Teacher Coaching Program – the Idea Linea B3 Project

Carole Salis[1], Davide Zedda[2], Giuliana Brunetti[3], Marie Florence Wilson[4]
[1]CRS4 - Center for Advanced Studies Research and Development in Sardinia – 09050 Pula (CA) Italy

Abstract

IDEA Line B3 is a two-year coaching program for teachers who wish to be updated on how to enhance their capacity to effectively implement specific technologies in their teaching practice. The project is a natural extension of a previous three-year project aiming at fighting students' disengagement through the implementation of extracurricular technological activities. Activities resulted attractive to students and participating school teachers expressed the need to be coached and supported in using critically technologies in educational contexts, with special attention to their implementation to didactics. Technology is not only useful in delivering lessons, but it also is useful for course preparation. In this paper we shall illustrate the project organization, its objectives, the target group, the training activities. We shall also describe the platform developed to store and share educational material and scenarios produced during the training period, the communication activities carried out, the methodology adopted, the organizational procedures as well as the monitoring activities. We shall illustrate the 3 themes object of this year's program and their related technologies: School Without Walls (with the use of Augmented Reality - AR); Computational Thinking (with coding, educational robotics, and Internet of Things - IoT); Interdisciplinarity (with Artificial Intelligence - AI).

Keywords: Teacher education, Technology Enhanced Learning Activities, Augmented Reality, Computational Thinking, Artificial Intelligence

1. Introduction

This project derives from an earlier project: the “*Tutti a Iscol@*” project, in which Innovative Didactic Laboratories were used in extra-curricular activities to engage students and reduce school disaffection and early school leaving (Wilson et al., 2018). The discussions the Educational Technology team had with the teachers involved the “*Tutti a Iscol@*” project showed their interest for using technology in their didactic but also their need to be accompanied in this process. They needed help them gain confidence and become more familiar with using technology when they conduct their lessons, which is in line with the results of the European Commission final Report: “2nd Survey of schools: ICT in education, Objective: Benchmark progress in ICT in schools” (European Commission, 2019), according to which when using technology teachers feel least confident in more complex tasks.

The Educational Technology team of CRS4 took up the challenge to conceive and implement a project that addresses teachers' requirements and offers a possible answer to their need to maintain or upgrade their professionalism. Our target was teachers from ISCED[1] Level 2 and Level 3, lower secondary and upper secondary schools respectively. Our scope is to contribute to the renewal of didactics using digital technologies.

The project is a joint initiative between CRS4, the Education Department of the Autonomous Region of Sardinia and Sardegna Ricerche Regional Agency. It is financed by the Sardinian Regional Ministry of Education with funds from the Cohesion Action Plan and POR FSE 2014/2020 (Regione Autonoma della Sardegna, 2018). For the two years of the project (school years 2018-19 and 2019-20) the allocated funds amount to € 2.8 Million.

2. Methodology and project design

The project gives participating teachers 3 themes (each based on the use of specific technologies) to choose from and the possibility to explore both the technology and its possible didactic use under the guidance of experts. These experts will work in pairs: a technological and a didactic expert interacting in a mutually supporting manner. Their role as coaches is to create an educational setup in which to develop or boost teachers' knowledge of the technology and illustrate some of its didactic use. They will hold 4-hour weekly meetings with teachers for laboratorial activities for a total of 48 hours. The second step will be for teachers to conceive their original educational setup and transfer it to their own classes. During this second phase the coaches will be available online for support.

2.1. Technologies and themes identified to be developed during the project experimentation

The tools and technologies identified were chosen because of their potential ability to enhance traditional education, stimulate students' creativity, improve their ability to solve problems effectively. The selected issues to choose from are:

- **School Without Walls** (SWW) – Teachers will use both SWW Web and mobile platforms developed by CRS4 (Salis et al., 2019). The choice of using mobile devices is due to the fact that they are commonly used by students (Lieberman, 2019) and because of their increasing importance as a tool for teacher education (Kearney & Maher, 2019). Augmented Reality (AR) was chosen as it catches students' attention, connecting reality and digital contents (Chen et al., 2017), (Li et al., 2013). Moreover, since 2017, AR is cited in literature as one of the promising educational trends (Rhea, 2017). The choice of georeferencing educational path on maps was made to help students make connections between school subjects and the world around them. The SWW platform is used to create educational scenarios that will broaden students' learning experience to outside the school premises and help them make connections between what is taught in curricular activities and real life.

