



## VIRTUAL EXCURSIONS: A NEW WAY TO EXPLORE SCIENCE IN CLASS

**Barbara Kieslinger<sup>1</sup>, Teresa Holocher<sup>1</sup>, Claudia M. Fabian<sup>1</sup>, Daniel Gallego<sup>2</sup>,  
Sandra Aguirre<sup>2</sup>, Enrique Barras<sup>3</sup>, Gina Mihai<sup>4</sup>**

Centre for Social Innovation - ZSI<sup>1</sup>, Universidad Politécnica de Madrid<sup>2</sup>, Agora Systems<sup>3</sup>, European  
Schoolnet<sup>4</sup>

Austria<sup>1</sup>, Spain<sup>2,3</sup>, Belgium<sup>4</sup>

*kieslinger@zsi.at, holocher@zsi.at, fabian@zsi.at, dgallego@dit.upm.es, saguirre@dit.upm.es,  
enrique.barras@agora-2000.com, gina.mihai@eun.org*

### Abstract

*The educational platform Virtual Science Hub (ViSH) has been developed as part of the GLOBAL excursion European project. ViSH (<http://vishub.org/>) is a portal where teachers and scientist interact to create virtual excursions to science infrastructures. The main motivation behind the project was to connect teachers - and in consequence their students - to scientific institutions and their wide amount of infrastructures and resources they are working with. Thus the idea of a hub was born that would allow the two worlds of scientists and teachers to connect and to innovate science teaching.*

*The core of the ViSH's concept design is based on virtual excursions, which allow for a number of pedagogical models to be applied. According to our internal definition a virtual excursion is a tour through some digital context by teachers and pupils on a given topic that is attractive and has an educational purpose. Inquiry-based learning, project-based and problem-based learning are the most prominent approaches that a virtual excursion may serve. The domain specific resources and scientific infrastructures currently available on the ViSH are focusing on life sciences, nano-technology, biotechnology, grid and volunteer computing. The virtual excursion approach allows an easy combination of these resources into interdisciplinary teaching scenarios. In addition, social networking features support the users in collaborating and communicating in relation to these excursions and thus create a community of interest for innovative science teaching.*

*The design and development phases were performed following a participatory design approach. An important aspect in this process was to create design partnerships amongst all actors involved, researchers, developers, infrastructure providers, teachers, social scientists, and pedagogical experts early in the project. A joint sense of ownership was created and important changes during the conceptual phase were implemented in the ViSH due to early user feedback.*

*Technology-wise the ViSH is based on the latest web technologies in order to make it cross-platform compatible so that it works on several operative systems such as Windows, Mac or Linux and multi-device accessible, such as desktop, tablet and mobile devices. The platform has been developed in HTML5, the latest standard for web development, assuring that it can run on any modern browser. In addition to social networking features a core element on the ViSH is the virtual excursions editor. It is a web tool that allows teachers and scientists to create rich mash-ups of learning resources provided by the e-Infrastructures (i.e. remote laboratories and live webcams). These rich mash-ups can be presented in either slides or flashcards format. Taking advantage of the web architecture supported, additional powerful components have been integrated like a recommendation engine to provide personalized suggestions about educational content or interesting users and a videoconference tool to enhance real-time collaboration like MashMeTV (<http://www.mashme.tv/>).*

## 1. Introduction

Europe is currently struggling with low achievement in mathematics and science education and a high rate of dropouts. Consequently, the European Union has defined the advancement of science, technology, engineering and mathematics (STEM) related skills as one of the priorities for 2020 [1]. At the same time higher education and research institutions are struggling to recruit highly qualified and motivated scientists. From this challenging situation the idea was born to create an online portal that addresses both issues. On the one hand, science teaching can be made more exciting by providing access to real lab equipment and other resources from the world of science. On the other hand scientific institutions may attract young students into following a scientific career by showing them the excitement of their labs. The Virtual Science Hub, short ViSH, is a hub where teachers and scientists can exchange resources and provide students access to scientific infrastructures such as microscopes, telescopes, etc. Thus the ViSH addresses the need of teachers to engage students in science teaching and the need from the scientific institutions to disseminate their work to a broad audience and the specific target group of adolescents in order to get them interested in science and possibly to engage in a scientific career in the future.

