4.6 Experiences from the TERECoP course at the Charles University in Prague

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4.6.1 Introduction

A pilot course was organized by the *Department of Information Technology and Education* during the summer term of the academic year 2007/2008. This optional subject was offered to the 4th class students of the 5-year Master degree studies of the Technical and Information Education, in combination with another general educational subject for the 2nd level of elementary and intermediate schools (secondary schools). Twelve students enrolled for the course, two trainers were involved in its preparation and realization. The students attended six educational sessions, each lasting 3.5 hours. Beyond these sessions, students could take advantage of regular consultations. Due to the compulsory pedagogical practice, mandatory for the 4th year students, the course was divided into two parts: the first two sessions dealt predominantly with the theoretical problems of constructivism, constructionism and robotics, while the next sessions involved mostly practical activities. Alike as in the other partners' international courses, the goal was to prepare the future teachers of the Technical and Information Education for a factual use of the acquired pieces of knowledge and skills from the field of robotics in the constructivist education during their pedagogical practice.

4.6.2 The training course

The lessons took place in a specialized ICT laboratory of our department. Students had available personal computers with installed programmes, necessary for their working (the Software LEGO Digital Designer and the Software Mindstorms Edu NXT Programmer). All course participants had the possibility to work independently on their practical assignments – there were more computers and building sets available than students - however, working in couples has proved to be more practical. The necessary supporting materials were available through the standard learning management system LMS Moodle, currently employed at the department, e.g. for curricula, theoretical resource texts, instructive presentations, demonstration programmes etc.

The course has been realized in compliance with the standardized curriculum, created and approved by the project partners (see chapter 4). The only introduced modification had been splitting the course into two parts, in connection with the obligatory student work experience.

The individual sessions had the following contents:

1st Session – *introduction to the problem area; motivation; theory (1st part)*

- Students have been acquainted with the course curriculum, with the supporting course Learning Management System Moodle, with the educational materials.
- Interactive presentation of the working possibilities of the LEGO Mindstorms NXT building sets and of the relevant software.
- First part of the theory explanations (constructivism, constructionism, robotics).

2nd Session – *theory (2nd part)*

- Second part of the theory explanations (constructivism, constructionism, robotics).
- Discussion.

3rd Session – *practical activities – familiarization with the LEGO Mindstorms NXT building sets*

- Practical activities with the LEGO Mindstorms NXT building sets, familiarization with the sets, building of simple models according to instructions, programming with the use of example programmes and tutorials.

4th Session – *practical activities – advanced work with the LEGO Mindstorms NXT building sets*

- Practical activities with the LEGO Mindstorms NXT building sets, building of more complex models and their independent programming.
- Preparation of designs of advanced models with the use of the Lego Digital Designer software.
- Identification of assets and liabilities and discussion pertaining to the educational use of assembled models.

5th Session – *practical activities – robots employed as an educational object and training instrument*

- Demonstration of various educational projects with the employment of robots, constructed with the use of the LEGO Mindstorms NXT sets.
- Preparation and implementation of one´s own educational projects (just a part of activities, with their continuation out of school).

6th Session – *conclusion – project presentation, evaluation of the course*

- Presentation of the worked-out educational projects.
- Assessments of projects, evaluation of the course.

Approximately in the last third of the course, students were engaged in their own individual projects, pertaining to the educational use of robotics in the constructivist education. Results of their work were presented at the end of the course, when the evaluation of the course was also carried out. The resulting outputs formed the basis for the course appreciation, besides taking into account other available sources (e.g., outcomes from discussions with students, results of continuously tackled assignments, etc.).

4.6.3 Training experiences and results

During the entire course, in our capacity as the course organizers and educators, we had noticed an unusual excitement over both, the assigned tasks and the related non-compulsory exercises (that holds good especially for the area of practical dealings with the LEGO Mindstorms NXT sets). On the other hand, at the final stage, when the formal outputs of activities had to be presented in a prescribed standard form, we were astonished by the students' reluctance to complete successfully the started work. Approximately just one third of the student projects was of a high quality and was presented in a timely manner. The remaining students had finally met the requirements, but with a delay and their projects were of poorer quality.

