Teaching for lifelong learning, and lifelong learning for teaching

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Abstract. When re-thinking the design of the curriculum for pre-service teachers (in our case in Informatics and Information technologies) we should start with the main question – what these teachers-to-be should prepare their students for? The authors' provide arguments in support of the belief that the school should be oriented to building competences identified as crucial for the citizens in a knowledge/creativity-based society. The paper presents authors' experience in applying some good European practices focusing on lifelong learning in the context of the pre-service and in-service education of ICT-teachers in Bulgaria.

Keywords: Teacher education, competences, lifelong learning (LLL)

1 Introduction

One of the most important features of the citizens of the knowledge/creativity based society is expected to be the lifelong learning ability. In order to cultivate such ability in their students, it is important for teachers and university professors alike to demonstrate that they themselves are ready to learn new things all the time (including from their students). In order to achieve this we should introduce a learner-centered methodology at all levels – from primary school to the University. "Teaching the way we preach" should be applied with special care when working with in-service teachers. Another important step is to build communities of lifelong learning teachers who are ready to integrate the innovative ideas of the younger teacher-to-be generation with the experience and expertise of the in-service teachers.

Before starting to educate the future teachers we should know what their students are expected to achieve according to the most modern standards.

2 Teaching Lifelong learners

2.1. Competencies for the knowledge society

According to the recommendations of the European Union Parliament and the Council, every member of the knowledge society is expected to achieve wide range of competencies the emphasis being on the following eight:

- Communication in the mother tongue;
- Communication in foreign languages;
- Mathematical competence and basic competences in science and technology;
- Digital competence;
- Learning to learn;
- Social and civic competences;
- Sense of initiative and entrepreneurship;
- Cultural awareness and expression.

From those we have identified "Learning to learn" to be the key competence for our setting, especially in such dynamic domains as IT and informatics. Although this competence has often been associated with the modern society it is quite in harmony with the ancient Chinese proverb: *If you give a man a fish he will eat for a day; if you teach a man to fish he will eat for a lifetime; if you* ***teach a child to fish*** *he may feed the world.*

Bringing this educational concept in the context of teacher education has been one of the main goals behind a methodology which was designed and implemented in the frames of the *Innovative teacher* European project (*I*Teach*) [1].

2.2. Methodology to Grow Citizens of Knowledge Society

The *I*Teach* methodology was developed in response of significant number of studies within the EC program *Education & Training 2010* [2]. According to them, a broad range of new competencies are expected from the teachers in the knowledge-based society, e.g. to design, develop, conduct, and facilitate teaching/learning process so as to enhance the so called *soft skills* by means of information and communication technologies (ICT). Thus, the focus of the *I*Teach* project has been on both developing a practical methodology and supporting tools for building *ICT-enhanced skills* – a concept coined to denote the synergy between soft skills and ICT skills. Through the collaborative effort of partners from seven European countries (Bulgaria, Germany, Italy, Lithuania, the Netherlands, Poland, and Romania) the skills identified as the *ICT-enhanced skills* needed the most in the countries involved were the following [3]:

- searching and selecting information
- presenting information
- working on a project
- working in a team

The *I*Teach* methodology is laid on the Project- and Problem-based learning methods. The main idea of the methodology is to build ICT-enhanced skills through *continuous, repeatable* and *gradually accumulated experiences and expanded activities* leading to concrete *goals* by performing specific *tasks* in different *context*.

This methodology is oriented to finding the balance between the full freedom of the learners to choose their learning path, and the necessity to follow strictly the fixed learning path offered by the teacher.

One of the main concepts of the methodology is that of *didactic scenario*. Each *I*Teach* scenario presents an educational goal to the learner, usually formulated as a *challenge,* gathered by brainstorming in the context of "real life" situations and taking into account the interests of the learners. To solve the challenge, learners need to pass through a set of *milestones*, each one associated with attaining specific results. Learners choose their own learning path while moving from one milestone to another. The trainers stay as invisible as possible, monitoring the workflow and helping/intervening only when there is a real need [4].

Thus, an *I*Teach* scenario represents a composition of tasks, to be executed in the context of an active learning environment. The metaphor behind such a scenario is a *path* (the process) traced by *landmarks* (the milestones) leading to the *peak* (the goal) as shown in Fig.1. Following the *milestones* to the final goal, learners gradually develop ICT-enhanced skills.

Fig. 1. I*Teach metaphor

The comprehensive description of the *I*Teach* methodology can be found in the *I*Teach* methodology handbook [5]. It contains explanation of all the active learning methods applied, and specific approaches for the development of *ICT-enhanced skills*. Last but not least, this handbook contains a rich set of exemplary didactic scenarios, designed and developed in support of the *I*Teach* methodology.