[1] The International Standard Classification of Education (ISCED) is a statistical framework for organizing information on education maintained by the United Nations Educational, Scientific and Cultural Organization (UNESCO). It is a member of the international family of economic and social classifications of the United Nations. [Wikipedia, https://en.wikipedia.org/wiki/International_Standard_Classification_of_Education, 26/09/19].

- The development of **computational thinking skills** through a problem solving approach, with the help of *educational robotics* for it provides impactful learning experience, (Anwar, et al., 2019) it increases students' motivation to learn (Sullivan, 2008) and stimulates scientific reasoning, the abilities to observe, think and make hypothesis (Mubin et al., 2013). *IoT* was chosen because it develops creativity (Tripathi. 2016) and enhances procedural learning. Also, since students develop an insight view of how IoT works, and become able to program IoT tools, they become smart users and develop a critical approach to new technologies (Salis et al., 2015). *Coding* for its cross-disciplinary approach to digital education. The importance of developing computational thinking is well described in (Kale et al., 2018).

- Understanding the **cross-sectional aspects of school subjects** with the help of concept maps generated from an Artificial Intelligence (AI) tool. As I. Tuomi states in the EC report "The impact of Artificial Intelligence on Learning, Teaching, and Education" (Tuomi, 2018), recent advances in AI and machine learning will have profound impacts on future labour markets, competence requirements, as well as in learning and teaching practices (learning, teaching, and education). Moreover, Artificial Intelligence, has the potential to lead to customization of learning content, based on students' preferred learning styles.

2.2. The actors of the experimentation

- **The Educational Technology team of CRS4** - Author of the project: we identified the concept, the educational objectives, the procedures, the actors, the set up, methods and technologies to be used. CRS4 took care of selecting the experts, monitor teachers satisfaction and goal achievements, as well as taking care of the financial and procedural monitoring activities.

- **Experts acting as coaches** - They are selected by the Educational Team of CRS4 based on the following steps. Initial screening: interested experts respond to an invitation to tender and send their résumé for our evaluation. The scope is to identify 48 experts to assist 24 groups of teachers all around Sardinia. The experts are divided in: Didactic experts (experts with specialized know-how in different aspects of teaching, in the development and implementation of educational modules) and Technological experts (experts in the technologies used in the project. In most cases, they are not school teachers).

  In order to guarantee standardization of their approach with regards to the project philosophy and objectives, and to instruct them on the project guidelines, short-listed applicants are brought into line with the project concept and philosophy. The following issues are addressed: Learning Design, Bloom Taxonomy, Artificial Intelligence, Moodle E-learning platform, Computational Thinking, presentation of the project platform, etc.

  After the training period, their applications are published in a list for schools to choose from. If chosen, they will work in pairs (one technological and one didactic expert) in order to give all around support to the teachers, help them explore and experience new practices, new methods and tools, making a sensible use of digital technologies. They will also coach teachers when they transfer the technological educational setup to their own didactics.

- **Head schools -** interested school teachers cannot apply directly to the project, but need to involve their own school. Schools that are interested must take a commitment to form a temporary association with other schools (Associazioni Temporanee di Scopo – ATS). Each school can belong to one single ATS. Applying schools will nominate a school as leader (the Head School). Each Head School will submit a project proposal that should comply with the indications provided for in the call prepared and published by CRS4 (See Tab.1). Each working group must be composed of at least 8 to 12 (max) teachers.

  Only 4 proposals will be selected, one for each Province of Sardinia. Successful Head schools will take part in the project. They will act as hubs or reference points for their ATS for administrative and bureaucratic procedures such as passing on information, proceed with payments, interact with the experts, the teachers and their respective schools, be responsible for reporting and accountability procedures, managing the funds allocated for the participating schools.

- **Participating schools and teachers** - Participating teachers must belong to schools that formed the temporary association (ATS). Schools belonging to ATS will receive a contribution to purchase the technological material needed when teachers will transfer their own educational setup to their classes. At the end of the experimentation period, participating teachers will receive a contribution from the Head schools. Our target is to reach 240 teachers willing to bring innovative practices and educational tools in their didactics.

