

Tablets in Science Education: Experience from Implementation in the Czech Republic

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Abstract

The paper describes a project entitled TABLETARIUM – Tablets in Science Education, currently implemented in the Czech Republic to pilot and evaluate different forms of use of tablets in school teaching.

Within the project we are preparing 18 original tablet apps (for physics, chemistry and biology), using different types of design and all of the main educational tools (e.g. Augmented Reality in its interactive as well as passive form, active GPS locations, student collaboration, and many interactive tasks). As an important part, the programming development stage also involves creating a common platform environment to share data/results within the classroom, working on the generation of final reports, and testing connectivity of the apps with different measurement probes and other devices (microscopes, micro-cameras).

In the education programmes, based on the apps, pupils define problems, search for possible solutions, collect and analyse data, draw, present and discuss conclusions – all this using tablets as their central working tools connected to other devices.

The programmes and individual apps are currently piloted with 2,500 pupils and 100 teachers. Based on this data and on our experience from the development process, the efficiency of the methodology (teaching approaches) and technology (stability, compatibility of tablets with other devices) will be assessed. As follow-up, a strategy for optimal integration of tablet use in science education will be created and presented to curriculum developing institutions in the Czech Republic.

1. About TABLETARIUM

TABLETARIUM is a comprehensive programme of the Scientica Agency Ltd. (Czech company developing interactive forms of scientific education), the Faculty of Science of the Charles University in Prague, and the Czech Technical University in Prague, aimed at identifying and assessing possible uses of multimedia tablets in the promotion and teaching of scientific topics.

Within the programme we have been implementing tablets in school teaching (including teacher training in CPD courses), in extra-curricular education and in interactive exhibitions. TABLETARIUM is also connected to several domestic as well as international projects helping to disseminate its outputs (e.g. ESERO – educational programme of the European Space Agency).

One of the projects within the TABLETARIUM programme is *Tablets in Science Education*, assigned by the Ministry of Education, Youth and Sports of the Czech Republic and by the Central Bohemia Region (*Way of Science and Technical Subjects across the Central Bohemia Region*) to create, pilot and evaluate 18 original apps for physics, chemistry and biology, covering various didactic approaches and teaching tools. The project started in October 2013 and will run until June 2015; then, all of its output including 18 educational apps will be released for use in schools, free of charge.

The project is in line with *the 2020 Digital Learning Strategy*, approved by the Czech Government in October 2014, and with the current national trend to equip schools with tablets.

2. Tablet apps as a basis for educational programmes

As a survey in the teaching community has shown, teachers find it difficult to use tablets in their classes without having precise scenarios for the educational programmes, helping them step by step to go through each lesson and explaining the technically difficult parts.

Tablets are relatively new tools (first released in 2010), so there are no official guidelines for using them in the curricula and, during their studies, today's teachers were not trained to use tablets in classes. This leads to the fact that, in practice, the use of tablets in classes often depends only on the personal interest or technical ability of the teacher; the quality of the lesson then depends on the teacher's willingness/time to find and implement convenient apps. The implementation of existing apps is quite a difficult task – the overwhelming majority of apps are not designed for classroom use, but for self-study, or they are mere “electronic textbooks”, lacking interaction between students and the teacher.

This is why we have made it the main goal of the project to prepare apps designed primarily for use in class, always in the framework of a compact educational programme ranging from one-hour lectures to six-hour project days on a specific topic. The programmes are prepared for teaching in classrooms and laboratories, as well as during practical fieldwork.

Fig. 1. Using of tablets in field work (counting biodiversity in different stages of succession)



3. Design and tools

In order to evaluate as many teaching approaches as possible we have used different types of design and tools in the tablet apps.

Design means graphical/visual interpretation, which can either be based on predefined templates, or be prepared from scratch as an original work. Developing an app in the first way is much easier and faster, but the result looks more or less like “all the other” apps. On the contrary, original graphics are much more demanding (in terms of creation and setting into the programming platform), but the resulting app can be more motivating and more likable for the pupils. For this reason important artists from theatre and graphic environment have been asked to help with the creative character of the design.

Fig. 2. Graphics based on predefined templates – a cheap but not so inspiring option. (Interactive counting of the relation between speed, acceleration and track in the Motion app)



Fig. 3. Original graphics (if prepared well) can intuitively motivate pupils to work with the app more thoroughly. Such graphics also have an important effect on the parents, who adopt a more positive attitude towards modern technologies in schools. (App The World of Birds, chapter Birds in their Ecosystem)



The other meaning of the word *design* is didactic design, expressing the arrangement of control features on the screen and the logical sequences of tasks and activities. Especially important is the orientation of the page (portrait or horizontal), the position of the menu and its composition, and the activity of control elements (what happens when you click on the button to be active).

With our 18 apps we want to cover all of the main tablet tools convenient for education. Besides implementing standard tablet equipment (camera, GPS, gyro) into the apps, we are testing the education potential of reprogrammed “content” tools, such as augmented reality (in active and passive forms), active layers, active GPS location, controlled drawing, zooming, or assigning tags to GPS locations.