2.3. Implementing the *I*Teach* methodology

In order to support teachers to teach lifelong learners in the school settings, a set of textbooks (applying I*Teach methodology) for ICT in 5th, 6th and 7th grade [6] were developed.

The idea has been to meet the specific requirements defined by the national standards together with the more general ones envisioned for the needs of a knowledge/creativity based society. As Chickering and Gamson suggest [7], in order to be actively involved students should not only listen but also read, write, discuss, or be engaged in solving problems. Most important, they should be engaged in such higher-order thinking tasks as analysis, synthesis, and evaluation. Using active learning techniques in the classroom is found vital because of their powerful impact upon students' learning. Our approach is based on numerous studies having shown that strategies promoting active learning are superior to lectures in promoting the development of students' skills in thinking and writing.

These ideas are realized through the *I*Teach* methodology incorporated in our set of ICT textbooks by means of didactic scenarios containing:

- A short introduction in which the **main objectives, both technical and soft skills** to be acquired, are specified;
- **A challenge** - a creative task motivating the introduction of new knowledge and skills, stimulating students to find and describe different ways to the final goal and encouraging the spirit of cooperativeness (Fig. 2);

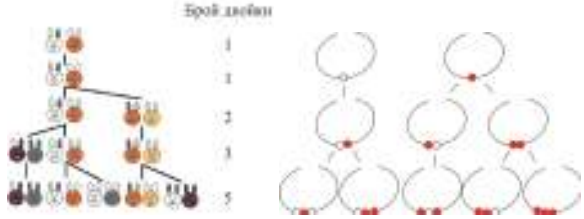

Fig. 2. The challenge: to calculate Fibonacci numbers
in the context of grandpa's rabbits and grandma's necklaces

- **Creative tasks** spread in several subsections, e.g. *Roll up your sleeves*, *Give free rein to your imagination*, etc.
- **Variety of paths to solving the challenge**. To prepare the students for citizens of the knowledge/creativity based society we try to encourage them to discover various solutions to the problem and compare them according to specific criteria (rather than to apply recipes in the *click and drag* style). For instance, after the two columns with different descriptions of opening a specific file an empty column is added to be filled by the students with alternative ways they have discovered (Fig. 3).

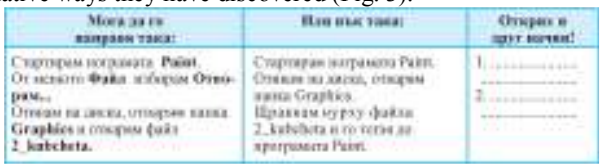

Fig. 3. Describing various ways of opening a graphic file

- A **friendly and collaborative spirit** of addressing the readers

Typical for the structure of textbooks is that there is a common *thread* linking

- the tasks in a lesson (5th grade [8]),
- the lessons in a common ICT theme (6th grade [9]),
- the ICT themes in the whole textbook (7th grade [10])

in the didactic scenarios.

The implementation of these ideas is best achieved in the textbook for 7th grade, the *red thread* being the theme of coding. The *grand finale* is a project requiring the students to put together all the subject knowledge and skills acquired during the school year and to work creatively in teams for the achievement of a common goal. During the project the students are faced with problems from real life and are expected to understand in a natural way *when*, *how* and *which* ICT tools to apply so as to solve the challenge of restoring archeological artifacts (Fig. 4).

Fig. 4. The challenge of restoring ancient vessels

For the purpose students are encouraged to explore computer models (Fig. 5) and to decode a message (Fig. 6) with hieroglyphs so as to help a local museum to restore ancient Greek vessels and guess their function.

Fig. 5. The computer model developed on the basis of an *Elica* [11] application

Fig. 6. The coded message

The project is a stand-alone entity in which students are expected to demonstrate their problem solving skills by means of ICT.

The project is designed as a prototype of a real large-scale project. The tasks in the project are connected at various levels of abstraction. Some tasks can be done in parallel, others require sequential execution. All these details are something which the students must accomplish as a first step of the project. They are also expected to split in teams and distribute work forces according to their skills and the amount of work.

The textbooks are not designed to serve as recipes for a good teaching. They offer examples for work on projects and could be treated as generators of ideas. We expect teachers together with their students to find their own challenges according to their interests and to follow the suggested approach.

