MATERIALS CREATED IN PROJECTS: HANDS-ON, ONLINE PORTALS, PAPERS...

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Abstract

This article provides an overview of the most commonly produced materials in international Science, Technology, Engineering and Maths (STEM) projects as well as the benefits and difficulties of using them, their purpose and suitability, while providing with several examples. In the first part, a distinction is made between [1] networking platforms, that allow participants to meet, face to face or online to exchange ideas and good practices; [2] training materials, particularly targeted at teacher formation, [3] reports, which provide an insight into the project’s development, and [4] portals and repositories, where project resources are being stored for user access. The article moves to evaluate the main strengths and weaknesses of each type of material. The objectives of the article are to determine why projects issue certain materials and to define to which project stakeholder is each type of material best suited.

Keywords: Materials, education, resources, events, online learning, online laboratories, MOOC, reports, web portal, communities of practice, STEM, European initiatives.

Introduction

Scientix, the Community for Science Education in Europe (http://scientix.eu) organizes regular networking events for science education projects and organizations involved in STEM education in order for participants to share and exchange their experiences, to present their work and to facilitate the creation of new collaborations and partnerships. Each of these events is centred on a specific topic or challenge in the mentioned area.

The information featured in this article is, partially, the result of the discussions carried out during the 5th Scientix projects Networking event (5th SPNE) organized in London, on Friday 24th of April, 2015 and in collaboration with the TEMI project (http://www.teachingmysteries.eu/) and the Queen Mary University of London. With the theme of “Materials created in projects: hands-on, online portals, papers...” the event brought together 17 representatives from 12 different projects (TEMI, EU Space Awareness, KiiCS, Go-Lab, CyberMentor, SID, Xnergic, 2015-1-ES01-KA101-014619 (Erasmus + Mobility project), SAILS, APQUA, Scientix and TTTNet) who discussed on a number of project management topics, such as the planning, production and monitoring of project materials as well as on the benefits, constraints and recommendations for its better use.
Sample of materials – Description

Over the last few years, many projects have focused on various areas of STEM education. Whichever their particular goals were (from creating communities of like-minded professionals to disseminating good practices or developing extra-curricular activities) the formulation of relevant project materials and other resources has always been common practice. On that account, and in order to present a general overview of the many choices available, some of the most frequently developed project materials will be described below.

Networking platforms

Face to face events: Conferences and workshops

Face to face events are gatherings were different experts from a same area meet in a formal, organized way in order to address a specific subject. These gatherings can vary in length and scope but the most common types are conferences, seminars and workshops¹.

Conferences are usually larger events that entail a variety of different activities such as talks, exhibition stands, roundtables or workshops in combination with networking spaces. This format is designed to promote participant interaction and often increases the exchange of information. Likewise, the bigger size of conferences allows different project collaborators to meet in a shared space which can help expand the project’s network.

As means of example, in October 2014, Scientix organized the 2nd Scientix Conference² with almost 600 participants in attendance. The event included talks, workshops and roundtables, among other activities. Along the same lines, TTTNet has held two international conferences³, gathering more than 100 participants each and bringing together a combination of teachers, university and PhD students, educational decision makers as well as pedagogy and science experts.

It is also common for a project to organize smaller events, such as workshops, often addressed to a specific actor (in STEM education initiatives, usually teachers, heads of school, project managers or policy makers) and typically focused on a specific topic of discussion. Along these lines, TEMI, as part of their Training Program, regularly organizes face-to-face workshops to implement in schools as a way to support curriculum materials and in order to promote Inquiry Based Learning⁴.

Communities of practice

A Community of Practice (CoP) is generally understood as a group of experts with similar interests and with an interest to debate over them, while sharing experiences and ideas and embracing mutual learning. In project management, the term is mostly used when referring to moderated spaces, normally led by a designated expert, where participants are encouraged

¹ While face to face events are not a project material per se, they are included in the article as one of the most common project resources that provides with a floor to assemble a wide range of materials. In the same manner, online portals are also described in this article as the platform that sustains online repositories.
² http://www.scientix.eu/web/guest/conference
³ http://tttnet.eu/page/engaging-pedagogy-for-science-education-142-1.html
⁴ http://teachingmysteries.eu/en/teachers/?cpd=1
to discuss about a topic of choice. While these communities can take place face-to-face in a physical setting, they are most likely to happen virtually.