Fig. 4. Alternative organisation of menu (app Chemical Bond)

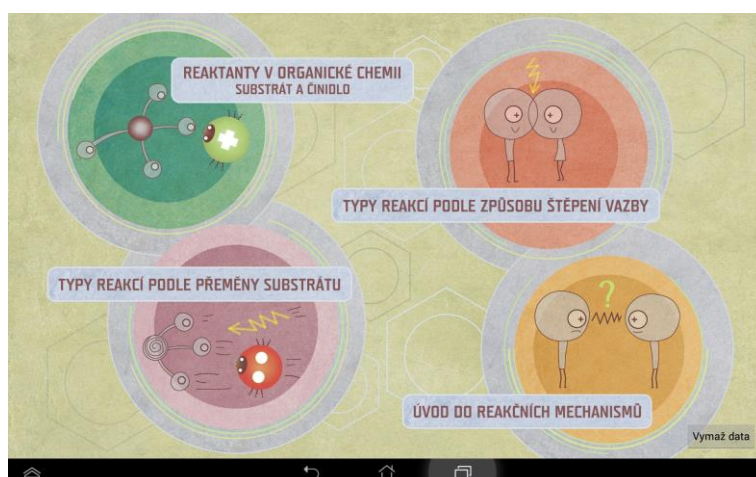
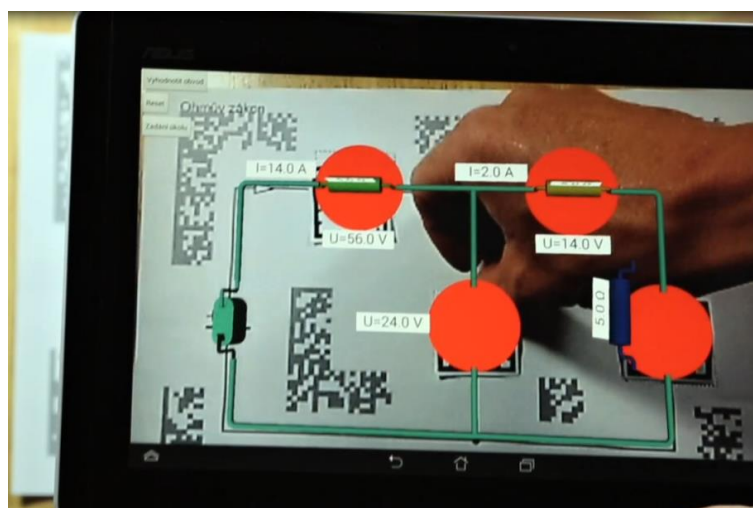


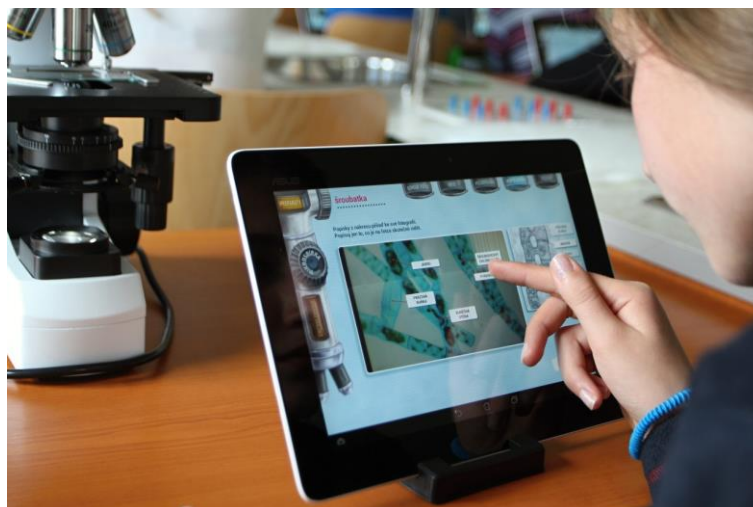
Fig. 5. Augmented reality in active form (putting together electrical circuits according to Faradays' laws).



A special part of the project involves testing the connectivity of tablets with various probes and other devices. For this part of the project we closely cooperate with the company PASCO (world-leading producer of probes and measurement devices for education), using its programming code for on-line connection of probes with the apps. Connectivity with other devices such as digital microscopes and micro-cameras is also being tested.

The programming development stage involves creating a common platform environment to share data/results within the classroom (which makes it possible for several groups of pupils to work together), and working on the generation of final reports which save progressive results and answers throughout the lesson (the reports are then automatically sent to the teachers' account or e-mail).

Fig. 6. On-line connection to the digital microscope and further work with scanned preparation (app MicroWorld)



4. Piloting

The educational programmes and the individual apps are currently being piloted with 2,500 pupils and 100 teachers from 20 schools in the Central Bohemia Region. Several methods for obtaining feedback are being used, including direct observation of the pupils' behaviour recorded with a camera, continual long-term questionnaires for different categories of classrooms, and qualitative interviews with teachers. We also plan to collect feedback from the pupils' parents, and to develop automatic recording of the pupils' activities as a tool directly implemented in the apps.

The project is currently in the middle of its pilot stage; complete results of the feedback will be known in August 2015.

5. Experiences

Although the project is still in its piloting phase and data from the feedback are not complete yet, we can already point to some facts concerning the use of tablets in schools.

First, teaching with tablets has three main aspects: technology (tablets and devices), apps and an educational programme (lesson) which uses them. Using the technology without appropriate content framed in a smartly prepared programme is inefficient, and sometimes even counterproductive.

Tablets in schools appear to be very efficient tools, especially to help explain difficult phenomena (use of videos and 3D animation), stimulate teamwork (sharing of data and progressive results within classroom) and motivate for inquiry-based learning (possibilities of connection to many "research" devices).

On the other hand, the use of tablets requires new skills and abilities on the part of teachers –teachers should be trained to use them during their studies and develop their skills through continuous professional development. The personality of the teacher still remains the key to successful lessons (the younger the pupils, the more important the teacher's personality is); tablets should only be used to help make the lesson more efficient and entertaining, not to take over the teaching role with the teacher stepping aside. It seems important to continuously combine tablet work with manual work and oral presentations and discussions (in order to develop other skills and not to create dependence on tablets), and to use tablets only when it is reasonable.