls within the topic of end-user programming, a skill that is considered among the most important ones in the 4th Industrial Revolution.

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DETAILED PRESENTATION ON THE TOPIC

A smart city is an urban area that uses different types of electronic Internet of Things (IoT) sensors to collect data and then use the data to manage assets and resources efficiently. This includes data collected from citizens, devices, and assets that is processed and analyzed to monitor and manage traffic and transportation systems, power plants, water supply networks, waste management, crime detection, information systems, schools, libraries, hospitals, and other community services (McLaren and Agyeman, 2015).

Deakin and Al Wear (2011) list the following factors that are included in the definition of a Smart City:

- The application of a wide range of electronic and digital technologies to communities and cities.
- The use of ICT to transform life and working environments within the region.
- The embedding of ICT in government systems.

The term "Smart City" is a relatively loose one that can be applied to:

- transport and ICT infrastructure
- people, especially in terms of an educated, flexible and creative workforce
- environment, viewed in terms of sustainability, safety, energy efficiency and quality of life
- governance in the widest sense, encompassing participation, transparency and a long-term vision.

The smart city thus promotes a concept of urban performance that does not depend only on the city's endowment in terms of hard infrastructure, but also, on the availability and quality of knowledge communication and social infrastructure (Caragliu and Nijkamp, 2008).

A Smart City System comprises of six key building blocks that are closely interlinked with each other (Vinod Kumar T, 2017):

- smart people
- smart city economy
- smart mobility
- smart environment
- smart living
- smart governance

These six building blocks are closely interlinked and contribute to the 'Smart City System

A Smart City Project has four main layers encompassing the above sectors:

- Sustainability, applications and value-added services for citizens
- Service Delivery Platform (elaboration and valorization of the

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Big Data of the territory)

- Sensors (IoT to collect the Big Data of the city and manage the infrastructure remotely)
- Infrastructure (networks, Wi-Fi availability and all technological equipment enabling the construction of an intelligent city)

Many examples around the world are considered as successful Smart City projects: Amsterdam Smart City Initiative, Barcelona with its CITIOS strategy, Manchester, Milan, Santa Cruz, etc. In all these cases the key sectors of the Smart City are mobility, economy, governance, people, living and the environment. The engagement of various stakeholders and the use of several pervasive means such as social media, open data, and sensors strengthen the collaboration between citizens and urban governments.

The theoretical part of this course should be organized as follows:

During the first phase, it is fundamental to introduce the concept of Smart City, presenting all different aspects. The suggestion is to let students think about different aspects of a city, not necessary the 'smart' ones, writing their suggestions on a blackboard (transports, schools, services in general, hospitals, roads, traffics, etc.).

Starting from this list, the teacher will present each aspect and discuss how it influences everyday life. After presenting the "traditional" aspects of the city, the instructor should move to the "smart" aspects, helping students understand the evolution from one to the other.

The second phase should encourage students to think about the connection among all aspects. This is a fundamental step to explain that a Smart City could be considered 'smart' only if all aspects are connected and contribute to improving the quality of life.

From a pedagogical point of view, this process encourages students to engage in "step-by-step" thinking.

At this point in the course, it is fundamental to present and describe case studies that demonstrate the key sectors where Smart City projects are applied:

- Mobility
- Economy
- Governance
- People
- Living
- Environment

Some suggestions of examples are included in Annex 1: Knowledge Resource.

During the third phase, students should be facilitated to understand

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the 4 steps for creating the roadmap of a Smart City project. To do that, they have to imagine an existing city and define the various steps to transform this city into a smart city. This process can be divided into 4 steps:

- Definition of the identity, challenges and characteristics of the specific locality where a Smart City project will be applied. Here it is important to analyse where the proposed city is, climate considerations (especially from the point of view of energy use), the presence of other cities or villages around (in order to understand the context for transportation), etc.
- Detailed research on the specific community in that locality in order to draw a plan of action reflecting the needs of the citizens.
- Presentation of a bottom up-strategy through the use of: a) web development and b) strategic plan. In this part, it is fundamental to show how to build a strategic plan. In particular, the plan must consider all aspects, interactions and roles of the different players contributing to the transformation into a smart city.
- Engaging the citizens and stakeholders: This can be done by developing and using an app. In this course this last step will be practiced by converting a WordPress page to an app. It is important to encourage students to think about how to involve people to contribute to the development of their Smart City.

