Mastering skills using ICT: An active learning approach

N.M. van Diepen¹, Eliza Stefanova², Malgorzata Miranowicz³

¹Institute ELAN, Twente University, PO Box 217, 7500 AE Enschede, The Netherlands, n.m.vandiepen@utwente.nl
²Faculty of Mathematics and Informatics, St. Kl. Ohridski University of Sofia, 5, James Bourchier blvd., 1164 Sofia, Bulgaria, eliza@fmi.uni-sofia.bg
³Faculty of Chemistry, Adam Mickiewicz University, ul.Grunwaldzka 6, 60-780 Poznań, Poland, groch@amu.edu.pl

This paper describes the upcoming of a new type of skill, the ICT-enhanced skill. It is important that pupils master these skills. So teachers must be prepared and they also have to develop learning materials. The I*Teach project offers a methodology for teachers to develop and teach ICT-enhanced skills.

Keywords ICT-enhanced skill; I*Teach methodology; active learning approach

1. Introduction to skills

In secondary education the pupils (in some countries these youngsters aged 12-18 are called students) learn in three domains. They have to acquire knowledge, they have to master skills, and they have to develop an attitude towards their own education. This paper addresses the area of skills.

In the type of skills that pupils have to develop one can distinguish three categories. The first category consists of the course-related skills. During math-class pupils learn how to solve quadratic equations. In chemistry they learn how to handle glassware and how to perform a titration. It is quite obvious that the responsibility for this kind of skills lies with the teacher of that course. Next category is the ICT-skills. During the last two, three decades ICT has conquered the world and has occupied an increasing place in every day life, at home, at work, in entertainment, in school. So in education attention has to be paid to working with ICT, and knowing the basic concepts. Most pupils learn in the schools how to work with file systems, with operating systems, and text editors. Schools organize these lessons, often given by a specially appointed ICT-teacher.

Third is the category of soft skills. These are general skills, needed not only to complete successfully an educational career but also to become a modern citizen. Skills to think of in this respect are for instance information skills, presentation skills, team working skills, and project working skills. These skills are related to the needs of the modern society, where citizens are expected to learn life long, to develop continuously, and to invest in their own education. In the educational institutes it is not always clear who is teaching what skill, if they are taught at all. In the process of mastering these skills pupils are starting to use ICT more and more, although not always in the most appropriate way.

These three facts (increasing importance of soft skills in school and society, unclear responsibility for these skills in schools, and the increasing use of ICT) urge educational professionals to think of ways to solve these problems. They must try to exploit the possibilities of ICT in order to raise the soft skills to a higher lever of proficiency. They must teach ICT-enhanced skills.

2. ICT-enhanced skills

One cannot think away ICT from modern society. It is there and it has its influence everywhere, period. So the mere existence of ICT forces to rethink some aspects of educational practice. But that is a rather negative approach. ICT can also be seen as a challenge and an opportunity to new instructional design. The area of soft skills, the topic of this paper, can benefit strongly from ICT, both in acquiring the skill and in executing the skill.

ICT can make a task, related to a soft skill, easier or simpler or quicker to do. A team of pupils writing a report together, that will be a tedious task without ICT. Assembling the parts, making annotations and revisions, managing the versions, lay-out, all these important aspects of collaborative writing are very difficult in the pen-and-paper world.

Using ICT can also deepen the skill. It offers the opportunity to perform on a higher level. A professional multimedia presentation with text, sound, images, movies, animations (collected from all over the world) is unthinkable without ICT.

A skill can be performed broader by using ICT. It can combine skills, or can force to use in a new area. You can practice collaboration skills in a classroom, but ICT offers the possibility to collaborate on a broader scale.
International co-operation is within reach. This requires extra communication skills and language skills. It also has a strong multicultural dimension, required for the citizen in modern society.

As ICT has such an impact on the essence of the soft skills a new terminology is introduced, the ICT-enhanced skills.

Profitable and proper use of ICT in acquiring those skills and fulfilling the skill related tasks doesn’t come easy. It requires a sound and methodological approach.

3. Active learning

Active learning implies an active role of the learner in the process of achieving new knowledge or skills and is associated with the term learning by doing. Pupils who actively engage with the material are more likely to recall information later and to be able to use that information in different contexts (Bruner, 1961). Piaget (1970), Vygotsky (1978) and Bruner are regarding knowledge as a composition of insights, emerging from a personal construction. Both in Bruner’s constructivist theory, as in the social learning theory of Vygotsky and in Piaget’s genetic epistemology with its concepts of cognitive structure there is an active role for the learner.