Scientix has been organizing online Communities of Practice throughout the year 2015 as a way to encourage the ongoing debate on the state of the art of STEM education. Accessible on the Scientix portal, the communities have been formulated in a structured way, including fixed discussion topics and incorporating a number of experts leading the debate. Similarly, eTwinning has been coordinating structured Communities of Practice (eTwinning Featured Groups), organized thematically and with an expert on the topic acting as moderator. These differ from the Scientix communities on its length and thematic flexibility, being the eTwinning communities less prescriptive and exemplifying how a CoP can be shaped in different manners.

Training materials

MOOCs

MOOC is the acronym used for what is otherwise known as a “Massive Open Online Course”. It refers to a web-based lecture designed to accommodate a great number of participants. Most MOOCs require students to perform different types of assessment and they can cover a wide range of subjects. MOOCs are usually addressed to researchers, teachers or tertiary education students as lifelong learning activities but can also be directed, with teaching purposes, to younger students.

Along these lines, Xnergic has developed a MOOC intended to teach how to use Scratch and how to integrate it with Arduino to design robots and videogames. Designed keeping in mind secondary education teachers, its main objective is that of contributing to teaching innovation through new tools while incentivizing the interest of youth in technology.

Online laboratories

A very popular and innovative didactic resource are online laboratories. These can be defined and exemplified through the Go-lab project, as it offers both real (remote) laboratories that can be remotely-operated as well as virtual ones. As the name already hints, remote laboratories can be used by students from remote locations to gather data from a real laboratory setup, while virtual laboratories offer the opportunity to simulate real equipment and experiments.

Lesson plans

A lesson plan is a set of guidelines and strategies, usually addressed to educators, to effectively teach students during a lesson. Lesson plans will normally incorporate student learning objectives as well as an outline of potential learning activities and a strategy to

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http://www.scientix.eu/web/guest/community;jsessionid=2BE10A26A60648135B4F4CCFF0DAEEB9
http://www.etwinning.net/en/pub/progress/groups.htm
http://lexicon.ft.com/Term?term=mooc
http://blogs.ucl.ac.uk/digital-education/2014/03/25/whats-the-benefit-of-moocs/
http://www.go-lab-project.eu/online-labs
implement them. Likewise, including a selection of lesson materials will be particularly useful as a way to support educational and pedagogical methodologies in the classroom\textsuperscript{11}.

A case in point are the modules for school programs developed within the APQUA project and addressed to both primary and secondary students\textsuperscript{12} or the TEMI lesson plans, specially designed with the purpose of promoting Inquiry Based Knowledge\textsuperscript{13}. The approach used consists on initially letting teachers act as experts, coaching the students while gradually letting them solve the learning activities on their own.

**Project reports**

Most projects include several written materials with an outline of their activities and/or the outcomes and results accomplished until a specific point in time. EU-funded projects, in particular, are usually obliged to submit a series of reports and deliverables throughout the projects' life.

Deliverables are understood as materials that portray a demonstrable output of the project\textsuperscript{14}. In that sense, they should not only include the initial objectives expected but also the projects' results. Similarly, progress reports will show the goals of the project, including achievements of any milestones and, in the same manner as the deliverables, they will include any differences between work expected and work effectively carried out\textsuperscript{15}.

A representative case is that of the now finished SAILS project -funded under the European Commission FP7-SIS program (Specific Programme "Capacities": Science in society) under the European Commission tutelage- who published regular progress reports, all of which are now available in the projects' results site\textsuperscript{16}.

**Portals and Repositories**

A web portal is a term that refers to a specific type of web page offering access to extensive information from other sources, in a systematic way and without having to travel across the network. A portal is characterized by integrating different areas to display the mentioned content while incorporating other features such as search engines, data storage repositories or even an intranet to help users’ navigation.

