Teaching and learning
design through the web

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Abstract

“…The students will deal with technological contents which focus on problem solving processes based on human needs.” (The syllabus for science and technology in lower secondary school in Israel, 1996)

ORT Israel Middle School is leading the implementation of new concepts in technology education. A model of a design process is used as a systematic and organised tool for teaching and learning technological problem solving.

The ORT Israel Research and Development Center has developed a variety of materials to promote design education:

1. a book – *Everything Starts with Design*
2. video activities – an educational kit that fosters design education
3. Internet site – a virtual learning environment.

The Internet site is linked with classroom activities. The teacher in effect acts as the tutor for problem solving skills – the design process. Each group of students chooses a problem from a bank of everyday situations and follows the process through the site. In every design step the students are exposed to another aspect of the process through an example and interactive activities. Every stage can be documented using a portfolio template that can be downloaded, printed, completed and evaluated. The site is supported by a virtual teacher whose main task is to help groups from different places to collaborate and share ideas about the same problem as a community.

The site was launched in September 1998. The course was offered to schools through the ORT Israel virtual school. Fifteen classes (20 students each) studied a model of a design process through the net. Through the presentation we are going to report, following the first two years, about the advantages and the current dilemmas of using the virtual course. The website (which was translated to English) will be introduced with the didactical concepts and a discussion will raise some intermediate conclusions based on our experience.

Keywords

Technology education, Design process, Distance learning, Problem solving, Cognitive skills, Virtual teacher

The National Curriculum of all lower secondary schools in Israel states that each pupil has to study science and technology in a social perspective. When looking at the details of the technology topics, we find that teachers have to teach pupils to solve problems that originate from human needs using a model of a design process. The entire topic on the syllabus is called ‘From Need to Product’.

In ORT Research and Development Center there is a group of curriculum developers that work together on these topics:

1. promoting the study of science and technology
2. integrating the computer in the teaching process
3. developing and evaluating teaching-learning models in future schools
4. promoting and updating teachers and principles.

In order to accomplish these goals, actions are taken in the following directions:

1. developing a curriculum for science and technology and computer literacy for junior high (Key Stage 3) and high schools (Key Stage 4 and post-16)
2. publishing books, CDs, websites and educational kits in various topics
3. advising and supporting in planning technological centers at schools
4. in-service teacher training.
The idea of teaching the design process as a method for solving technological problems is relatively new around the world, and even more so in Israel (the syllabus requiring this topic was issued in June 1996).

Technology Education has many different interpretations, and the meaning of the term is not unilateral. However in most cases, it is accepted that the pupil’s attitude towards the technological world must be by means of examining and analysing the technological world (How does it work?) and by creating solutions to address human needs (Action). In recent years it has become acceptable in Israel to say that one of the most important processes in teaching technological thinking is a model of a design process.

We would like to teach pupils cognitive skills without neglecting their creativity so that they can internalise the process. Nevertheless we want pupils to be able to solve many different problems during their lifetime applying the model they learn.

While there are references to different models of the design process around the world, all of them contain the following stages:

- identifying the problem and defining needs
- research and investigation
- generating ideas and selecting the best solution
- construction
- evaluation.

The stages can be linear, cyclical, or they can appear in any order or without order at all (Hutchinson, J. & Karsnitz, J.R., DES, De Vries, M.J., Barlex, E., Hennessey, S. & McCormick, R.)

In our first stages of implementation it was decided to teach the design process as a cyclical process (with internal loops) for solving technological problems which involve both reasoning and performance.

Since we view problem solving and the design process as a primary aspect of teaching technology in lower secondary schools, we have developed a diverse learning environment that contains: study units (textbook), a bank of laboratory-based design activities, activity kits that are combined with video and an Internet site.

The purpose of opening the website was to add another component to the learning environment; where the extent to which the web is utilised is up to the teacher, their pupils and the physical equipment at the technology laboratory.

In our learning environment we have chosen a model of five stages, which are represented by a cycle (enabling pupils to ‘skip’ between stages). We decided to do so from a belief that we should teach the pupils process-oriented thinking during the first period of their experience, and later on to allow them more freedom of action without abandoning the most important components. The objective is not to turn the pupil into a problem-solving robot, but rather to provide him with an organising model.

The use of the design website is not a replacement for textbook study or learning in class, but rather another teaching alternative. Learning takes place on the website through guidance by the classroom teacher and virtual support from a specialist in the field (a virtual teacher). Physical construction (of the mock-up or the prototype) is done in the classroom, in collaboration with the electronic community via the web gallery.

The site was designed as an open tool – the pupils can go through the different stages as they choose. The site allows these interactions:

1. pupils and the computer – queries, surveys, multiple-choice questions
2. discussion and thinking groups – creating an electronic community around the country (or the world) working together on solving the same problem
3. groups of pupils with a virtual teacher – subject specialist.
Structure of the website

Opening page
The course begins with an explanation about the site, the objectives, assignments and following this there is a list of stories (every day situations). The stories are taken from different contexts, so pupils can choose a problem to solve from a context they feel is familiar to them. This will be the problem on which they employ the entire design process, through its various stages.

Home page
An illustration of the design process showing the five stages (Identify the Problem, Investigation, Ideas, Construction and Evaluation). Links provide access to each of the stages. The purpose of this page is to introduce the design process and its various stages to the pupils, where each stage connects with the following and previous stages. The arrows represent the many opportunities to go back, to check, and move on to the next stages.

The stages
All of the stages have the same structure: a textual explanation followed by examples and interactive exercises. At the end of each phase there is a link to the personal portfolio.

There is uniformity throughout the entire process so as to make it easier for the pupils to work and find their way around the site.

Advantages of learning in an Internet environment
The site enables the pupils to deal with problem solving while being supported by an ‘organising tool’. The site helps ‘keep things in order’ for pupils who are having a hard time formulating their work and ideas within the portfolio. The site operates 24 hours a day and enables pupils to learn without being concerned with time and place. Learning through the site encourages collaborative design learning between pupils in classes that are far away from one another. It also includes components that require pupils to deal with essential issues relating to the decision making processes within the design process, and particularly for the purpose of collecting and organising relevant data from a bank of information.

Difficulties with the Internet environment
Learning in an open environment depends on the motivation of the pupils and teachers in the class. There are still technical difficulties with drawing directly on the web (in order to overcome this, drawings must be made using suitable programs and then sent via e-mail). Creating an electronic community between pupils in different locations requires a great deal of careful planning and lots of work with the teachers using the website. Technical and communication problems are shadowing frequently the path of learning and create student aggravation.

We completed developing the site at the beginning of the previous school year (1998), and several classes have already employed it in their studies. Based on experiences during the past year, and following feedback from teachers, we have made changes and improvements. This year, too, several classes will be learning via the Internet, with support from a virtual teacher.

References