This of course has consequences for the design of the educational environment. Gagné (1977) distinguishes nine steps of instructional design. Keller (1983) developed his ARCS model, referring to Attention, Relevance, Confidence and Satisfaction. According to Galperin (1992) an active learning process consists of a stepwise formation of mental acts.

Active learning requires carefully constructed activities that challenge the learners to perform the tasks the instructor has in mind. It can be done in many forms, like problem-based learning, project based learning, discovery learning, inquiry-based learning, simulations, games, writing papers, debating, ... All forms are based upon learning by doing and learners are engaged in their own learning. To develop skills and competences learners must thoroughly reflect on their actions. And last, but not least active learning is often done cooperatively.

4. I*Teach approach

The identified needs for skills and competences relevant to the knowledge-based economy and the independent life-long learning gave birth to the I*Teach (Innovative Teacher) project that started in the autumn of 2005 with the goal of developing a set of practical methodologies, approaches and tools targeted at day-to-day use by teacher trainers and teachers.

A specially developed questionnaire has been disseminated over a wide audience of teacher trainers, pre-service and in-service teachers from Netherlands, Germany, Italy, Poland, Romania, Lithuania and Bulgaria. Analysis of the results led to the conclusion that all over Europe

- information skills
- presentation skills
- working on a project skills
- working in a team skills

were regarded as most important soft skills, that were naturally and necessarily connected with modern ICT-skills. These four skills were selected for the I*Teach project on ICT-enhanced skills. Table 1 from Forcheri et al. (2007) gives a taxonomy of these ICT-enhanced skills.

<table>
<thead>
<tr>
<th>Categories</th>
<th>Subskills involved</th>
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| Information skills       | to determine the information problem  \
                          | to determine the relevance of the various information sources  \
                          | to search by applying relevant techniques  \
                          | to localize and acquire the information found  \
                          | to evaluate the information found and readjust the search  \
                          | to process the information found so as to reach the preset goal  \
                          | to use the information found ethically and legally |
| Working on-a-project skills | to identify tasks and subtasks  \
                           | to make a plan  \
                           | to divide tasks  \
                           | to communicate internally  \
                           | to communicate externally  \
                           | to keep track of the progress |

*See http://i-teach.fmi.uni-sofia.bg/
The idea behind the I*Teach approach is that building ICT-enhanced skills is done through continuous, repeatable and gradually accumulated experiences and expanded activities leading to concrete goals by performing specific tasks in different context (Sendova et al. 2007). This leads to educational scenarios as the base for the methodological framework.

Sendova et al. (2007) define a scenario as “a composition of tasks in the context of an active learning environment leading the students to a general goal (producing a specific product) via a path (working/learning process) traced by milestones (intermediate objectives/ stages of the product development). At each milestone pupils are expected to have finished a concrete stage of the product development and mastered a concrete skill. By passing along the set of milestones the students/pupils would hopefully build up a set of ICT-Enhanced Skills naturally interwoveed with predetermined teaching objectives. “

A scenario is built of tasks. And performing a concrete task the student/pupil works on concrete skill(s) or sub-skill(s). Describing the scenario as composition of tasks ensures reusability in different contexts. Each task is a consequence of activities with concrete outcomes.

The milestones in the scenario’s and tasks are developed thus that they are closely connected to the desired skills or sub-skills.

To assist the teacher using the I*Teach methodology a set of tools has been developed for constructing scenario’s and tasks, for searching in existing materials an for collaboration with fellow-teachers.

### 5. Developed tools

**5.1 Repository**

The base of the I*Teach methodology is the online web-based repository†. This repository stores the scenarios and corresponding tasks developed according to the I*Teach methodology. Selected users can create educational scenarios, by building and composing tasks. Tasks and scenarios are provided with metadata. Among these metadata are the creator, creation date, subject, duration, milestones, age of learner, and so. Very important metadata are the (sub)skill(s) aimed at. Dimitriu et al. (2007) describe the development of the repository.

The repository is multilingual. It supports for now English, Romanian, Bulgarian, Lithuanian, Italian, Polish, and German. This can be extended in the future.

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† See [http://i-teach.info.uaic.ro/iteach/bin/view/Main/](http://i-teach.info.uaic.ro/iteach/bin/view/Main/)
Any teacher can use the repository. By selecting searching criteria the teacher can find scenarios and task suitable for the learning activity she or he had in mind.

