

# E-Learning Platform for Science Education

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**Abstract.** At the Center for Science Education and Training (<http://education.inflpr.ro/>) we are training elementary and middle school science teachers. In order to provide a broader access to information and to deliver a richer content, we designed an e-learning platform. The platform includes: an archive of learning units (Physics, Chemistry, Life Science or Environmental Sciences), several fora for participating teachers, and a virtual library. The e-learning platform was developed in the frame of the project "Inquiry-based science education for elementary and middle school teachers-Discover!", financed by the European Social Fund and we use it to support teachers' training also in the frame of the European Union funded "Fibonacci" project, our Center is coordinating in Romania.

**Keywords.** E-learning platform, Moodle, teachers' professional development.

## 1. Introduction

The Center for Science Education and Training - CSET, established six years ago at the National Institute for Laser, Plasma and Radiation Physics in Bucharest, has as a main focus the support of science education at all the pre-university levels, from kindergarten to high school. It coordinates at national level the educational network "Hands-on Science – Romania", created as an output of the European Union funded Comenius project "Hands-on Science". Over time, CSET run or was partner in several national and international science education projects such as: "Science Education and Training for a Knowledge-based Society", "Pollen", "Save the Earth", "PHOTON - Problem Based Learning", "Optics and Photonics related drawing contest", "Discover!", "Fibonacci", "Build yourself a carrier", "The would-be researcher".

In the frame of most of our projects we developed science related activities for school students, such as: science fairs, science contests, courses, demo sessions, and students' visits at our Institute premises. The subjects of these activities cover a broad spectrum from the impact of LIGHT on our everyday life to environmental issues or robotics applied to science teaching. Almost every year we are organizing an international event (a conference or a workshop) dedicated to "Science Education in School".



- (1) Dr. Adelina Sporea is a graduate of the Faculty of Chemistry at the "Politehnica" University in Bucharest. She holds a PhD in material sciences. After working for more than ten years in a research institute dealing with rare and radioactive materials she started a research career at the National Institute for Laser, Plasma and Radiation Physics in Bucharest. In the mean time, she devoted some efforts to promoting inquiry-based science teaching at pre-university level.

## 2. Teachers' training programs

As part of our science education activities we focused in the last years on the professional development of science teachers. We are aware that a true reform of the educational system has to start with the way science is taught in school. Our professional development program has as target group in service, pre-university science teachers. For the beginning, we started by assisting elementary school teachers and after that we addressed the middle-school science teachers (physics, chemistry, biology) needs. For teachers we developed training courses and run demo sessions. We are supporting the high school teachers through special projects and dedicated activities.

In dealing with science teaching methods we choose the inquiry-based science teaching model [1-5], as promoted by renown programs and projects such as: "La main à la pâte" [6], "Pollen" [7], "Fibonacci" [8]. This active, constructivism-based methodology supports pupils' creative, participative, social learning development, and encourages the acquisition of new skills such as: learning to develop hypotheses, setting up experiments, drawing conclusions, working in groups and interact with peers, reporting findings, and using research notebooks.

We directed our efforts with a focus on elementary school teachers for several reasons:

- The newly adopted Law for National Education assigns quite an important role to science teaching at elementary level, for the first time in the Romanian educational system.
- Romanian elementary school teachers are not at all prepared to face this challenge, as they miss the scientific and pedagogical background for this task.
- They were not trained to use such a method.
- They are not accustomed to the train students to acquire skills, not only knowledge.
- By their very nature and manner of teaching, these teachers can develop more easily, if properly assisted, interdisciplinary lessons.
- Students at this early age are very curious and are more open to the investigative approach in teaching science and technology.
- At this stage, experiments and simple investigations can be carried out by using trivial materials, at very low cost.

The next step of our philosophy to assist school teachers in dealing with science was directed to middle school science teachers as:

- Middle school (lower secondary school level) represents a transition from a one-teacher educational frame to a multi-disciplinary approach.
- Basic notions on the major science studies at this age (physics, chemistry, biology) are offered to students, so there is no difficulty to integrate these three fields of science
- Simple experiments using data loggers and sensors can be performed in the classroom.