Four projects have attracted attention:

School bus: The project deals with the simulation of the school bus task. The fully equipped robot uses three different sensors – optic for the perception of the line representing the way to school, sonar for passengers' identification, and touch for the final stop. The task of the robot is to go the whole way, stop by every pupil staying next to the way, arrive with all passengers at school and finish there.

Vehicle that observes the speed limits: This project is based on the use of pen fixed on the specialized arm. Robot can put it down and draw the line during the movement. The task is divided to two steps. It is necessary to set the motor of both wheels to the level on which the drawn line is straight first. Then the experiment is realized. The robot goes for 5 seconds, for 3 of them with the pen switched down. From the known time and measured distance the speed could be calculated. Finally the table of investigated speeds corresponding to particular engines sets is build.

Security guard: This project brings the theme of alarm designing to classroom. Pupils are introduced to the possibilities of different systems by the discussion first. Then the functions which could be fulfilled by the Lego Mindstorm are found – touch sensor for door opening, sonar for object penetration, general sound

detection, smoke detection etc. Connection with the possible use of GPS and mobile connection is also discussed. Finally pupils make experiments with own robots. The task includes the schedule for round trips, violators warning and alarm switching.

Economy train: The main aim of this project is to improve the classroom environment, make pupils more active and involve the innovative pedagogy into the curriculum designed in correspondence with the new Czech educational system. The activity uses the normal wheel based robot equipped with the light and sound sensors. The robot as a train goes following the drawn line as a track. The economy principle is taught by the fact that the train stops on the station only if the sign by the hands clap appears.

All the projects mentioned above have been thoroughly elaborated, with an above-standard involvement of students in the implementation of project goals; besides that, the projects overreached the ICT region, penetrating into other disciplines.

Along the class sessions, a range of practical findings have been achieved, over the scope of the defined TERECoP international curriculum and beyond the experience of other European partners – so many findings that, presently, it was impossible to make a full use of them. It is hoped that these outcomes will be found useful in future courses at home and abroad. Let us introduce two examples:

The utilization of multimedia in the courses has proved to be very important. Throughout the courses, we took photos of some of students´ working processes and of some of students´ results and recorded them in video sequences. Unfortunately, these activities had not been performed systematically. We had realized only during the course that a well-thought out capitalization of the digital photography and of multimedia could be of a considerable use.

For the future, we might think of procuring a quality video recording of all important course parts and of using the records, for instance, for a distant support of other courses and the relevant assessments. We also intend to recommend to our students to make the best out of using photos and video records in their individual projects. Of benefit there might be, e.g., records of working procedures when constructing robots, records of robot activities, factual presentations regarding preparations of particular project segments, instructional pictures, videos, and the like.

A relatively profound support had been extended to the course participants on the part of the trainers. It still might be more extensive in the future. Even a material support might be envisaged, next to the present contentual assistance - for instance by lending set boxes to students out of the faculty, enabling them to work at home on their own projects, with a consecutive successful attestation of the results achieved at school.

4.6.4 Conclusions

Without any doubt, principles, methods and processes of the constructivist education have their indispensable place in the Czech educational institutions and complement properly the other, generally utilized concepts. However, a reasonable preparation of trainers and educators, who are willing to use this approach, is a necessary condition. Teachers of the Technical and Information Education, wishing to utilize this educational method, may profit from the potential of ICT and robotics, with the aid of which it is easy to realize many activities more easily and with excessively better results.

A preparatory course of such teachers on the use of robotics in the constructivist education has taken place in its pilot run at our working unit. It has offered students a possibility to learn more about the theories of constructivism and constructionism and has inspired them to take advantage of new educational technologies. A successful realization of these practices and the awoken positive response have persuaded us that the goals, course topics and thematic directions, as well as the choice of the students addressed, have been properly executed. An important aspect for a smooth realization of the course was an existing excellent background, based - among others - on the availability of an extensive theoretical base and on a quite satisfactory material outfit; this implication had coherence with the course inclusion in an international project (TERECoP).