Sciences Education: Mobile Resources for Holistic Learners

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Abstract

INTACT (Interactive Teaching materials Across Culture and Technology), a multilateral Comenius Project involving six different countries develops interactive teaching and learning resources for bilingual education in different science fields and provides them on an online platform developed that allows synchronous, collaborative work at different locations on a shared task. The online platform can also be used as repository and facilitator. Teachers can easily combine existing resources with the developed ones and thereby create new scenarios tailored for their classroom.
The project has created and implemented reliable teaching resources for Mathematics, Geography, Technology, Primary Science, Secondary Science and Environmental Education with the aim to promote a culture of collaboration among students and an interactive approach to learning inside and outside the classroom. Since the technological requirements in schools are diverse, the teaching resources will be implemented in HTML 5, thus ensuring independence of specific hard- or software.
Society is in permanent mutance and education, particularly, the education in sciences, must follow this dynamics e answer to the current demands. The aim is to invest in holistic, scientifically informed citizen, who are capable of adapting to the demands of the modern society. By providing digital interactive resources, the INTACT project is an asset for both students and teachers, since it allows access to several ideas and suggestions to work on sciences in different contexts and, as such, contribute to significative learning in a bilingual setting.
Our resources are attractive, dynamic and intuitive, thus showing an original and innovative approach meeting children's and adolescents' expectations in a language they are used to on their mobile gadgets. The topics approach relevant questions associated with a variety of phenomena belonging to everyday lives, privileging Sciences in the STS perspective (Sciences-Technology-Society-Environment). From the methodological point of view this appears as an essential approach to basic concepts and representations which are a pillar to a more comprehensive and sophisticated understanding of Science and Technology. In this way education in sciences supports the increase of literacy in Children and young people.

1. Introduction

The Comenius project INTACT (Interactive Teaching Materials across Culture and Technology) brings together the Pedagogical University Ludwigsburg in Germany, Complutense University, Spain, Kecskemét College Teacher Training Faculty, Hungary, St. Patrick's College Dublin, Ireland, Polytechnic Institute Bragança, Portugal, Babes-Bolyai University in Cluj, Romania with the main goals: (i) to develop reliable teaching materials for mathematics, natural and social sciences to be used on such platforms as whiteboards, tablet-PCs and smart phones; (ii) to promote a culture of collaboration among students and an interactive approach to learning; (iii) to develop materials in accordance with the national curricula of all the countries involved (DE/HU/IE/PT/RO/ES); (iv) to connect in real time the schools from all over the continent and to provide the students with a truly European education.

2. Education in sciences and the need for innovation

Nowadays education in sciences is viewed as one of the ways to educate active, engaged and informed individuals who are capable of making decisions in the society they live in. In that sense it is unanimous that education in sciences should be for everyone and start at early ages.
According to Sinha and Mason [1] children start building their literacy in the first years, mainly through the exploration of the world by themselves and using the support of adults. Following this perspective we consider that education professionals must stimulate both curiosity and research spirit in children, thus promoting situations and resources which motivate more deep and concrete learning [2].
It is mandatory to allow children to explore their observations and to understand natural phenomena which occur in their everyday lives, as well as factors that influence these phenomena. This allows to develop deep-rooted scientific competences. Still, in the same point of view Harlen [3] considers the

carrying out of research as fundamental in early years as a way to involve children in the natural world, to prove their ideas and develop them.
On the other hand the quality teaching of sciences from an early age prevents the construction and sedimentation of conceptions which are not scientifically rooted and enhances future learnings. Harlen states that [4] in the process of rebuilding and developing ideas the education in sciences must: help learners to become aware of their own ideas and to have access to other people's ideas for comparison; help them to apply their ideas and others' ideas to a problem or situation in order to prove its use in specific situations; to help children to critically think about how ideas can be used and proven and then look for more effective ways to perform those tasks.
All of this requires an effort that can only be made by the teacher if he/she is convinced of the true value of education in sciences. They must also be convinced that the implementation of innovative didactic and pedagogical practices, namely those including values linked to scientific, technological and STS interactions, require appropriate teaching and learning resources. This implies "opportunities for the teachers to become aware of innovative aspects and to reach new ways by explore their practices and finding the appropriate theoretical frameworks to reach new goals" [5] Apart from the adequate resources the adoption of new methodologies and approaches promote scientific literacy of citizen, thus emphasizing social, historical, political and economic contexts.
On one hand it is necessary to work with professionals so that they can understand the holistic nature of this perspective and allow them to value innovative strategies in what is now called the STS perspective (Science-Technology-Society-Environment).
The INTACT project is clearly an example of how this is possible for learners at an early age, but also for older ones, as well as teachers. The available resources comprise several sciences – Mathematics, Geography, Technology, Primary and Secondary Science, Environmental Education – and result as appealing, attractive and innovative.