In the case of high school (upper secondary school level) it is by far more difficult to teach science in an integrated manner, as very specific subjects are taught. As compared to the previous two levels, high school science teaching does not permit teachers' training on an integrated course. For this reason, we adopted the project-based approach, when multi-disciplinary investigations can be done in cooperation, by teachers of physics and chemistry, or chemistry and biology. More sophisticated data loggers and sensing systems or even robots can be used to promote science in this case.

### 3. The distance learning methods used

In dealing with the professional development of the first two teachers' categories, elementary teachers and middle school science teachers, we faced the following challenges:

- In Romania training sessions for teachers are organized ONLY in the classical, face-to-face format.
- Teachers do not use extensively the Internet and the electronic resources in preparing their lessons plans.
- There is a great demand for professional development courses on science teaching. In fact, today, there is no such accredited course at any level in Romania.
- Today courses are more or less formal and there is no means to see and to evaluate the way teachers apply in the classroom what they were trained on.
- Romanian teachers use the classical methods for transmitting knowledge, they do not coach students to acquire and use competences.

In order to overcome these drawbacks of the Romanian educational system we devised a modern, revolutionary course set-up. Our teachers' professional development program includes:

- a) a traditional, face-to-face course delivered on demand, at the user's premises or at our facility. Such a course includes theory background presentation, demo sessions, hands-on practice, participants surveys, and covers up to 25 % of the overall training program.
- b) a distance learning module, extended over 65 % of the program time. The core of this distance learning unit includes: unlimited access, for the course duration, to an e-learning platform and to a videoconference server.
- c) several assessment steps (10 % of the program), run either during the traditional course or as the final evaluation of a project developed in the classroom by the course attendees.

This complex and challenging teachers' professional development infrastructure was developed as part of the national project "Inquiry-based science education for elementary and middle school teachers - Discover!", financed from the European Social Fund through the Operational Sectorial Program Human Resources Development, and co-sponsored by the Romanian Government and our Institute. [9], [10]

The distance learning module solves several of the above mentioned limits on the Romanian science education system:

- Teachers from all over Romania can access at any time the educational resources, as far as they are enrolled to the program.
- School teachers are introduced to modern training systems (e-learning, videoconferencing) as a premiere to the Romanian pre-university system.
- Course attendees are more or less "forced" to apply in the classroom what they learn as they are required to prepare their own projects for the final evaluation.
- Through the e-learning platform they gain a higher visibility for their projects and innovative techniques they use.
- A community of school teachers focused on the same pedagogical problems is formed. They can exchange opinions and best practice experience.
- Teachers' feedback to the professional development program can be monitored.

The e-learning platform adopted is based on the open-source learning environment "Moodle". [11] By using "Moodle" we developed a dedicated interface – TeachScience (Figure 1). [12] The platform includes:

- a space dedicated to elementary school teachers;
- a space dedicated to middle school science teachers;
- a virtual library;
- several fora, dedicated to teachers' feedback and announcement of school events.