Table 1: Working groups breakdown by geographical area and theme

Geographical area of competence	Tot. n. of groups	Max. n. of part. teachers	Number of experimental groups per theme			
			AR	Comp. Thinking	AI	Free choice
M. C. of Cagliari & S. Sardinia	10	100	3	3	3	1
Sassari Province	7	70	2	2	2	1
Nuoro Province	4	40	1	1	1	1
Oristano Province	3	30	1	1	1	0
Total	24	240	7	7	7	3

2.3. The experimentation part of the project

A core aspect of the project are the two cycles of experimentation to be carried out in academic years 2018-2019 and 2019-2020 respectively. Each experimentation will be divided in two steps. First, teachers and tutors will engage in the above mentioned 4-hour weekly meetings, then they will replicate the practices explored during the first stage of the experimentation in their classrooms. To sum up, the implementation of the project consists of:

- selection, recruitment and training of the experts/coaches
- schools form temporary associations and select one to be their Head School
- selection of project proposals presented by Head Schools
- weekly meetings for a total amount of 48 hours, participating school teachers experiment with technologies under the guidance of their coaches
- school teachers implement what was experienced with experts/coaches in their didactics by the end of the school year

2.4. Completing the team

We enriched our CRS4 regular team with the following figures: an educational technologist, an expert in communication, a team manager, expert in computer science and information technology, responsible for the development of the technological platform, computer specialists, an expert in the management and reporting of financial resources, a financial and procedural monitoring expert and two assistants for administrative support.

2.5. Purchase of material/devices

Since it is impossible for teachers to identify the tools they will need to do the experimentation, and the purchase procedures can be long, CRS4 will purchase a number of devices to be supplied as loan for use for 5 years. This will enable schools to purchase what is required and allow the continuation of the experimentation for a time span of 5 years.

2.6. The first year of activities

In this first year of activity, the experimentation took place in two phases: between May and October, the coaches held the above mentioned weekly meetings with school teachers. This time was dedicated to work on methods, on innovative didactic tools, on the use and implementation of the themes and technologies chosen for the experimentation. In the second phase (between October and December), coaches will guide, supervise and give support to school teachers during the experimentation in the classroom. Teachers will transfer what was explored during the weekly meetings with tutors in their own classes and in their own didactic. They will also receive online support from the coaches during that particular phase.

2.7. Monitoring and Evaluation of the project

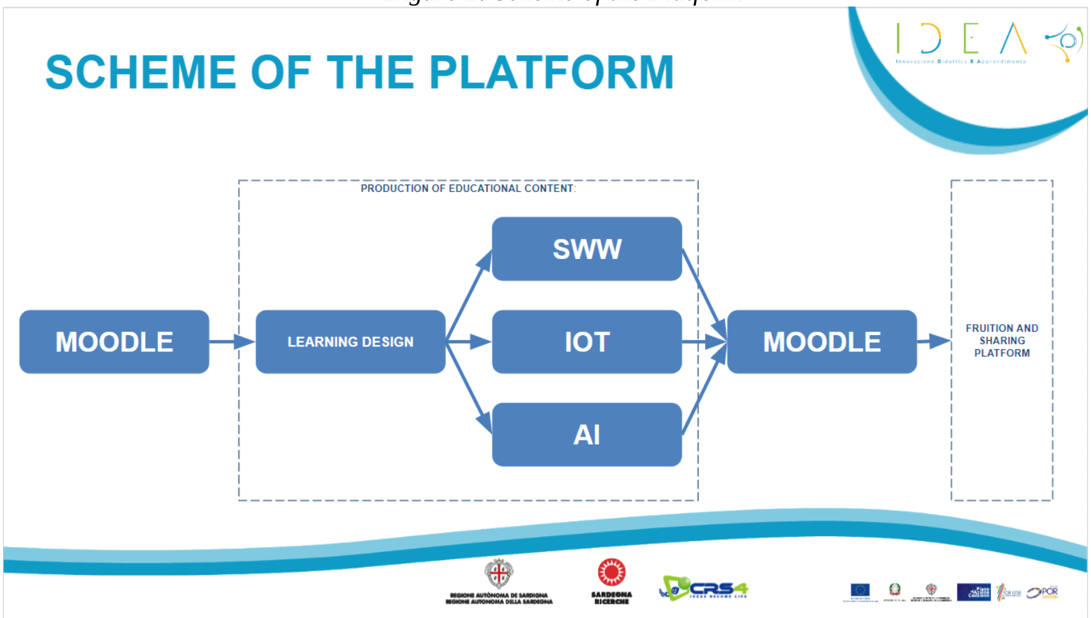
- **Teachers and coaches satisfaction -** An appraisal questionnaire will be administered to evaluate the teachers approval rating.