5.2 Off-line tool for scenarios and tasks
As said the repository offers facilities to selected users to add tasks and scenarios. Nevertheless the I*Teach team developed an off-line tool to produce tasks and scenarios. It is closely connected to the repository, with exactly the same metadata, and multilingual facilities.

To develop learning material off-line has three big advantages. At first, making learning material isn’t an easy job. It requires writing, rewriting, thinking, rethinking, putting it away for a while, picking it up again. To do this online is too big a demand on the connection to the repository, and to the repository itself. It’s much more productive to build the scenarios and tasks off-line, preview them, and make corrections and improvements. And then it can be uploaded to the repository.

The second advantage is even bigger. Only selected users can upload materials to the repository. But everyone can make learning material off-line. Any teacher can write scenarios and tasks, and hand it over to a selected user. Consequently this user can upload it, perhaps after a quality-check.

The offline tool is also applicable in exploiting the multilingual facilities. Teachers who are multilingual can translate the texts of scenarios and tasks from one language to an other language. Thus all material can be made available in all supported languages.

Appendix 1 shows an example scenario from Sendova et al. (2007), made with the off-line tool. The skills, belonging to this scenario, are also listed, using the tool. The tasks are not printed here.

5.3 Virtual training centres
All participating partners in the I*Teach project are building a Virtual Training Centre (VTC) in their home country. This VTC is a Moodle-based environment that is serving as an online community for anybody involved with ICT-enhanced skills. It provides all a community needs. Materials, links, discussions, FAQ’s, news are part of the VTC. Dodero et al. (2007) give an impression of these VTC’s.

5.4 Paper forms
To help the teacher/tutor the I*Teach project developed some paper forms like templates, guidelines, tips, checklists, etc. Also some sample forms are available for evaluation and assessment of the various skills.

5.5 Application of the instruments
The way a teacher will use the I*Teach methodology is of course a decision of herself or himself. He or she may have done an I*Teach training and got only some ideas from that. One can also follow a procedure like below, taken from Sendova et al. (2007), that leads to proper use of the methodology, and hopefully to fruitful active learning activities of learners.

A teacher enters the repository through the national VTC to find scenarios for specific skills. He finds some interesting scenarios, but these don’t meet his needs fully. He decides to use these as an inspiration and to develop his own tasks and scenario. He uses the appropriate checklists and forms from the VTC. He gets the offline tool from the VTC en fills in the tasks and scenarios. Then he uploads everything to the VTC. The moderator of the VTC checks the scenario and tasks and, in case of approval, uploads them to the repository. The moderator translates the material also into English and uploads again to the repository. Thus all users all over can benefit from it.

Nikolova and Miranowicz (2007) describe some positive experiences with the I*Teach methodology.

6. Enlargement community of I*Teach practitioners
During past two years after the end of I*Teach project community of I*Teach practitioners is enlarged through two main channels – teachers trainings and VTC.

For example, in Bulgaria teachers training continues. More than 700 ICT and non-ICT teachers were trained how to apply developed in the frame of the project methodology. During the trainings I*Teach approach is applied at meta-level: the methodology itself was used by teachers trainers, making teachers as much as possible active. Finally, the results are: - most of the teachers change their point of view on active learning (finding in

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See also https://i-teach.unige.it/
I*Teach balance between freedom and absolute direction): - large group of trained teachers joint to the community of I*Teach practitioners.

In addition, communities of teachers interested in the I*Teach approach are build around the VTC. Using VTC (e.g. in Poland and Bulgaria) to the teachers are introduced the principles of Moodle, as well as how to use distance teaching and learning (implement this form of education to expand their own qualifications). In both countries e-learning is not yet very well grounded in schools and well prepared teaching staff is essential.

VTC (E-edukacja)§ at the Faculty of Chemistry, Department of Chemical Education at Adam Mickiewicz University in Poznań as well as VTC (E-learning)** at Faculty of Mathematics and Informatics of Sofia University St. Kliment Ohridski have been used to teach pre-service and in-service teachers students as well as post-graduate students working as teachers. Various workshops dealing with educational research and methodological materials for teachers are available on both VTCs. VTCs offer also many courses, some of them are delivered remotely. The additional Moodle platforms, in Poland - E-test††, in Bulgaria - Training‡‡, are linked to the VTCs. Both platforms provide to the teachers possibility to create their own on-line courses. The teachers use Moodle forums to share their experience on practice with I*Teach methodology.