## 2. Designing the ViSH in Partnership

While the project itself was initiated by a small group of educational experts, developers and scientific institutions the active involvement of end users from the very beginning of the conceptual design has been given high priority and the participatory design has become a core philosophy of the project, for the pedagogical concept as well as the technological implementation.

### 2.1 Participatory design

Participatory Design (PD) generally refers to a process where developers, designers and future users of a system engage to work together, exchange perspectives, learn about each other's skills and values and define an appropriate set of requirements. The focus is on bringing to light the tacit aspects of human activities that are usually not articulated [2]. Participatory design assumes that these tacit aspects can be productively and ethically examined through design partnerships in which researchers, designers and participating future users cooperatively elaborate artefacts, workflows, and work environments. Applied tools and techniques allow the participants not only to provide relevant descriptions of the current working processes but also to collect concrete experiences with the future system [3].

In the GLOBAL excursion project the goal of the PD process for researchers and e-Infrastructure providers has been to better understand the classroom context, such as the teachers' practices and experiences from the conduction of experiments in the classroom, the usage of artefacts and technical equipment during experiments, the interaction patterns among students and between students and teachers, etc. For teachers, on the other side, the focus has been to better understand the research interests of GLOBAL excursion project existing e-Infrastructures and technological tools supporting collaboration and eLearning, and possible application scenarios for the use of existing e-Infrastructures in the classroom. Finally the aim was to establish a mutual learning process that required the sharing of knowledge of one another's domain with an innovative product as an outcome.

During a first set of workshops, face-to-face and online, the two domains have been brought closer and an initial level of mutual understanding has been reached. The shared knowledge between teachers, researchers and e-Infrastructure providers has been the basis for the participants to make decisions on what features to incorporate in the ViSH, how to adapt current teaching processes around the features of the new system and how to embedded existing e-Infrastructures into pedagogical frameworks and curricula of the school context.

### 2.2 Pedagogical concept

The pedagogical concept is based on different needs and requirements of today's teaching and learning. The learning units that are making use of resources combined into a sequence and/or virtual meeting are called virtual excursions. Within a virtual excursion, a variety of pedagogical models can be applied: project oriented learning, problem-based learning, inquiry based learning, individual methods, group work, classical plenum teaching, experiments, simulations, case studies, guided

research model, game based learning. The range of teaching methods that can be implemented in the ViSH is very broad and lends itself even for interdisciplinary project work.

By connecting e-Infrastructures, resources and tools with schools, pupils can experience challenging and authentic learning scenarios. Thus students gain insights in scientific real work and relive interest in natural science education. The pedagogical scenario describes the different roles, the tasks for students, the learning activity, the aims, necessary pre-knowledge and skills as well as didactical method and approach. An example of the pedagogical scenario is Doñana. In this scenario, a teacher uses the excursion editor in order to create an excursion focusing on the differences in the types of fauna and animals that one can find in Doñana and in the town/area of the school. Furthermore, the teacher explains what Doñana is about, shows a map and some pictures of the most unique plants and animals that one can find there (pictures are taken from the resources section). The teacher can also integrate one of the cameras and show live lynxes. Students are then asked to collect information and pictures about the plants of their area. For this, they plan a visit to the botanical gardens and they take pictures with the mobile app also provided by ViSH. When they are back in the class and with the help of the teacher, they organise the info and put together an excursion presenting their findings. Finally, they identify the main differences and try to understand the reasons that cause these variations (climate, geomorphological differences etc.).

### **3. Technological challenges and main features of the ViSH**

ViSH is a social network where teachers and scientists share their resources, meet themselves and collaborate. In this section we will present the main challenges in the ViSH design and details about its implementation, pointing out the main features that the ViSH presents nowadays.

#### **3.1 Challenges**

The main challenges designing and developing ViSH were related to the multi-device use of the platform. This problem exists in all websites and platforms especially when external e-Infrastructure resources that use different formats and technologies have to be integrated. To tackle this issue we have used HTML5 [4], the latest web standard, for the development of the platform. Also the uploaded videos are encoded in HTML5 compatible formats so they can be played in any device. Nevertheless some e-Infrastructure resources cannot be used in some devices and cannot be transformed (i.e. Java applets and flash applications) so we detect them and show a warning message to the user.

