518300-LLP-2011-IT-COMENIUS-CNW

Successful Integration of ICT in Chemistry Lessons

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Abstract

For the three years of the "Chemistry is All Around Network" project, the main focus of the Belgian working group was ICT, and particularly how to use ICT appropriately in class so that it can really motivate students and help them understand the topic (integrating experiments, interactions between students...). As planned in the project, teaching resources have been collected and reviewed since its beginning. Yet, Inforef and its teachers involved went further as they used this opportunity to create new resources and train teachers to use them. Different working groups of teachers were formed. Since late 2013, Inforef has organised the testing of those resources in the different schools involved in the project. The audience includes secondary school students of various levels and future science teachers.

1. ICT in Walloon schools

1.1 Background

Based on an official survey [1] by the Walloon Region and a European survey [2] of schools, it emerged that, in comparison with most European countries, Walloon schools are behind in terms of ICT equipment. This has an influence on teacher's use, but it is not the only factor. The survey pinpoints several measures that should be implemented to improve the situation: 1) developing and improving the network infrastructure, which includes an internet connection for each classroom; 2) raising the number of connected computers. Schools already have many desktop computers but they should be better equipped with mobile material (laptop, tablets...); 3) training and assisting teachers to an educational use of ICT. It is indispensable to raise their confidence so that they use ICT in class; 4) creating favourable conditions to command ICT in school. Training "resource people" to provide assistance (not replace!) teachers in the use of ICT and giving those people a status; 5) fostering the creation of digital resources and expertise sharing, for example through call to projects and supports to initiatives; 6) setting up a narrower cooperation between the people active in digital development.

1.2 École Numérique

Of the measures listed in the previous paragraph, the fifth one is particularly relevant to the project activities. One such call to project is called "École Numérique" [3]. This initiative – that literally means "Digital School" – comes from several ministers, including the minister of compulsory education. The call for projects includes two axes:

1. compulsory and continuing education: projects based on an innovative use of ICT in the educational approach;
2. educational categories in colleges: future teachers' initial training to implement ICT in their educational approach and to create educational contents and resources.

The selected innovative educational projects will make it possible to:

- test new ICT-supported educational uses in the context of education through skills, as it is carried out in the French-speaking Community of Belgium ("Fédération Wallonie-Bruxelles");

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- assess the relevance of using, in the context of education, a large array of technological equipment and digital resources;
- identify factors that guarantee the dissemination of educational uses and technologies on which they are based, and the means to solve possible difficulties, at the level of the French-speaking Community.

Two schools participating in the project "Chemistry is All Around" (HELMo and Collège Sainte-Véronique in Liège) were selected to carry out sequences in chemistry: "Using the IWB and modelling to complement the experimental approach". This sequence integrates experiments, ICT – with the Interactive Whiteboard – and the systemic approach.

2. Experiences in the framework of "Chemistry is All Around Network"

A series of ICT resources collected on the "project portal were tested in schools involved in the project. In this section will be presented the most significant results.

2.1 Testing resources in English

Two resources, "PhET" [4] and "BBC School Science" [5], were tested at *Collège Sainte-Véronique* in Liège with 73 students of third, fourth and fifth secondary years (14-17 years old). Those were English immersion classes. Therefore, the students were able to use and evaluate the resources in English.

a. PhET

This website contains nearly forty simulations in chemistry (and more in other sciences) freely available online. Each animation ends with a quiz to assess knowledge. Three animations were tested with the students. The topics were: "Balancing chemical equations", "Build an atom" and "Isotopes and Atomic Mass". Thanks to the animations students could better understand chemical concepts through visualisation of the microscopic level and using different approaches. The animations were used to reinforce subjects seen in theoretical lessons. Each student used it on an individual computer but discussions were allowed.

Teacher's feedback

"Students consider it gave them a clear view of chemical concepts and therefore help them better understand these. Most of them felt they would be able to explain the topic to someone else after using the animations. Students were stimulated by the animations. The students took the quiz as a challenge and tried to answer faster than their classmates. [...] This website is a great source of teaching material. This approach is innovative as each activity includes an interactive animation, with a recap and a quiz at the end. It can clearly help to understand better as it gives another approach to learning with different types of explanations."