The number of new teachers willing to participate in forthcoming courses shows makes us to believe that the community of I*Teach practitioners will continue to enlarge. Furthermore, this confirms that the I*Teach approach works in day-to-day teacher’s practice in international context.

7. Conclusions and questions

Soft skills are influenced by the existence of ICT. It is necessary to design instruction to take advantage of ICT in improving the soft skills: ICT-enhanced skills.

For acquiring skills, not only ICT-enhanced skills, the adagium is valid: learning by doing.

The developed tools may support teachers in their job of tutoring ICT-enhanced skills. But to proof it more research has to be done. The effects and the benefits of the multi-linguality have to be researched, too. And it is also an open question: does this method contribute to the correct attitude of pupils towards learning in general and life-long learning in particular?

References


§ http://zdch.amu.edu.pl/moodle
** http://e-learning.fmi.uni-sofia.bg/moodle
†† http://ezdch.amu.edu.pl/moodle
‡‡ http://training.it.fmi.uni-sofia.bg
## Appendix 1: Example scenario

<table>
<thead>
<tr>
<th>Title: A log-on mechanism for a website</th>
<th>No 1</th>
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</thead>
<tbody>
<tr>
<td><strong>Author:</strong> N.M. van Diepen, C. Terlouw</td>
<td></td>
</tr>
<tr>
<td><strong>Country:</strong> Netherlands</td>
<td></td>
</tr>
<tr>
<td><strong>Language:</strong> English</td>
<td></td>
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</tbody>
</table>

**Description (300-400 symbols)*:** A project team is building a website, for instance for the football club. Part of this site is for members only. This part must be protected by a log-on system. Two team members are to find information on log-on mechanisms. They have to write an internal report on their findings for their fellow team mates. In this report they present the results of their information search and they recommend a specific solution for the members-only part of the site.  

**Age:** 16-18  
**Duration:** 12 hours  
**Subject(s):** ICT, security, web applications

**ICT enhanced skill(s):** see table below

**Active learning method(s):** Two-person task within project work

**Learning objectives:**  
Knowledge of and insight in various log-on systems  
Knowledge on how to insert a log-on system in a web site  
Ability to write a recommendation, based on research  
Ability to explain and defend a report

**Prior knowledge and skills:**  
Operational knowledge of HTML and PHP  
Basic knowledge on databases and SQL

**Results/Products:**  
Internal report to peers

**Process:**  
- **Task 1** Orientation on the information problem  
- **Task 2** Collecting information  
- **Task 3** Internal report to peers  
- **Task 4** Peer-evaluation of recommendation

**Tools:**  
Web-based search engine  
Word processor

**Resources:**  
Evaluation forms  
Checklists

**Student Assessment:**  
- assessment by peers (checklist), both on process and product  
- assessment by tutor (checklist), both on process and product
ICT Enhanced skills

Information skills
- X ability to determine an information problem
- X ability to determine the relevance of an information source
- X ability to search systematically by applying relevant searching techniques
- X ability to locate and retrieve information
- X ability to evaluate information
- X ability to process information effectively, in order to reach a preset goal
- X ability to use the information ethically and legally

Presentation skills

Written presentation
- X ability to select and order information
- ☐ good command of the language
- ☐ ability to structure and build up a report
- ☐ ability to lay-out a report
- X ability to make correct references and citations
- ☐ ability to use a word-processor properly

Oral presentation
- ☐ ability to select and order information
- ☐ fluency in the language
- ☐ ability to structure and build up an oral presentation
- ☐ ability to design an oral presentation
- ☐ ability to make correct references and citations
- ☐ ability to use a presentation tool properly
- ☐ ability of public speaking

Project working skills
- ☐ ability to make a planning
- ☐ ability to identify tasks and divide tasks into subtasks
- X ability to communicate internally
- ☐ ability to communicate externally
- ☐ ability to keep track of the progress
- ☐ ability to integrate results
- X ability to report results
- ☐ ability to use the proper tools properly

Team working skills:
- ☐ ability to communicate internally
- ☐ ability to communicate externally
- ☐ ability to give feedback
- ☐ ability to receive and utilize feedback
- ☐ ability to resolve conflicts
- ☐ ability to support the team loyally, as a good colleague
- ☐ ability to bear responsibility