After this phase is finished, and once students have learned how to consider all aspects in the definition of the evolution of a city into a Smart City, the instructor should browse ICOS (http://icos.urenio.org) and explain the methodology of creating and Intelligent City Platform.

By the end of this fourth phase, students should be able to work with basic tools in order to build their own platform. They are expected to also build the basic strategy for their own Smart City ideas.

SCIENCE COMMUNICATION GUIDANCE TO INSTRUCTORS

Lecturing must be supported by examples of applications developed for various cities. Information about such applications can be found in the platform of ICOS (icos.urenio.org) and the Platform of Smart Cities and Communities Stakeholders (http://eu-smartcities.eu/solution-proposals).

The presentation of the case studies should be interactive and promote discussion and analysis. In this way, students will be able to apply what they have learned to a specific problem of their locality and understand how the Smart City logic might help them solve it.

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Lecture planning sheet

GOAL	The lecture aims at helping students understand the Smart City concept as a way to change their cities, and to improve their quality of life, efficiency and safety. More broadly, the lecture should help students envision what impact digital technologies have on their communities and on their lives.
SETTING	- 10-25 learners organized in groups of 5-7. Each group should try to identify a problem. Alternatively one problem area could be identified for all the groups and then the groups will work on a solution that they can propose. - The space should be possible to divide so that each group can work separately. - Duration: approximately 2 academic hours - Instructors can use PowerPoint presentations for their lectures, and the whiteboard for sketching the layers of a smart City projects.
LOCATION FOR THE TALK/LECTURE	The activity should take place in a classroom equipped with a multimedia.
POSSIBLE INVOLVEMENT OF UNIVERSITY STUDENTS IN THE ACTIVITY	University students can be involved in this activity. It is expected that they would be adequately prepared by other university staff in advance in order to act as facilitators for the secondary school students during both the learning and the practical activities.

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TIMING & RUN-DOWN

Phase no.	Description of phase	Time allocated
1	**Welcome and presentation of the aims of the Route to Science Class**	5 min
2	**The instructor should ask students to mention an app or a website that they use every day more than once** *Following a short discussion with the participants, teachers and students altogether will try to describe what the impact of these apps is on their everyday lives. The participants will be invited also to mention an idea of an app that would make their life better.*	10 min
3	**The instructor will explain the link between apps and websites** *S/he will then go on to present the Smart City concept and how it works.*	15-20 min
4	**Break**	5 min
5	**Presentation of case studies and discussion on the diverse problems they address**	20 min
6	**Brainstorming on how the ideas in these case studies can be replicated in the students' own environment.**	15-20 min

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Hands-on activity/experiment planning sheet

GOAL

The goal of the hands-on activity is to help students develop a simple Smart City project, based on initial considerations and an existing city.

SETTING

- The groups that have been formed before should be preserved in the computer lab
- Each group should have 5-7 learners and there should be 2-5 groups (a total of 10-25 learners)
- There is at least one facilitator assigned to each group (university staff/student).
- The space should be possible divide so that each group can work separately.
- The duration of this phase is 2 academic hours.

LOCATION AND EQUIPMENT

Computer Lab at the school; needed software: Wordpress and Appy Pie.

POSSIBLE INVOLVEMENT OF UNIVERSITY STUDENTS IN THE ACTIVITY

University students can be involved as group facilitators. It is important that they be adequately prepared before the implementation of the activity so that they know what they should do and how they should facilitate the learning process for secondary students.

CONTENT OF THE HANDS-ON ACTIVITY

The Route to Science Class encourages students to critically think about their living environment. Transports, houses, social factors, services: all these aspects are part of a Smart City and they must be transformed and integrated to improve the quality of life. Students will think about each aspect and will learn how to put together these aspects to improve the results.

The students will learn how to work with Wordpress. A basic and good guide, both for students and teacher not skilled in Wordpress, can be found at: https://infotechcademy.com/wp-content/uploads/2019/04/WordPress-for-Beginners-IT-HUB.pdf.pdf.