3. Technology and science: hand in hand

By now technologies are commonly used in teaching and learning scenarios. Current literature includes several examples that show how interactive whiteboards [6,7,8,9,10,11] or mobile devices [12,13] can be integrated in educational settings and as such approach learner's needs. In the last years especially the use of mobiles devices has grown rapidly and has become of growing relevance inside outside and within the classroom. Mobile devices facilitate the possibilities to learn anytime and anywhere, since the personal learning environment can be carried along and learning is no longer limited to the classroom [14]. Clark and Luckin [15] outline the current state of research in the field of mobile learning. Furthermore results and studies are available covering several different aspects [16,17,18,19] in the field.
Technological requirements in European schools are diverse and widespread. Existing resource often require schools to either use a specific technology that demands a specific software (e.g SMART when using SMART interactive Whiteboards) or to be bound to use proprietary software like *flash* that will not work on all kinds of mobile devices. Up to now there are hardly any resources that allow students to work synchronously and collaboratively on the same resources at different locations independent from the technology used.
The INTACT-Project faces these challenges and develops interactive resources for bilingual contexts in sciences and second language learning with a user-friendly technological approach. In order to enable flexibility and independency from a specific software, the resources are implemented using HTLM5. In this way it is possible to use the resources in schools all over Europe with different devices from interactive whiteboards or computer to tablets and smartphones. To allow synchronous, collaborative work at different locations on a shared task an online platform is almost fully developed. The INTACT online platform comprises the INTACT resources and teachers can use it as repository and facilitator. They can easily be combined with existing ones and enables teachers to create new scenarios for their classroom in an intuitive and user friendly manner.
The project addresses the schools' need for reliable interactive teaching and learning resources which are usable in bilingual educational settings as well as in collaborative, synchronous settings across borders and cultures and easily adaptable to individual classroom settings and curricula.
The project presents a set of diversified resources in various fields, available in English and several national languages emphasizing a Content Language Integrated Learning methodology in the case of English. The resources are intuitive, user-friendly and teachers have the liberty to use and explore activities in several didactic ways and according to the target learners. This does indeed respond to the needs of a permanent scientific literacy among all users.

All resources bear in mind scientific rigour and are at the same time appealing. This is also one of the approaches defended in science education, because it makes science closer to the learners and they perceive it as something highly positive.
Our resources definitely allow teachers and other education professionals to implement more innovative resources in specific educational contexts. Beyond doubt these resources are motivating for students and involves them in the process of building solid knowledge.
Each resource within the fields of Mathematics, Geography, Technology, Second Language learning, Primary Science and Environmental Education, Secondary Science and Environmental Education was carefully designed from the theoretical point of view (pedagogy and didactics underlying the resource) and were then developed according to a conceptual framework which was distributed to every member in form of a template. The design of the resources involved a previous discussion with pilot teachers, followed by language review, peer review and eventually experts review. After all these steps the final and definite resources were already presented, evaluated, piloted and are being implemented throughout the whole year of 2015.
Each partner cooperated with at least one pilot school. All resources took into account the different curricula of the countries involved as well as the language level to be used. Table 1 shows the subjects and topics of the developed concepts for the resources from the field of sciences. Other topics and subjects were also addressed.

Table 1 *Developed concepts for resources*

Subject	Topics
Biology	Immune System; Circulatory System
Geography	Climate elements and factors
Primary Science	Creatures of the night; Magnetism; Water expenditure, Light and Darkness
Mathematics	Construction of Triangles

The selection of the resources to be piloted and evaluated at a first step was based on the level of collaborative content, the overall level of development of the Unit of Work/Lessons and the development of the Learning Objects in each. A further criterion was the availability of pilot schools for pairing since the resources to be evaluated were designed in one country but piloted in another in order to check for any faults.

3. The Online platform in itself

Based on the functional requirements collected by the project consortium that consists of university lecturers as well as teacher, the online platform was implemented by an external company.
The online platform integrates three types of behaviours that are key to the project, in a way that is transparent to the users (teachers or educators, instructional designers and students):

1) **Repository of learning objects**: a Content Management System (CMS) to store learning objects created or imported into the system (component database), and semi-automatically described through metadata (LOM - Learning Object Metadata), allowing access and managing permissions to the contents and functionality from each type of user.
2) **System creating contexts and learning objects**: component for the production of learning objects and learning contexts (unit of work with lessons), allowing to create, combine, modify, reuse, and share content or learning objects once or to aggregate them in already existing learning contexts or absolutely new ones.
3) **Cooperation Platform** (Virtual Community): a component that allows working, communication, collaboration, cooperation and interactivity tool among teachers, instructional designers and students allowing synchronous or asynchronous interaction. The online platform can be used as a space for interaction among peers: among teachers, students, teachers and students of different countries. The aim is to foster a community that will grow and develop synergies thus allowing reflection and interaction with objects and learning contexts.

The online platform is based on the open-source Content-Management System Drupal and its learning management system extension Opigno and BigBlueButton.

4. Conclusion

This multilateral project wants to live longer than the timespan of the project, which find its full stop by November this year. The project members believe that the teaching resources implemented in html 5 are more adapted to current and future needs of both schools and learners, thus contributing to make learning as mobile as students' lives. Apart from using the latest background technology to achieve that purpose it combines with the latest trends in the teaching and learning of sciences across Europe.

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