Most of the current STEM education projects heavily rely in web portals to share project content and to offer services to project members. This can be exemplified through the Cybermentor initiative. The aim of the project is to offer the services of a personal mentor to young students engaged in STEM activities in order to provide them with information on potential academic and career options\textsuperscript{17}. The mentoring is done through the projects' online platform, which includes features such as an email service or a forum. Likewise, the Scientix portal is a basic

\textsuperscript{11} \url{http://www.crlt.umich.edu/gsis/p2_5}

\textsuperscript{12} \url{http://www.apqua.org/ca/}

\textsuperscript{13} \url{http://teachingmysteries.eu/en/classroom/?act=1}

\textsuperscript{14} \url{http://www.fp7.asm.md/node/3}

\textsuperscript{15} \url{http://ec.europa.eu/research/participants/data/ref/fp7/89692/project-reporting_en.pdf}

\textsuperscript{16} \url{http://results.sails-project.eu/}

\textsuperscript{17} \url{http://www.cybermentor.de/}
element of the project as it works as a platform to offer its users with information and training options organized through characteristic web portal elements, such as content repositories¹⁸.

**Sample of materials – Strengths and weaknesses**

Given the large number of choices available and its clear heterogeneity, it is convenient to point out the prospective benefits and flaws of each of the project resources described above in order to help determine in which context and to which stakeholder they are more suitable.

**Networking platforms**

**Face to face events: Conferences and workshops**

On the one hand, face to face events -and in particular conferences- are an exceptional chance to bring together different stakeholders within a same project to share experiences and exchange viewpoints. Conferences also provide a platform from which to give specific project stakeholders (who might not be directly involved with the execution of a project) with more visibility opportunities while increasing their cooperation with other project participants.

On the other hand, smaller events like workshops offer attendees with the opportunity to gain both knowledge and hands-on experience in particular subjects. As workshops tend to be aimed specifically at one type of actor, they facilitate a more contextualized and actor-oriented organization.

As downsides, in addition to possibly elevated costs, attending events can be very time consuming, even more if it entails international travel. There is also a widespread concern on the continuity of such events: Following up with the outcomes of a meeting is still proving to be a challenge both in terms of content and in regard to the networking possibilities which could even be limited in the same event. A possible lack of visibility and/or dissemination of the occasion will also put a burden to its success.

**Communities of Practice**

The main advantage of Communities of Practice (CoP) lies in its dynamism and flexibility. The community format facilitates an easy flow of information between many different stakeholders while allowing fluctuations on the discussion topics and promoting an open dialogue.

Although CoP offer different degrees of participation, this can be detrimental for the discussion purposes, as it can contribute to a potential lack of engagement. This can also be consequence of the need for specific language or digital skills in order to participate successfully. Moreover, the sustainability of Communities of Practice as valuable training opportunities has been examined as it is certain that a single community will not as effective as one included in a series, where better substantiated conclusions could be extracted.

**Project reports**

Reports are necessary to ensure transparency and accountability within a project, especially if publicly funded. Besides, they are a useful resource for project managers to assess what

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¹⁸ [http://www.scientix.eu/web/guest/resources](http://www.scientix.eu/web/guest/resources)
can be improved within the project and for other stakeholders—such as policy makers or evaluators—to get an insight on its development.

However, projects’ reports and deliverables have, like any other product, an expiration date. They go through the product life cycle: they are introduced, they grow, they reach maturity and they decline. And while a project report might have been useful in a specific context or timeframe, it can rapidly become obsolete. Specifically, projects in STEM education, being an area in constant change, will most likely develop a few reporting materials that will only be applicable in a particular policy framework or academic context.

**Training materials**

**MOOCs.**

MOOCs offer the unique opportunity to simultaneously connect with a wide—often international—audience using an innovative format that involves the use of new technologies. They mostly use interdisciplinary approaches and deliver a space to try different educational methodologies like flipped classrooms. Furthermore, due to the flexibility in its content and access, they can be useful for a variety of project stakeholders.