- **Goal achievements -** The evaluation of the scientific results will be carried out by a consultant, professor of experimental pedagogy at the University of Cagliari. Such evaluation (with control and experimental groups) will be carried out at the end of the second cycle of experimentation to assess the impact of the use of technologies on students' learning achievements.

3. Web platform and its integrated tools

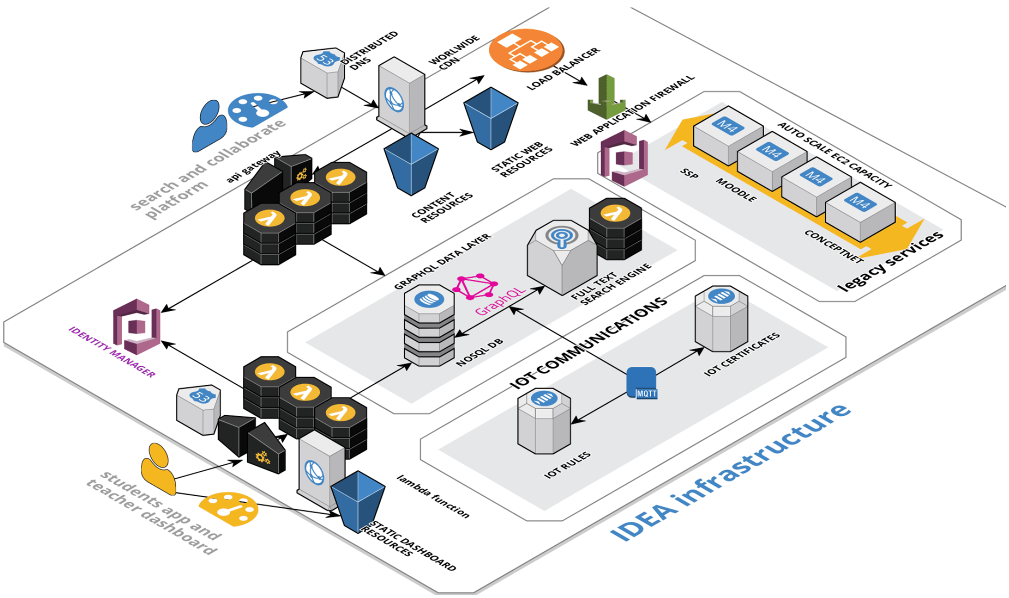
The project platform (IDEA platform) ensures the use, exchange and sharing of educational resources. It is not a simple repository, a place to upload and share educational material created through students apps and teacher dashboard, it also allows fruition and indexing of contents. The free e-learning platform Moodle integrated into the project platform is used as a document management tool to create and collect the educational contents associated with technological experimentation. The IDEA platform also integrates and gives access to the Learning Designer tool that helps teachers to plan and organize lessons; the School Without Walls platform is used for students to live ubiquitous learning experiences, the ConceptNet Artificial Intelligence platform (semantic network) to help students understand the cross-sectional aspects of school subjects (see Fig. 1).

Figure 1: Scheme of the Platform



The IDEA platform is built on the public Cloud AWS (Amazon Web Service) - See Fig.2. It integrates other technological platforms, built in SaaS mode (Software as a Service) and uses serverless technologies to ensure performance, reliability, scalability and cost containment. The project platform uses a centralized identity provider and management system compliant with Oauth and Openid technology and a set of software managers for NoSQL data storage and indexing in fulltext search mode. In addition to serverless services for computing and data management we find the management of legacy services through the use of automatically scalable virtual machines that host the various services, such as the Moodle software and The AI platform.