Student's feedback

The resources received positive reviews from the students. Most of them enjoyed using it because of the interactivity. They particularly enjoyed the final quiz. They thought this resource fostered interactions and help them understand. Not all of them considered it more effective than books, because it contains less information, but they at least think it fostered practice. Most students think after using this resource they could explain the subject to another student, including those who felt the resource did not teach them much. Several students noted that, unlike in a lesson or with books, they are not disturbed by their mobile phones while using a computer. This highlights the motivating aspect of ICT resources.

Some quotes

"It's funny to learn because we are playing but we still learn."
"It's like a real course but we are the teacher because we do the job."
"We are easily talking and helping each other, and we can illustrate what we are saying with the website."

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b. BBC School Science

The website proposes six activities; three were tested in class on the following topics: Particle model, Atoms and Elements, Compounds and Mixtures. This resource was tested by the same teacher as PhET, in a third year class of sixteen students (14 – 15 years old). Unlike with PhET, it was impossible to use the resource individually because of oral explanations in the animations. The resource was therefore projected on an interactive whiteboard and one student was appointed to conduct the lesson in front of the classroom.

Teacher's feedback

"The activities proposed on this website are useful to reinforce what is seen during 'theoretical' lessons. As it gives a different approach, using individual computers, it may raise the interest of some students. I'm not sure that it can help students understand faster but it can clearly help to understand better as it gives another approach with different types of explanations. I think that this approach is innovative as each activity includes an interactive animation, with a recap and a quiz at the end."

Students' feedback

The students enjoyed the interaction but it was limited as only one student had the possibility to run the activity in front of the class. The video recap and final exercises helped them understand better. Most of them felt they could explain the subject to their classmates after using the resource.

2.2 Discovering the chemical reaction

This resource [6] was tested at *Haute École Libre Mosane* (HELMo) in Liège, with twenty-two first year students. This learning sequence was created by a HELMo teacher, Divna Brajkovic, and Inforef. It favours the experimental and systemic approach of the chemical reaction. Therefore, the activities (laboratory, observations of phenomena, modelling) are organised so as to facilitate a progressive gradation of abstraction levels (from the macroscopic to the microscopic levels). The interactive whiteboard is used as an open and interactive written support all along the sequence. The varied ICT resources integrated on this support makes the modelling of the phenomena, and thus transition to abstraction, easier. Since the resource is addressed to a secondary school audience, it did not teach much in terms of content to those future science teachers; the focus here was on how to use the resource with younger students.

Students could provide their feedback through a questionnaire on the learning platform Moodle. When asked what they learn, most students answered how to use the interactive whiteboard, or further applications of the IWB. Others said it helped them refresh some notions related to the chemical reactions. Students considered the sequence was well organised and stimulating, and could help understand the topic.

2.3 Evaluation of ICT tools – an experience in England

Jerome Kariger, a third year science student who writes his dissertation on ICT in learning, travelled to Portsmouth in United Kingdom. During an observation internship, he tested a resource with English secondary school students. The resource uses animations presented on the Interactive Whiteboard. He then submitted questionnaires to teachers and students to evaluate the resource. This trip also provided the opportunity to observe the methods and technologies used in English science classes and to compare with the Belgian situation and practices. The experience is the object of another conference [7] in this session.

3. Conclusion

Various surveys and projects showed there is a great need and demand for more ICT tools in Walloon schools. Yet they also pointed out that equipment is insufficient without proper training and integration in the lesson. Belgian participants in the "Chemistry is All Around" project worked in this sense, creating learning scenarios that associated students' questioning, experiments and ICT. Testing and evaluation of those experiences showed students were motivated and often understood better than during a "traditional" lesson. Through the involvement of future teachers in the testing, we hope to extend and develop those innovative

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practices.

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[2] European Schoolnet and the University of Liège, Survey of schools: ICT in education, 2013 http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=1800
[3] École Numérique. http://www.ecolenumerique.be/
[4] PhET, http://phet.colorado.edu/it/simulations/category/chemistry
[5] BBC School Science, http://www.bbc.co.uk/bitesize/ks3/science/
[6] Découverte de la reaction chimique, http://chemistrynetwork.pixel-online.org/TRS_scheda.php?art_id=248&lck=&top=&pep=&sua=&tgl=&ltr=&q=
[7] Kariger, J. (2014), “An integrated use of the interactive whiteboard and experiments”

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