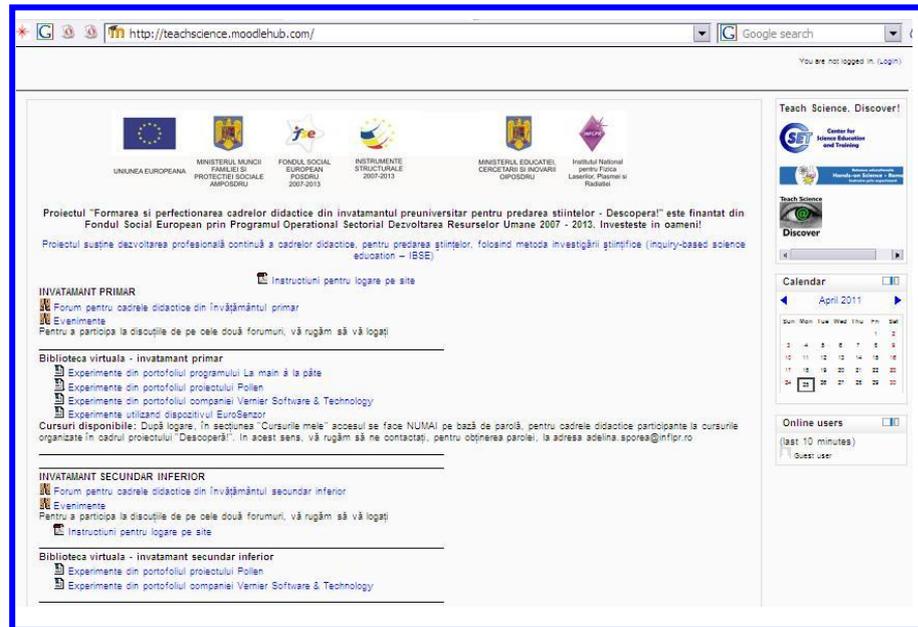


Figure 1. The user's interface for the TeachScience e-learning platform with several fora and the virtual library

In the spaces dedicated to them, each teachers' category can access, after registration, different teaching units tailored according to the national school curriculum, and divided by subjects: physics, chemistry, biology (Figure 2). Each such a module includes references to the curriculum, lists the competences it targets, describes various experiments related to the discussed subject, provide assessment tests for students.

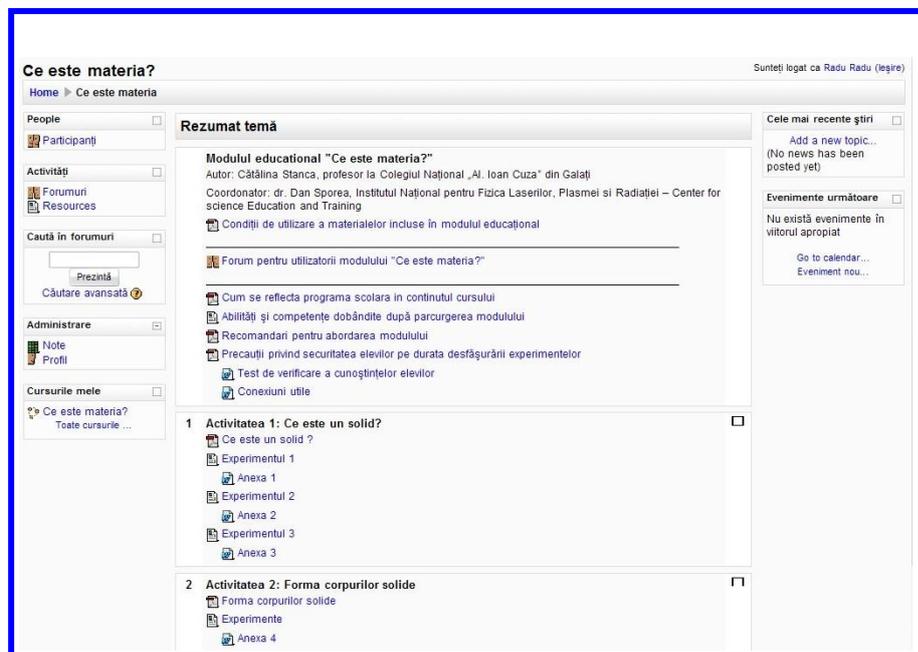


Figure 2. An example of the teaching units available for elementary school teachers structured on several activities containing experiments.

The tests are presented in different very attractive formats such as: puzzles, crosswords, games, animations (Figure 3).