The following issues will be addressed:

- Introduction to WordPress
- Install WordPress
- Edit Profile in WordPress
- Create a New User in WordPress
- Creating Categories in WordPress
- Creating Posts in WordPress

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- Manage Comments on WordPress
- Creating Pages in WordPress
- Create WordPress Widgets
- WordPress Themes
- Settings in WordPress

In the second half of the hands-on activity, the instructor will teach the students how to convert the created website into an APP through the Appy Pie software: https://www.appypie.com/convert-website-to-mobile-apps

An Appy Pie tutorial and online help are available here: https://www.appypie.com/help-desk

Before proceeding with the conversion, the instructor should present the environment of an app by showing how to do the following:

- Choose the app's category
- Build a basic layout.
- Work with a demo of the app on a sample on-screen phone
- Adjust text
- Add pages, colours, photos, media, links and more.

TIMING & RUN-DOWN OF THE HANDS-ON ACTIVITY

Phase no.	Description of phase	Time allocated
1	**Teaching WordPress and Appy Pie**	50 min
2	**Break**	5 min
3	**Brainstorming on how to address the problem.** *Facilitators coordinate the activity*	15 min
4	**Create a step by step work plan preparing a list of tasks to be performed in both Wordpress and Appy Pie** *Facilitators coordinate the activity*	10 min
5	**Develop report/presentation of the steps by using the Tools of the Web. More advanced students can make a plan immediately in Wordpress, while less advanced students can draw the strategy in their notebooks** *Facilitators help to distribute work within groups*	20 min
6	**All groups meet together and present orally their reports, explaining their**	10 min

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	considerations and the difficulties they encountered.	

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Annex I: Knowledge Resource

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DEFINITIONS

Due to the breadth of technologies that have been implemented under the Smart City label, it is difficult to distil a precise definition of a Smart City. There are two widely accepted definitions of the Smart City:

a) It is a city paradigm, constructed by top-down or bottom-up educational processes that act as a strategic device for modern urban production factors (Komninos N., "Smart Cities", The SAGE Encyclopedia of the Internet, 2018).

b) It promotes a concept for urban performance that does not depend only on the city's endowment of hard infrastructure but also on the availability and quality of knowledge communication and social infrastructure (Caragliu A., "Smart Cities in Europe", Journal of Urban Technology, n.18, 2009.).

Anthopoulos & Fitsilis (2014) define a Smart City as an ICT-based infrastructure and services environment that enhance a city's intelligence, quality of life and other attributes (i.e. environment, entrepreneurship, education, culture, transportation etc.). One interesting addition to the concept of the smart city is the concept of smart community. Giffinger & Gudrun (2010) define smart community in a following way: "A smart community is a community that has made a conscious effort to use information technology to transform life and work within its region in significant and fundamental rather than incremental ways."

Innovation in a smart city environment requires an ecosystem approach where local authorities do not act in isolation but in collaboration with other stakeholders in the ecosystem (Chourabi *et al.*, 2012).

The Intelligent City Platform that we use in this Route to Science Class as a Smart City methodology of work can be defined as follows:

It is an online page / pages developed for a specific locality in order to encourage citizen participation and the use of technology to change the way a specific place works. This platform can be applied to ideas for consuming less energy, ideas for better mobility, and ideas for acquiring general information that can help citizens live and function better.

EXAMPLES OF SMART CITY PROJECTS

- Mobility: Urban mobility is described as the lifeblood of modern cities, a critical economic factor, and a facilitator of smart, sustainable development. Planning a smart city that delivers effective and equitable urban mobility solutions is one of the most pressing problems for cities around the world. From the link: https://hub.beesmart.city/solutions/en/smart-mobility/smart-mobility-challenges-and-solutions-in-smart-cities, the instructor can access a large number of external links to projects

- Economy: due to the positive correlation between urbanization and economic development, cities are now recognized as engines of economic growth. This has led governments, such as in China and India, to include urbanization in national economic development plans. For the economic sector, a good guide is offered by the example reported in this article:

Vinod Kumar T.D. (Ed.), *Smart economy in smart cities*, Springer ed., 2017

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- Governance: examples are available in:

Deakin, M. 2014. *Smart Cities: governing, modelling and analysing the transition*, Routledge.

