Chapter 4

Teacher Training Course in Introducing Robotics in the Curriculum - The TERECoP Project Proposal

4.1 The training methodology

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Introduction

In this chapter we present the training methodology that we adopted through the training courses implemented in the TERECoP project and the training and evaluation materials used in the courses. In particular, the training methodology is constructivist in the sense that it is focused on learning experiences enabling trainees to build their own understanding of the technological and pedagogical perspectives of educational robotics. As far as the implementation of the courses is concerned, we adopted a combination of face-to-face meetings with online learning in order to enhance communication and collaboration among the course participants. However, each national team decided on specific aspects of the training context, such as the schedule, the trainee's profiles, and the activities developed through the course.

Research on the implementation of innovations show that it is not easy to change teacher behaviour (Fullan, 1991). When designing a teacher training course, it is useful to remember the educator's maxim "teachers teach as they were taught, not as they are told to teach". Thus, trainers in constructivist professional development sessions should better configure learning activities that teachers can apply in their own classrooms. It is not enough for trainers to describe new ways of teaching and expect teachers to translate from talk to action; it is more effective to engage teachers in activities that will lead to new actions in classrooms.

The training methodology that we adopted cite a constructivist precept: learning takes place as people build their own understanding of a subject or set of skills; the act of building understanding is more meaningful to learners than the memorization of facts or procedures. The training course is constructivistic in the sense that we provide experiences that enable the teachers to build their own understanding of the technological and educational perspectives of educational robotics and the design of robotics-enhanced activities (Papanikolaou, Frangou, Alimisis, 2008).

4.1.1 Design characteristics of the teacher training course

Constructivist professional development gives teachers time to make explicit their perceptions of learning (e.g. is learning a constructive process?), teaching (e.g. is a teacher an orator or a facilitator, and what is the teacher's understanding of content?), and professional development (e.g. is a teacher's own learning best approached through a constructivist orientation?). Furthermore, such professional development provides opportunities for teachers to test their perceptions and build new ones.

Based on the above ideas, we developed a constructivist teacher training course, during which teachers work on projects in order to build their own understanding of the technological and educational perspectives of educational robotics. In our case, teachers are trained based on the methodology for designing robotics-enhanced activities (see Chapter 3, Section 3.1.3), which is also the main focus of the training course. The particular course integrates the main principles of constructivism, constructionism and project-based learning aiming to create a powerful learning environment with a balanced whole of cooperative, learning- and teaching-focused approaches.

Learning tasks of the course were organized as small or large scale projects that encouraged trainees to design and develop their own products. Themes of the projects were either ill-defined by the trainer or freely chosen by the trainees. In that way, trainees had the opportunity to express their own ideas and to select themes close to their professional needs and personal interests. Therefore, trainees were 'personally connected' with their projects, a fact that forms an additional requirement for invaluable creative work and effective learning (Resnick, 1991).

The *active involvement* of the trainees in all the parts of the course was of high importance. A teacher training course can contribute to the professional development of teachers by forming relations between teachers' existing experiences and the proposed new educational technologies. So, from the beginning of the course, trainees were encouraged to express themselves and to participate in all activities of the course through work and discussions in small groups, presentations in plenary sessions and publications on the e-environment. In this way, current ideas, beliefs and attitudes of the participants were made explicit and evaluated within the constructivist approach.

Throughout the course, all trainees were working autonomously. The role of the trainer was to facilitate the learning process by creating an interesting and stimulating learning environment: giving feedback at regular intervals, raising interesting questions, guiding the research concerned and synthesizing ideas. Trainees, on the other hand, were responsible for their work, they could follow their own path in their exploration and could develop their own ideas. They were supported in their work by appropriate resources, such as worksheets, representative examples and

user guides. Diaries were kept where the activities of each session were recorded with a view to addressing the most important issues.

Finally, a constructivist learning environment is based on *cooperation*. Social interaction within small groups generates a fruitful learning environment, where ideas are expressed, discussed and developed. So, most of the learning tasks were performed by trainees working in small groups.

To enhance the sense of community and promote collaboration through the course an e-workspace was also maintained. Through this e-workspace, teachers are able to ask questions easily and efficiently outside the classroom, contact and ask trainers/peers to clarify doubts and problems, exchange ideas and share resources. Moreover, trainers are able to make announcements to the class and provide resources and support in a more efficient way. Finally, the e-workspace was used as a common 'meeting' space that promotes a sense of community among the teachers and of contiguity after the completion of the training course.

4.1.2 Constructivist views of learning and teaching

The main principles of constructivism, constructionism and project-based learning are building elements of the training course. These principles and their implications to teaching are briefly introduced in this section.