3 Lifelong Learning to Teach

3.1. Educating Teachers of Lifelong Learners

It is easy to say "You have good textbooks. Follow the methodology we suggest!", but we found that the teachers needed special type of teaching and encouragement in order their imagination to be unlocked. As discussed by Syslo and Kwiatkowska in [12], changes in education may be expected according to the model for ICT development when the first stage (*Discovering ICT tools*) and the second stage (*Learning How to Use ICT Tools)* are passed, and the third stage (*Understanding How and When to Use ICT Tools*) is reached. Thanks to numerous training courses in ICT for mathematics teachers in Bulgaria the first two stages have been passed successfully. Now the most difficult and important one has come– understanding *How* and *When* to use ICT tools so as to achieve particular educational goals.

The *I*Teach* methodology suggests *How and When to use ICT*. Based on previous experience we were convinced that it was not possible to use the old manner of teachers' training if we wanted teachers to use innovative ways of teaching. That is why we would like to focus on the most interesting question here: "*How did we train teachers?"* The answer is: *recursively* - we, the team of trainers, applied the methodology itself to educate the teachers how to apply it. Usually the training sessions started with a short introduction of each participant answering 3 questions *In which area do you feel an expert?*, *Why do you think you are an expert*?, *How did you become such an expert?*. Through their answers we succeeded to demonstrate that the driving force to learn is the learner's interest and motivation. In addition, answering the third question, they realized that to become an expert you should apply your knowledge many times. But we would make these comments later. In the beginning, it looked just as a non-standard introduction of the participants.

After that, we would conduct a brainstorming session around the topic, which we had previously identified as important and interesting for the participants. As a result, the participants were grouped according to the specific interests they expressed during the brainstorming. Next, they had to solve their first challenge – to plan how they would work as a team on the project on the theme chosen by them. The teachers worked on their project exactly the way we expected their students to work - learning new things in the area they had chosen. Finally, they had to present their results and to

share their achievements with the other participants. Finally, we reflected on their presentation, and asked them to analyze what, and how had been achieved during the training. In such a way the teachers discovered the main ideas of the *I*Teach* methodology by themselves. We guided them to derive the main conclusions about the training process in a group discussion. Thus they felt like co-authors of these new ideas. When you have the feeling that an idea is your own, then you are ready to apply it more easily and with a greater enthusiasm. And as a result, we observed high motivation and engagement in performing all the tasks, which unfortunately is missing in their traditional school practice. In addition, during the training they were encouraged to generate new ideas and challenges, and to prove to themselves that they could be innovative. These arguments were sufficient to motivate them to implement the methodology in their teaching.

It should be noted that the participants were active in the process of learning, playing a central role in it, and completing the training with specific final products developed by them. In addition they felt co-authors of the methodology, having in fact re-discovered its basic ideas during the course. When interviewed at the end of the course, the teachers expressed their high appreciation of the methodology for training teachers (Fig. 7), although in some cases were skeptical about its applicability in a real class setting.

Fig. 7. A teacher proud of her creative integration of various software tools.

More than 500 pre-service and in-service teachers in the last two years were trained to apply the methodology.

First the methodology was probed with pre-service teachers from two Master of Science programs at Faculty of Mathematics and Informatics in Sofia University: E-learning and Technology of Mathematics & Informatics Education.

Next, it was applied during the workshop with in-service ICT-teachers being re-qualified from other subjects, e.g. mathematics, physics, arts, etc. The teachers trained proved the applicability of the methodology in their classes [4].

Later on, the methodology was introduced to pre-service teachers in Mathematics and Informatics in Bachelor of Science Course. Let's note that we would choose specific challenge for each group of students, based on their interests and background.

The workshop, organized as a satellite event of the *Annual Spring Conference of the Union of the Bulgarian Mathematicians*, Varna, 2007 with math researchers and

teachers of highly achieving students in mathematics and informatics, was the next place where the I*Teach methodology was demonstrated in action [13].

During the trainings the teachers pointed out additional conditions for spreading the methodology on a larger scale:

- To continue the training within the newly built communities;
- To harness the power of the collective intelligence [14]
- To suggest to other teacher trainers and University's professors to apply similar methods during pre-service teacher education since – *One teaches the way one was taught*.

These three problems inspired our further activities.

3.2. Teachers and University Professors as Lifelong Learners

To provide a solution for some of the above mentioned problems, we decided to apply our "recursion approach" on the next level – to put some university professors in the role of learners [15]. In order to prepare them to teach teachers in implementing the *I*Teach* methodology, we used again the methodology itself. But we decided to combine the training of the university professors with the piloting of the Personal Competence Manager (PCM) - a tool developed in the frames of the FP6 TENCompetence project [16]. The idea was to use the PCM for both – continuing the training and providing an environment for community building.