- People: A good guide is offered by case studies in this paper:

Gupta, S. 2017. "Smart People for Smart Cities", Advances in Smart Cities

- Living: Case studies on smart living can be found from this link:

http://www.smartlivingprojects.com/smart-cities/.

- Environment (pollution, water footprint, carbon footprint, waste, energy, etc.). Some case studies and considerations are reported in this paper:

Anand, S.K., and Anand M. 2017. "Smart cities: environmental challenges and green computing", International Journal of Advanced Research in Computer Science.

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Vinod Kumar T.D. Ed. 2017. *Smart economy in smart cities*. Springer.

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Annex II: Co-Creation

University Students

Selection	
The following university students can be involved in the design and delivery of the activity: - Students of Engineering, Environmental Sciences or Computer Science, in any year of studies, as long as they are knowledgeable in the area of Internet of Things, Control&Data Management Systems, Sustainable Mobility, Software Technologies for Building a Smart City. Knowledge of WordPress is also necessary. - Students should be selected by the faculty member responsible for the activity and should have worked with this faculty member before (in class or in educational outreach activities). The selected students should stand out for their science communication skills rather than their excellence and academic achievement per se.	
Role (in order of relevance)	**Guidance**
Pedagogical co-designers of learning, teaching and assessment; facilitators in hands-on and lab experiments	The selected university students: - should work together with high school students during the practical activity in order to help them design a Smart City project and use WordPress - should participate in the assessment of student performance during the activity and in the evaluation of the effectiveness of the training - should also be actively engaged in the self-reflection phase, staying with the student team in which they worked.
Mentors of SE VET students	The selected university students can be asked to share their contacts with bright or motivated high school students who may want to learn more about Smart City technologies and their application. The possibility of involving high school students in teams working on university projects or contests should be explored.
Consultants in planning and designing the learning and teaching process	The selected university students should be fully engaged in the design of the hands-on activity in order to ensure that the tasks would be manageable for younger students without academic background. Students can be given the task to prepare the Power Point presentation for the activity, as well as any handouts and supporting materials. They should, however, do this on the basis of clear instructions from the faculty member

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	who will lead the course.
Co-researchers contributing to subject-based research	The selected university students can be asked to preliminarily develop possible ideas for projects to be implemented in the hands-on activity session. They should be instructed to keep the level of difficulty close to the knowledge of high school students.

High School Teachers (supporting role is suitable for teachers in Computer Science or Mathematics)

Consultants in planning and designing the learning and teaching process	The accompanying teachers should have the leading role in selecting trainees from among the students. They should be approached in advance and consulted about the relevance of the presented examples and the suitable level of difficulty for the theoretical presentation (in view of the intended group of trainees). Special attention should be paid to the selection of manageable practical tasks and the avoidance of tasks that go beyond the compulsory curriculum. Teachers should be consulted about the best way to draw parallels and to link the content of the course to compulsory study programs, e.g. Computer Science, Engineering, Geography or Economics.
Pedagogical co-designers of learning, teaching and assessment; facilitators in hands-on and lab experiments	The accompanying teachers should work together with high school students during the practical activity in order to help them master the use of WordPress, design viable projects, and provide clarification those of them who have failed to understand the presented material or apply it in practice. Most teachers would be in position in which they themselves will work on the topic of Smart Cities for the first time. They should be given the chance to learn themselves. High School teachers should be the primary source of feedback about the effectiveness of the training. They will also be in the best position to assess the performance of their students. Teachers should play a central role in maintaining discipline during the activity.

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University-high school partnerships

This course in particular would be a suitable addition to the study programs in schools with a profile in Computer Science and the Natural Sciences. It can be the beginning of a series of extra-curricular courses on WordPress or Smart City technologies. If there is such an interest, contact between the accompanying teachers and the university should be made well in advance and the course should be planned as part of a larger set of topics. The course can be combined with open lectures or lab sessions at the university. One particular high school teacher or administrator and one particular university faculty member should be tasked with the organization and should act as contact persons and "boundary spanners". For further collaboration to be planned, it is advisable that an educational manager from the school attend (part of) the course in order to witness the effectiveness of the training. If this is not possible, then a report on the achieved results and the satisfaction of students should be presented to the school management, together with a proposal for further collaboration.

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