The last challenge that we faced was the interface design to make the ViSH platform friendly and usable. Three very different kinds of users will access the ViSH: students, teachers and scientists. So ViSH interface was done following the participatory design process explained in section two and considering these user's profiles.

#### **3.2 Features**

ViSH platform is a social network, where users can follow each other acting as a link between science centres and schools [5]. They can also share resources that they have found or have created, as well as e-Infrastructure resources, to be used by others. In order to facilitate the integration of these resources, ViSH has the Virtual excursions editor which allows the creation of a mash-up with these resources in the form of a presentation. This editor presents many enhanced features like the introduction of external resources such as Youtube videos, Flickr images or any website. It also allows the transformation of the presentation into a flashcard [6], offering interactive hot zones that the user can click or touch to show extra information.

Taking into account the overwhelming number of learning resources available in ViSH, personalized recommendations [7] of resources are provided by the system bearing in mind the specific user's profile. In addition, the system recommends users with similar interest in order to encourage the collaboration in the network. Figure 1 shows some ViSH printed screens. Virtual excursions can also be shared synchronously using a videoconference application integrated in ViSH. Therefore teachers and their classrooms can communicate with scientists in real time to go through a virtual excursion and enjoy the resources explanations of the scientists. In addition, ViSH provides smartphone applications (both Android and iOS) to enhance the creation of resources, where users can take photographs and videos, and share them with the community in a very easy way.



Finally excursions can be evaluated by any user following and adapted version of the Learning Object Review Instrument (LORI [8]). The compilation of these evaluations is presented to the users as a bar chart; hence with a simple view the user can see if the excursion meets its learning goals, motivate and engage the students and has enough quality.

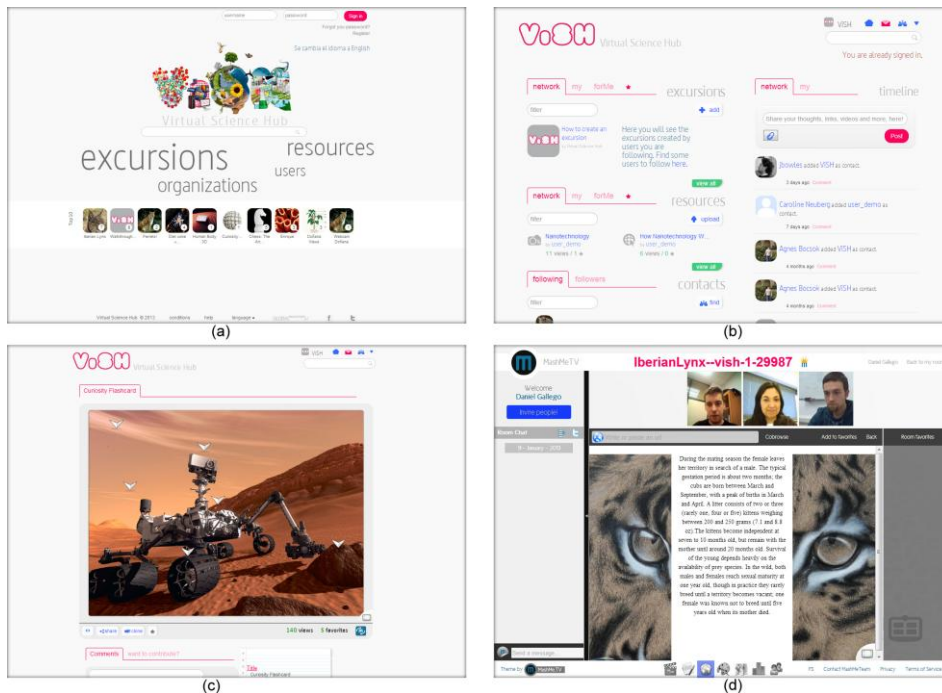


Figure 1. (a) ViSH entry page. (b) ViSH user home with social network features. (c) Flashcard example. (d) Virtual excursion shared synchronously using videoconference.