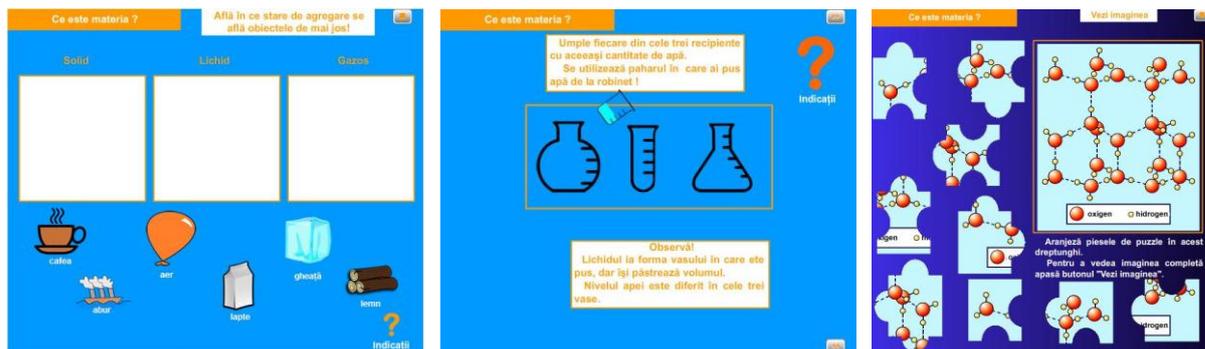


Figure 3. Some examples of the assessment tests for elementary school physics.

After completing the face-to-face course, every course attendee is asked to register to the TeachScience platform and select two teaching units he/ she want to apply in the classroom for the next one month and a half. Within this time span, the teacher has access both to the theory related to the selected subjects and to the associate described experiments he/ she can handle with pupils. Besides that, he/ she keeps permanent e-mail contact with the tutor for support and advice. By the end of this period of time, the candidate has to present a project run in the classroom, project which includes:

- a) a short description of the selected subject theoretical background;
- b) a lesson plan, detailing the pedagogical objectives, the methods used, the resources employed, the time schedule;
- c) a portfolio composed by the files filled by all students participating to the project, underlining their results and conclusions for all the run experiments.

In order to finish the course and to obtain credits for this activity, the teacher has to defend the project before an examination commission formed by the course tutors, locally designated experts and one evaluator from the Romanian Ministry of Education, Science, Sports and Youth department in charge with teachers' professional development programs. Our teachers' training courses are accredited by this department and provide 18, respectively 20 transferable credits. They are the first such courses accredited in Romania.

We are offering an additional support to school teachers through access to dedicated educational movies which can be access on our videoconference server. [13] In this approach, teachers can play on their browser movies illustrating various experiments on physics, chemistry and biology subjects, upon receiving a user name and a password.

Until now, over 400 elementary school teachers graduated our courses and we provided access to educational movies to more than 650 teachers.

In order to build a community of teachers interested into science teaching and to encourage them to develop innovative lessons, we created a space on our e-learning platform where teachers' projects are posted. Some of them developed their own web site dedicated to science education and the way they apply the inquire-based approach in teaching science. [14], [15], [16]

#### **4. Conclusions and future work**

An innovative approach for Romania in the field of professional development of in-service elementary school teachers and middle school science teachers was introduced. The e-learning platform based on the Moodle learning environment was presented along with its basic components. Additionally, the use of a professional videoconference system to support science teaching through educational movies was described.

Based on the available infrastructure we intend to extend these technologies by:

- offering access to a greater number of school teachers;
- providing opportunities to school teachers to upload themselves their project on the e-learning platform, when they will be skilful enough to do it;
- diversifying the subject content of the teaching units;
- organizing on-line assessment of the participants to our courses;
- building a stronger community of science teachers;
- enriching the virtual library content;
- making room on the e-learning platform to school students to post results and comments.

As the “Discover!” project approaches its end, the e-learning platform will contribute actively to the development of additional projects aiming to support science teaching at pre-university level, such as the EU funded project “Fibonacci” or the cooperative bi-cultural project “The would-be researcher” which we run with the French High School in Bucharest.

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