Figure 2: Platform Infrastructure



3.1. Instructional Design Tool

According to the 2nd Survey of Schools: ICT in Education Objective 1: Benchmark progress in ICT in schools, Final Report, [2], "Across all ISCED levels, more than 90% of students have teachers using ICT to prepare lessons … In terms of digital content creation, teachers feel most confident with basic activities (e.g. producing texts) while they feel least confident in more complex tasks (e.g. coding)."

Learning Designer is a tool to help teachers design their teaching activities, re-use them and share them with other teachers. The pedagogical design is structured in a modular system, so that the steps can easily be reused or adapted to different learners doing similar types of activity. The tool presents a Designer screen from which to create from scratch. If you conceive a new learning design, you should indicate the title of the design, the theme, the size of the class, the time span in which you expect students to carry activities, and last the pedagogical outcomes.

The way we suggest to reason about outcomes is, based on Bloom's taxonomy, to choose the primary outcome, i.e. the educational goal we wish the students to reach that is divided into smaller outcomes. The lesson is composed of: Teaching Learning Activity (TLA), which is subdivided in the following Activities: read, watch, listen, collaborate, discuss, investigate, practice. Once all the learning types are filled, the system provides as feedback a segmented, coloured line which is a visual representation of your Learning Design, useful to verify at a glance if your lesson is balanced or if it really corresponds to your scopes.

Each colour represents one of the actions, for example the colour purple means the use of practical activities. In this project, practical activities can be related to one of the 3 identified themes (School Without Walls, Computational Thinking - cross-sectional aspects of school subject**s** with Artificial Intelligence). Ideally, unless you decide to put the stress on one specific aspect, all colours should be balanced.

3.2. School Without Walls

School Without Walls is a Web platform and an App that uses Augmented Reality in Didactics to turn school concepts learned during lessons into a ubiquitous learning experience. On the platform, teachers can create maps in which Educational Scenarios can be geotagged, that can range from non-STEM subjects to any scientific topic, provided they are related to the school curriculum. A typical Educational Scenario consists of: a title, geographical coordinates, different tags, an image shown during the Augmented Reality activity, a Single Select Multiple Choice Questions with its predetermined set of possible answers. From the point of view of teachers, the SWW is user friendly as it does not require any special technical skills. The one thing students will have to do to be able to access the educational contents prepared by their teachers is to scan the corresponding QR code.

3.3. Developing Computational Thinking Skills (Robotics, IoT, Coding)

For teachers that are not familiar with programming but wish to use educational robotics, and for the younger students (Junior High school students), we suggest the use of mBot, a user-friendly visual programming language based on Scratch. No knowledge of programming is required, as using mBot is simple and intuitive. For more advanced teachers and older students, Arduino C will be used. It is possible to make the robot independent from the computer by transferring the code inside its processor. For more advanced teachers and students it is possible to configure IoT devices based on Arduino. It is possible to connect different input/output devices, and the teacher can decide to show the data flow of one or more device. The device is linked to the platform.