Constructivism. Central idea of constructivism is that human learning is *constructed*, that learners build new knowledge upon the foundation of previous learning. This view of learning sharply contrasts with one in which learning is the passive transmission of information from one individual to another, a view in which reception, not construction, is the key. Constructivism has roots in philosophy, psychology, sociology, and education. But while it is important for educators to understand constructivism, it is equally important for them to understand the implications this view of learning has for teaching and teacher professional development.

Two important notions orbit around the simple idea of constructed knowledge (Hoover, 1996). The first is that learners construct new understandings using what they already know. Learners come to learning situations with knowledge gained from previous experience, and prior knowledge influences what new or modified knowledge they will construct from new learning experiences. The second notion is that learning is active rather than passive. Learners confront their understanding in light of what they encounter in the new learning situation. If what learners encounter is inconsistent with their current understanding, their understanding can change to accommodate new experience. Learners remain active throughout this process: they apply current understandings, note relevant elements in new learning experiences, judge the consistency of prior and emerging knowledge, and based on that judgment, they can modify knowledge.

Key assumptions of the constructivist perspective are summarised below (Driver and Bell, 1985):

- What the students currently believe, whether correct or incorrect, is important;
- Despite having the same learning experience, each individual constructs on individual meaning;
- Understanding or constructing a meaning is an active and continuous process;
- Learning may well involve some conceptual changes;
- Learning is not a passive process, but active and depends upon the students taking responsibility to learn.

Constructivism has important implications for teaching that should be carefully considered when designing teaching and learning (Hoover, 1996):

- Teaching cannot be viewed as the transmission of knowledge from enlightened to unenlightened; constructivist teachers do not assume the role of the "sage on the stage" but rather "guides on the side" who provide students with opportunities to test the adequacy of their current perceptions;
- If learning is based on prior knowledge, then teachers must notice that knowledge and provide learning environments that exploit inconsistencies between learners' current perceptions and the new experiences. This challenges teachers for they cannot assume that all children understand something in the same way. Further, children may need different experiences to advance to different levels of understanding.
- If students must apply their current perceptions in new situations in order to build new knowledge, then teachers must engage students in learning, bringing students' current perceptions to the forefront. Teachers can ensure that learning experiences incorporate problems that are meaningful for students, not those that are primarily important to teachers and the educational system. Teachers can also encourage group interaction, where the interplay among participants helps individual students become explicit about their own understanding by comparing it to that of their peers.
- If new knowledge is actively built, then time is needed to build it. Ample time facilitates student reflection about new experiences, how those experiences line up against current perceptions, and how a different understanding might provide students with an improved (not "correct") view of the world.

This constructivist view of learning also influences the role of teachers. The main task that teachers are assumed to perform, according to constructivism, is no longer the transmission of knowledge, but the facilitation and coaching of learning (Korthagen, Klaassen, & Russell, 2000).

Constructionism. What is the difference between Piaget's constructivism and Papert's "constructionism"? As Ackermann (2001) suggests "Beyond the mere play on the words, I think the distinction holds and that integrating both views can enrich our understanding of how people learn and grow. Piaget's constructivism offers a window into what children are interested in and able to achieve, at different stages of their development. Piaget suggests that children have very good reasons not to abandon their worldviews just because someone else, be it an expert, tells them they are wrong.

Papert's constructionism, in contrast, focuses more on the art of learning or 'learning to learn' and on the significance of making things in learning. Papert is interested in how learners engage in a conversation with [their own or other people's] artifacts, and how these conversations boost self-directed learning and, ultimately, facilitate the construction of new knowledge. He stresses the importance of tools, media, and context in human development. Integrating both perspectives illuminates the processes by which individuals come to make sense of their experience, gradually optimizing their interactions with the world."

Moreover, Papert also approaches the issue of relevance and emotional attachment with an observation that by adding new objects such as "cybernetic construction kits" for LEGO/Logo, children might "want to learn it because they would use it in building" (Harel and Papert, 1991).

Papert (1980) and later Resnick (1994) lay out a vision for learning-by-design which enables students to learn by participating in the design of digital environments, such as Digital Manipulatives (Resnick, 1994) and Logo (Papert, 1980). Within the constructionist framework, the learner is not a passive recipient of information; rather s/he is an active participant in the learning process, working to construct knowledge through experience, thus shifting the control of digital learning into the hands of learners. Papert (1980) describes four learning-by-design principles:

1. Individuals are active learners and control their own learning process;
2. Individuals create concrete, tangible evidence (artefacts) that reflect their understanding;
3. Artefacts are shared collectively as well as reflected upon individually to extend one's understanding;
4. The learning problems and contexts are authentic, that is, they focus on solving a practical problem.