Our observation from the *I*Teach* training workshops has shown that the knowledge and competencies gained do not finish with the end of the training [4]. Most of the teachers would face new challenges during their work in the class. Thus they would feel the need of on-going exchange of good practices within the professional community formed during the course. We identified a strong need of the trainees to continue their further competence development preserving all the information channels built during the initial training. The *I*Teach* trainers found the PCM as the most appropriate tool to provide teachers with a relevant support and ensure their lifelong learning. They considered PCM to be a tool for converting an established professional community into a virtual one, rather than just a tool for communication. In addition, we found it very easy to put all available *I*Teach* learning resources and information into the PCM system. But most of all, our expectation was to use successfully the PCM for teachers' competence development and to give them a chance to continue work on e-learning materials in collaboration with other colleagues and students.

Which characteristics of the PCM have been identified as the most important ones for the *I*Teach* trainings? PCM is a system designed especially to support people's personal and Life Long Competence Development. In contrast with existing learning systems, designed around concepts like lecture, course, training program, the main concepts in the PCM are learning network, competence profile, and competence development program [17]. PCM gathers competence related information drawn from sources at multiple levels, and presents this information in a context, structure and format, which are determined by the user.

The PCM system is available as a service-oriented architecture with a Java Eclipse client, with new Web-based client interface planned to be available at the next stage of the TENCompetence software infrastructure development.

The PCM functionalities include forming/joining virtual *communities* (learning networks) with common professional and/or personal interests. Each community can develop different *competence profiles*. For each competence profile different *competence development plans* can be designed, leading to improving or achieving a set of specific *competences*. Each plan may contain various learning paths, comprised by different learning activities and supported by specific knowledge resources (Fig. 8).

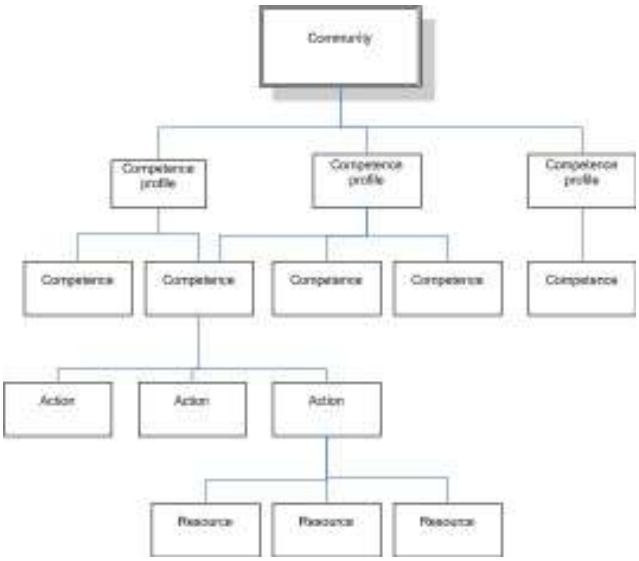

Fig. 8. Structure of the PCM community

When working with the Personal Competence Manager the users can choose their own competence development plans, follow them and thus built the desired competences. They can rate any existing object (plan, activity, resource) in relation to achieving specific competence profile. They can easily share their plans, ratings, resources and ideas using the embedded communication tools. The self-assessment instrument and *best way* map help learners to find the most efficient (for them) learning path through any competence development plan.

All these features make PCM the perfect tool for putting in action the idea of *collective intelligence*, followed by the I*Teach trainings so far.

Having the power of the PCM tool, we chose the same *I*Teach* scenario, we had already used with the teachers, with one small change: asking the university professors not only in what area they have competence, but also to name three areas in which they would like to become competent (to achieve new competences). We turned the university professors in learners the same way we did with the teachers.

The methodology succeeded once again. We managed to train professors to train lifelong learning teachers of lifelong learning pupils.

In addition, through the PCM we stimulated the professors to use the tool for sharing their knowledge and experience among them and the teachers, training later on teachers how to use tools like PCM to build their own communities or to join already existing communities in their area of interests.

4 Conclusions

In a nut shell, the most important competence the future teachers should acquire is the readiness to learn lifelong, to think creatively, to be ready to make choices and to defend their decisions. Not only is it challenging and motivating, but is applicable for the pupils they would teach, as well as for the professors by whom they have been taught. This holds especially for such a dynamic area as the information technologies. Learning concrete facts, even gaining a deeper knowledge, available at a given moment, is far from being enough. After graduating, the teachers (IT teachers specifically) should continue to learn about the novelties in their subject, the methodology of teaching and would be ready to share the joy of learning with their students.

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