Education and Information Systems: Technologies and Applications

EISTA 2003

International Conference organized by IIIS in cooperation with CCCT

Orlando, Florida - USA
July 31st - August 2nd, 2003

Didactics and Web Technologies: a Proposal for the Monitoring of the Didactic Process

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Why an Information System?

a. Students’ misconceptions and mental schemes as emerged from the author’s researches and from many other studies carried out all over the world (the MLRG site can be a useful guide to this concern); all agree on the presence of wrong ideas also after very good teaching practices and when the students seem to have reached a meaningful learning (in a specific topic or discipline)

b. Today’s theories and explanations for misconceptions and mental schemes, that often don’t explain the presence of wrong ideas, and the author’s hypothesis for the construction of new knowledge (it is the result of the superposition of scientific paradigms on natural mental schemes; scientific paradigms never substitute natural mental schemes and intervene or not in students’ explanation of phenomena according to the strength they are impressed in their minds)

c. The scarce success of the educational systems and the inefficacy of teachers' work as emerged from many international researches, like the IEA, IEA-SISS, IEA-SAL. Many authors suggest that the reasons of the above failures have to be searched in: a. the rigidity of the school systems and the organization of the studies, b. the ineffectiveness of the traditional teaching praxis (based on: 1. knowledge transmission, 2. learning control and 3. learning assessment), c. the lack of an effective vocational guidance in the schools. They also point out that attention has
to be focused on the teaching process more than on the learning process.

d. Today’s theory and practice of Educational Technologies mostly involved in the teaching process in a top-down or bottom-up perspective (i.e., they intervene in the design and the carry out of a learning environment or can be used in single teaching experiences), but not in the analysis of the process. Good examples are Taylors’ metaphors of the computer or the extensions that Galliani made of them and, at last, the use of the Net for the creation of special virtual communities (situated learning, learning communities and learning apprenticeship).

e. The research instruments until now used in cognitive psychology and didactics, i.e. tests or interviews. The former ones evaluate the didactic process only at the beginning and at the end; the latter ones require the continuous presence of the researcher, can be done only on little students’ samples and modify the students’ learning processes.

**In the author opinion the time has come for a change in the analysis of the teaching process: the students’ access to disciplines and topics has to be continuously monitored and the student-computer interaction has to become transparent** so that no interference can intervene in modifying the didactic process while great part of it (all of it, if it's possible) can be stored.
The Information System monitoring the students' behaviors

It is a dynamic Web site planned to attain the following main aims:
- To implement the knowledge tree of the discipline's topics in the Web site while putting great attention to the results of the research on misconceptions and mental schemes (in its first carrying out the system has been used to support a Computer Science basic course).
- To offer various communication areas to teachers/professors, tutors and students for the implementation of virtual social environments (an electronic blackboard, different forum areas and an e-mail system).
- To offer special areas for the experience sharing that involve all the actors, i.e. teachers, tutors and students.
- To make the evaluation and assessment tests' administration as easy as possible.
- To let scholars, professors and tutors know from different points of view how students access the various course pages and materials and how they interact among themselves with the communication services.

As a result the system doesn’t offer to the teachers any autonomous instrument for the uploading of didactic materials (the course Web site has to be planned and implemented after a careful acquisition of data concerning students’ starting levels).
To achieve the above results five main levels of access were hypothesized:
- The **system administrator** who accesses all the resources, creates the accounts for all system users and validates scholars, professors, tutors and students accessing the system. He/she also cooperates with the teachers in the implementation of the knowledge tree structure of the disciplines within the site.
- The **teachers** who can only browse the course pages as a Web site and can send short messages to a notice public area, access the electronic blackboard and leave messages in it, enter in the chat and participate in the discussions, send e-mails to single students or to groups of them, propose study cases and create specific areas for them, propose forum themes, create evaluation and assessment tests and analyze the students' answers, query the system to have statistical data on the access of single students or groups of them to the course and its resources.
- The **tutors** helping the teachers in the management of the course.
- The **students** who have two access areas: a public one and a private one. In the public area they can read the notice messages and the scores they obtained to the assessment tests. In the private area they can access the course pages and the communication services.
- The **researchers** who can only extract and analyze the information that professors, tutors and students left in the system.
The wider problem in the site planning (concerning a basic Computer Science course) was the individuation of the information units to put in a page (i.e. the nodes in the hypertext tree) for two reasons:
- to make unambiguous the knowledge tree the site represented (if too many information were collected in the same page)
- don’t fragment too much the knowledge’s units (if different portions of the same information appeared in more than a page)
A solution to the above problem come from the analysis of the students misconceptions:
- with respect to the usual top-down design of a site and to the equi-distribution of information units, now great attention was devoted to the creation of pages better describing the themes strongly related to specific misconceptions that appeared in the entry tests the author proposed to the students,
- self-assessment tests with closed answers were put at the end of each theme to let the students verify the knowledge level of the single topics; when selecting a wrong answer the students were leaded to the re-analysis of the Web page with the description of the corresponding theme.
Two statistical functions letting the teacher and the scholar know how the students accessed the on line materials were developed:

- a first function gives the number of the accesses to the course's pages (reporting them in the tree structure of the course) that single students or group of them did till the query date (the first figure reports an example of a query of this kind),

- another function gives the sequence of the accesses of a single student into the Web site, ordered by date and hour of access. It reports also the messages the student left in the electronic blackboard, in the chat, in the forum and in the case study areas and lets the teachers compare them with other data in the same time interval (the second figure reports an example of this kind of query).
Analysis of an experience carried out with the Information System

When the platform was ready to start all the courses were already ended or were at the end and it was impossible to plan its use in the teaching work. It appeared a good idea to use it for a make up action (if needed) in the course of Educational and Learning Technologies that still had to be delivered (the students attending this course already had a basic CS course). The teaching work in that course was organized as follows:

- **a.** first of all there was an entry test on the basic computer knowledge and skills of the students attending the course;
- **b.** the answers to the test were then discussed with the students;
- **c.** soon after a two weeks full immersion distance course including two presence meetings and two on line discussions started (for the students who needed it);
- **d.** a further test (assessment test), with questions a bit more complex with respect to the first ones, was then proposed to the students;
- **e.** the answers to this test were once more discussed with the students.

The results of the two tests are reported in the table below and the comparison of the columns of the table containing the data of all the students attending the course (cols. (a) and (c)) shows that the scores obtained after the use of the on line materials has a better distribution with respect to the former set of scores.
To obtain better information from the students’ answers 25 students were selected (with respect to all the 66 students): they took part in all the course activities, i.e. they were involved in the following operations: a) they answered the questions in the entry test, b) they used the on line materials for the make up job, c) they answered the questions in the assessment test.

The data concerning these 25 students are reported in cols. (b) and (d) of the above table.

The least differences among the statistical parameters of the sets of data (class and sample) induced the author to regard this sample as a good representative for the whole class.
The data in the table show that the students had better scores at the assessment test with respect to the entry test (the mean value, the median and the least value of the second set of data are higher than the ones in the first set). The class grouping of the scores that the students in the sample had at the entry test and the ones at the assessment test are reported in table below and are represented in the figure.

<table>
<thead>
<tr>
<th>Classes</th>
<th>Entry Test</th>
<th>Assessment Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>31-40</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>41-50</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>51-60</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>61-70</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>71-80</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>81-90</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

The main results emerging from the observation of the data stored in the data base are reported below:

1. some of the students with the highest scores at the entry test used only partially the on line materials and had the same if not less scores at the assessment test,
2. all the students that had a decrease in their scores used only partially and sporadically the on line materials,
3. all the students having low scores at the entry test browsed most part of the on line materials and had better scores at the assessment test,
4. the students having very high scores at the assessment test systematically and repeatedly browsed the on line materials,
5. little score increments while passing from the first to the second test have always to be related to a good browsing of the on line materials.
Conclusions

a. The results from the experience with respect to the author's expectations:
   1) the system revealed very important in helping the students to overcome their difficulties, 2) the use of the PC to learn CS elements helped the students in gaining better skills in the use of a PC, 3) in the author's opinion there is a great difference between the use of new technologies in special highly motivated contexts like the professional ones, with respect to their use in more traditional contexts like schools or universities

b. Unexpected results:
   First of all there is to say that the author had serious doubts on the use of the above platform for a make up action for the simple reason it wasn't planned for this job; it had to be used to teach topics while starting from zero and had to adopt different times with respect to the short ones that were available. The need for an instrument that could help the students in overcoming their difficulties (as emerged from the entry test) prevailed against all perplexities but showed also that the platform had the numbers to be adopted for a wider didactic action with respect to the initial one. Further studies are needed to ameliorate the actual platform so that it can be more effective during a make up action.