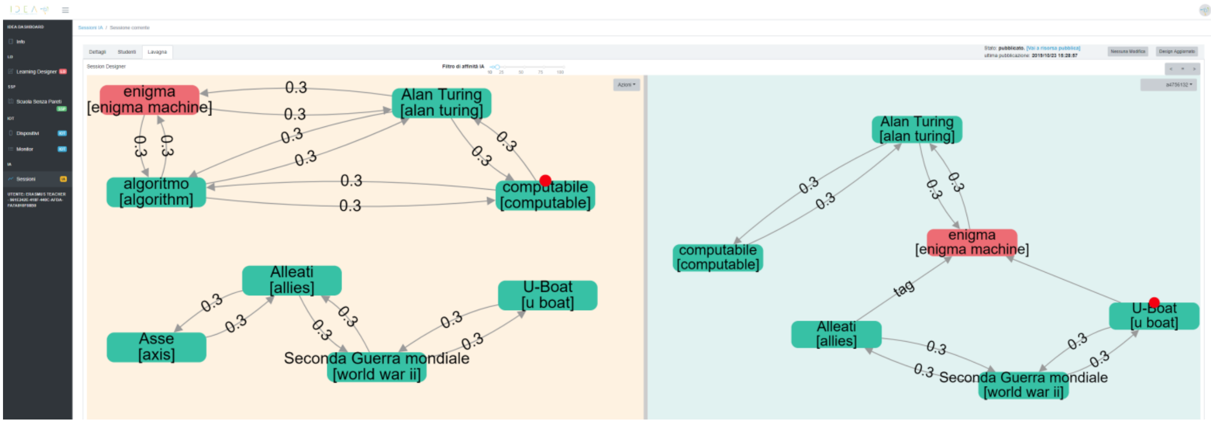
3.4. Artificial Intelligence

Students tend not to connect information obtained from different subjects, that remain isolated concepts. With the help of Artificial Intelligence, our primary objective is to create a more global, exhaustive knowledge in the form of conceptual maps.

Two or more teachers can decide to collaborate. It is necessary that their subjects somehow overlap. From the common area the AI will be able to create sets of keywords that belong to both curricular programs. The ideal situation is when both teachers teach the identified topics simultaneously: for example, a history and a computer science teacher are covering World War II and the Theory of Computability of Algorithm at the same time. They work on a common list of keywords (that will include, for example Turing, …) see Fig.3. They can then feed the AI with the list and verify what conceptual map was generated. They still can make changes, add, cancel keywords or links.

The second step is for teachers to create students credentials. The student can log in and see the list of key words put at his disposal. He too can change the list, create links between words and label the connections. Once done, the work can be controlled by teachers and compared with the original AI created map.

Figure 2: Artificial Intelligence Conceptual Map



4. Communication: How to Promote the Project, seminars and Webinars

Communications issues are fundamental to the success of a project: the information needs to reach the right audience through the right channels. It is essential to identify the best way to reach our target. Before the project was launched, a campaign of dissemination of project information was made throughout the Sardinian Territory, meeting school heads and teachers and presenting the project. A dedicated internet site was developed: https://www.ideab3.it/. The project was also publicised through social media. Webinars and seminars were organized: an opportunity to go deeper into the themes and technologies used. The seminars were organized between May and July throughout the Sardinian territory in order not to penalize teachers who operate in more isolated environments.

5. The Project is a Work in Progress

Four school proposals were selected. Two hundred and thirty six (236) teachers are involved in the project, divided into twenty four experimental groups. The average amount of teachers per group is ten. 89 teachers (38%) comes from Junior High schools whereas 147 (62%) from High schools. The teacher population by gender is illustrated in Tab. 2.

Table 2: Teacher population by gender

Gender	Number	%
Males	86	36
Females	150	64
Total	236	100

The selected projects are:

1. **"#Ajoaiscol@"** - The head school is: Istituto Tecnico Professionale "Ianas" of Tortolì. The area covered is the territory of the **Nuoro Province** (Ogliastra and Siniscola) and the proposal involves **eight schools** for a total of **40 teachers**.

2. **"IDEA provincia Sassari 1"** - The head school is: Istituto Comprensivo "S. Satta - A. Fais" of Perfugas. The area covered is the territory of **Sassari Province**, and the proposal involves **twelve schools** for a total of **64 teachers**.

3. **"Innovating thought, renewing didactics"** - The head school is: "Istituto Superiore S.A. De Castro" of Oristano. The area covered is the territory of the Province of Oristano, and the proposal involves **six schools** for a total of **30 teachers**.

4. **"Innovative digital technologies and didactics"** - The head school is: Istituto d'Istruzione Superiore IT Minerario "Giorgio Asproni" - ITCG "Enrico Fermi" of Iglesias. The area covered is the territory of **South Sardinia and the Metropolitan City of Cagliari**, and the proposal involves **twenty-six schools** for a total of **100 teachers**.

6. Conclusion and Future work

The most chosen theme (42.37%) was **computational thinking** with coding, educational robotics and IoT. This choice is not surprising as this theme was the most familiar to teachers. Almost 28% chose to experiment with Artificial Intelligence and the remaining 29.66% with the School Without Walls platform and Augmented Reality.

Presently, most participating schools are in the middle of phase II of the first year experimentation. The monitoring and evaluation aspects have not been done yet, but informal feedback we received so far is positive. The evaluation of the scientific results will be carried out between January and June 2020, (at the beginning of the second cycle), with a classical design of evaluation (experimental and control groups). Our team is working to launch the second year of experimentation.

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