As an extension of constructivism, the constructionist approach involves learners building knowledge and meaning through the construction of something *external* or *shareable* (Papert, 1991). Furthermore, such a process also provides a motivating context for students to learn the subject matter and content and test their knowl-

edge. Just as maintained by Puntambekar and Kolodner (2005) that when students are engaged in cycles of designing, evaluating, and redesigning, they have also the opportunity to confront their understanding and misunderstanding of concepts (p. 185). This means that the learner is a designer, rather than just the receiver of designed materials. The teacher is thus charged with designing/creating a learning environment within which the learner can explore and create. Facilitators later serve as advisors to learners, who are dealing with their own needs within the environment (Hannafin & Hill, 2002).

Papert (1991) described the value of construction as actively engaging participants in creating something that is meaningful to themselves or to others around them. Constructionism urges learners to build a context for learning through community-supported collaborative construction (Bruckman, 1998). In this way, a constructionist learning environment can provide learners a self-motivated and peer-supported environment

Educational robotics. Some general principles may be derived about how constructionism may be applied to educational robotics and the role of teacher in this context:

- Educational Robotics is not taught to add new competences to traditional curricula; actually, it is not taught at all. It acts as a problematic challenge to both, teachers and students, to address practical problems, where other competences can be exploited to find effective solutions that are hereafter used as argument of discussions and as source of new problems.
- Guidelines on using educational robotics can refer to specific (programming) languages and robotic architectures (kits), but they should not strictly depend on them. The goal should be how to instil a 'Logo spirit' when constructing, programming and moving robots: experimentations with different languages and robots could result in much more methodological validity. Moreover, suggestions (and not compulsory recipes) on how conducting discussions and on possible improving the given solutions must be supplied together with basic materials, such as constructing instructions, program skeletons etc.
- Even in robotics there is no "right/wrong" dilemma: the learning activity proceeds step by step refining the problem specs and improving the more or less acceptable found solutions. It will be very common that the teacher has to afford unpredictable or at least unknown situations during which he/she is co-learner with his/her students. These situations will spontaneously arise during the lab activities because of the nature of robotics itself, and they give new opportunity to teachers and students to try out their skills and eventually their 'believed' limits.
- If we want to emphasize the "constructional side" of digital technology in spite of its "informational side", educational robotics is a perfectly balanced synthe-

sis of "material" (the robot) and "immaterial" (the program) construction. In this sense, other activities, such as exchange of experiences and guidelines through the Internet, can be allowed without the risk of becoming prevailent over the mainstream activity.

Self-awareness, self-efficiency, self-regard, self-assessment, self-rewarding should be the focus in designing experiences with educational robotics. The role of the mediator is important as a co-learner during the developing and problem-solving phases.

4.1.3 The e-workspace

In order to enhance class communication and cooperation during and beyond the face-to-face meetings, we developed an e-workspace that we maintained throughout the course. To this end, we used the open source e-class platform offered by the Greek Universities Network and the University of Athens (http://eclass.gunet.gr).

Trainers used the 'virtual class'

- to *provide* trainees with *resources* (course content, worksheets, presentations) and *support* such as timely information about the course content & scheduling, useful resources and links, on-time support through the public areas of 'announcements' and 'forums',
- to *promote a sense of community* among the members of the class (trainers and trainees) providing opportunities for communication/collaboration and sharing of resources during and beyond the face-to-face meetings.

The e-class was organized to support communication and collaboration at two levels: at *class* and *group* levels. To this end, we used *public areas* for all the members of the class with different rights for trainers and trainees, like the 'Announcements' area that permits trainees to make announcements to the class, the 'Documents' area that allows the trainers to upload content, whilst trainees can only download the available files, the 'Agenda' area that allows the trainers to describe the course structure with time and session information, the 'Links' area where the trainers may suggest interesting Internet sites to the trainees, the 'Forums' area for discussing topics, where trainers and trainees are allowed to create discussion topics and submit messages.

We also arranged *private areas for each group*, where trainees could upload their products when working with activities (such as programs or texts, the group diary kept at the end of each session, the materials of their own project), discuss topics, and exchange e-mails. This area was also accessible to trainers. In several cases, the trainees could share their group products if these were copied in the public area.

During the course, we used the *public areas as tools* for *administration purposes*, for example, for providing the course content and worksheets before each session and timely information about the course organization or each session, as well as the *public and private areas* for *teaching purposes, promoting reflection and social interaction.* For example, we used the public forum to organize a 'helpdesk' where everyone could submit a problem or provide a solution, to stimulate trainees introduce themselves and share their expectations, to make trainees express themselves in specific discussion topics, share and reflect on their peers' ideas, experiences, and perspectives - e.g. trainees at the end of each session submit a comment on their learning experiences of the day or suggest interesting and useful links on the Internet.

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