Nevertheless, while MOOCs—in the same way as other online trainings—encourage digital literacy, one must be aware of the burden of the so-called digital divide: If the course materials rely exclusively on multimedia content, it is not unimaginable for certain audiences to not be able to access it. Besides, while MOOCs present a flexible and casual approach to learning, this particularity could discourage participants who might not be motivated enough as to finish a whole course (although this can be compensated by giving participants accreditations or awards).

**Online laboratories**

The first main advantage of online laboratories is the possibility to access high-tech scientific instruments (in this case, virtual laboratories) that are normally only available for research purposes. In that sense, it helps to create a link between research professionals and non-professionals, while it will strengthen communication and collaboration on scientific topics and enables the creation of new pedagogical frameworks for inquiry learning. The second main advantage is that in case of more standard virtual labs, compared to real laboratories, students in virtual labs are able to make more experiments in less time, to see phenomena that cannot be seen in real situations, and can be supported with specific (online) and interactive tools.

The main disadvantages of online laboratories are the lack of confidence from the potential users (which will mostly be STEM education professionals but non-researchers), paired with the time needed to learn how to use the tools. When being implemented in educational centres, other difficulties can be found, such as incompatibilities to implement activities using the online laboratories while complying with national or school curriculum or a lack of time to introduce them in the classroom.

**Lesson plans**

Apart from being a useful resource to formulate and execute a lecture or training in an organized manner, lesson plans have one other key advantage, which is the possibility to outline how to introduce innovative pedagogical and educational approaches in the classroom.
Accordingly, any STEM education project whose objectives include incentivising a certain pedagogical approach will usually develop a set of lesson plans. Moreover, while the main target for lesson plans will be educators and students, they offer the possibility to be used for further analysis of educational pedagogies too.

Nevertheless, when put into practice, lesson plans can be quite limited. Most resources to be used directly in the classroom will have to be adapted to a number of elements, like a certain academic curriculum, specific school demands or the students’ performance. Consequently, both their implementation and outcomes will vary greatly depending on the context and will be difficult to extrapolate.

**Portals and Repositories**

The main benefit of developing a web portal is that it ensures sustainability and continuity within a project, working as its central access and being able to integrate an extensive amount of information. Additionally, it will be veritably useful to increase user interaction and to promote project content, tools and other resources. Overall, it has the potential to create a real network that can provide an easy access the most frequently developed project resources. However, the regular update and maintenance of a web portal will require continuous monitoring and a strong information technology team.

**Conclusions and project recommendations**

The article has featured an extensive list of materials and project tools frequently developed in STEM education projects, specifically content materials or resources that enable the provision of STEM content. While it does not portray with a full picture of all materials and resources currently available, it does provide with some relevant and recent examples. It must be highlighted that all materials (in addition to always be adapted to the project objectives) are normally adjusted to the targeted stakeholders. Moreover, it is advisable to keep in mind a number of variables, such as time constraints or available human and financial resources, when producing materials and to reflect on the potential benefits and burdens of each. Nonetheless, the overall approach should always be subject to the main goal the project aims to reach. Finally, and in order to ensure project sustainability, it is commendable to produce a relatively mixed variety of products, in order to help disseminate the project. If the goal is to reach a wider audience, and considering that many products are designed to appeal a certain stakeholder, a greater variety will help to reach a much diverse audience.

**Acknowledgements**

This paper is part of the Scientix observatory series. Scientix, the community for science education in Europe, facilitates regular dissemination and sharing of know-how and best practices in science education across the European Union (http://scientix.eu). In order to help the development and dissemination of different science education projects Scientix has set up the Scientix observatory which provides short overviews on the state of play of different topics related to science education (http://www.scientix.eu/web/guest/observatory). The work presented in this document is supported by the European Commission’s FP7 programme – project Scientix 2 (Grant agreement N. 337250), coordinated by European Schoolnet (EUN). The content of the document is the sole responsibility of the authors and it does not represent the opinion of the European Commission, and the Commission is not responsible for any use that might be made of information contained.