#### 4. Experience from use

Following a participatory design approach we retrieved user feedback from a very early stage on and can report on some important changes in the design and development of the ViSH that were triggered by user feedback. First of all, the lead users gave important feedback regarding the use of the ViSH for specific teaching scenarios and helped to embed the ViSH scenarios in authentic school settings. Teacher stressed e.g. from the very beginning the use of mobile devices for students to watch excursions. They initiated the introduction of flashcards, the cloning and drafting features for excursions. Lead users suggested the integration of quizzes and the linking to additional online resources and repositories and the federation of resources. While some of these suggestions came early in the design process some of the requested features are the results of some early use of the ViSH. Cloning excursions and being thus able to slightly adapt them and localise them in terms of language, curriculum, etc. has been purely motivated by an active exploration and use of the ViSH in their specific educational contexts.

In addition to the feedback obtained from the teachers, scientists also contributed strongly to the development of the current version of ViSH. The provision of access to scientific infrastructure has been facing unexpected challenges and thus certain conceptual elements of the ViSH had to be redesigned or modified. The mobile apps to upload content on the go e.g. have been triggered by the specific situation in scientific labs and the expensive equipment that cannot be modified easily.

#### 5. Conclusions

A lot of effort has been put into implementing a science hub that truly corresponds to the needs of both sides, the teachers and the scientific institutions. After the official launch in December 2012 target

groups' experience will tell now how the users are responding and how they are integrating it into their teaching on the one hand and the promotion of their scientific work on the other hand.

There are still a few open issues. Language might be a concern and some of the resources might need to be translated and localised. The cloning feature that has been requested by the lead users might be a means to deal with translations in a user-motivated manner. With this option users can clone an excursion and modify them according to their specific needs.

Another aspect that still has to be tackled relates to quality measures and the definition of standard procedures. Following prominent examples, such as a self-regulated process for quality assurance is foreseen and authority should be left within the community, but clear guidelines as how to deal with it still have to be defined. A further challenge for the future development will be the definition of a clear model for promoting scientific institutions on the ViSH. While the current concept is focusing on the individual users, be it teachers or scientists, we plan to offer a space for the scientific institutions as well.

The scenarios developed by the teachers in combination with the use cases that came out of them, reveal the potential that ViSH has to accommodate a wide variety of resources and provide excursions that will be original, of high-quality and based on teachers' curriculum needs.

## Acknowledgements

We wish to acknowledge our gratitude and appreciation to all the GLOBAL excursion project partners, and each one of the project team members, for their contribution during the development of various ideas and concepts presented in this paper. This work is financially supported by the European Union under FP7, Infrastructures.

## References

- [1] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions (2012): Rethinking Education: Investing in skills for better socio-economic outcomes.  
[http://ec.europa.eu/education/news/rethinking/com669\\_en.pdf](http://ec.europa.eu/education/news/rethinking/com669_en.pdf)
- [2] Spinuzzi, C. (2005). "The Methodology of Participatory Design." *Technical Communication* **52**(2): 163-174.
- [3] Kensing, F. and A. Munk-Madsen (1993). "Participatory Design: Structure in the Toolbox." *Communication of the ACM* **36**(4): 78.
- [4] "HTML5" 2012. W3.org <http://dev.w3.org/html5/spec/Overview.html>. Accessed: 12 April 2012.
- [5] T. Holocher-Ertl, B. Kieslinger, and C. M. Fabian, "Linking schools with science: How innovative tools can increase the effectiveness of science teaching in the classroom," in Proceedings of the 2012 EDEN Annual Conference, 2012.
- [6] E. Barra, D. Gallego, S. Aguirre and J. Quemada, "Facilitating the creation of K-12 interactive learning objects using a multi device web tool", in Proceedings of the 42nd ASEE/IEEE Frontiers in Education Conference, Seattle, Washington, USA, October 3-6, pp. 106-111, 2012
- [7] D. Gallego, E. Barra, S. Aguirre and G. Huecas, "A Model for Generating Proactive Context-Aware Recommendations in e-Learning Systems", in Proceedings of the 42nd ASEE/IEEE Frontiers in Education Conference, Seattle, Washington, USA, October 3-6, pp. 1364-1369, 2012
- [8] K. Belfer, J.C. Nesbit, & T. Leacock, Learning Object Review Instrument (LORI) Version 1.5, 2008. Retrieved January 2012. Available at <http://www.transplantedgoose.net/gradstudies/educ892/LORI1.5.pdf>.