

## A LEARNING ENVIRONMENT MODEL BASED ON KNOWLEDGE MANAGEMENT

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### A LEARNING ENVIRONMENT MODEL

A *learning environment* is the space where it is possible to manage knowledge or, rather, ignorance. Knowledge management (KM) can be seen as the process of integrating information, to get sense out of incomplete information and to renew it (Paradela (2001), Wiig (1999)). An original and effective learning environment model based on KM is presented.

The model consists of (see: **Figure 1 Architecture**):

- a) **Entity student**: it keeps the student's or group's information, their guide of work and learning preferences;
- b) **Entity professor**: it keeps the teacher's information;
- c) **KM module**: it keeps the knowledge repository; and
- d) **Supervisor process**: it performs the intelligent tutorship.

The **entity student** represents a student or group. While interacting within the environment, through their accesses to the module of KM, a record is made to a "portfolio" or "work portfolio", in which a binnacle notebook is kept for everything carried out, as well as their learning preferences. This entity can also collaborate in the assessment of knowledge types, for their re-categorization if necessary, and for incorporating knowledge, for example, learned lessons.

The **entity professor** will have participation and direct interaction with the module of KM, by defining and restructuring it according to the use of the own environment by the students. When using the environment, the students will be

able to indicate their preferences (or these might also be recorded by the supervisor process or intelligent tutor), which will allow the teacher to adjust the contents of the KM module.

The **KM module** will have the knowledge repository as well as an interface that allows easy “navigation” in it. The repository will contain:

- “*heuristic*” knowledge (HK): examples are learned lessons (LL), best practices (BP), frequent and not frequent questions (FAQ and NFAQ) and the yellow pages (YP);
- “*descriptive*” knowledge (DK): it is the knowledge with which a situation is described, a concept or an idea;
- “*procedural*” knowledge (PK): it is the knowledge required to take an action, procedure or process ahead; and
- “*anecdotic*” knowledge (AK): it refers to anecdotes, histories and stories linked to knowledge.

The **supervisor process** will carry out the intelligent tutorship, starting from observing the users’ actions, and will suggest action paths according to users’ preferences.

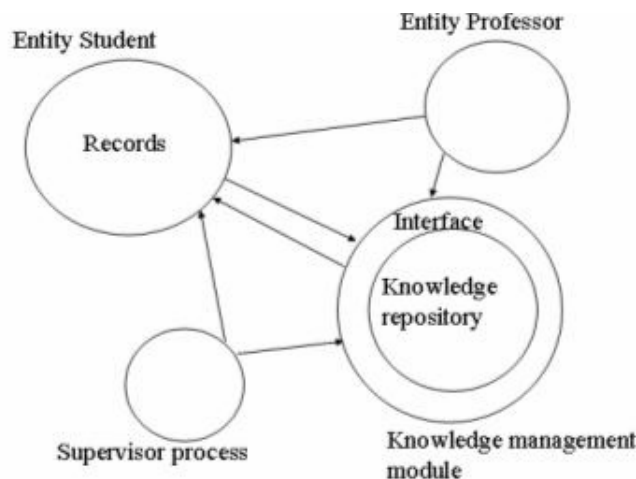


Figure 1 Architecture

The format of each component of the KM module is: **Describer-Knowledge-Counter**.

- The **describer** will be one of the values: LL, BP, FAQ, NFAQ, YP, HK, DK, PK, AK.
- **Knowledge** contains the description of the knowledge itself and it also has as attributes the level of required minimum skill, to what learning strategies it is directed and in what medium it is presented (text, video, multimedia, sound, etc.).
- The **counter** will contain the number of accesses to the record, being increased by one each time. With this value the system will be able to reclassify a question or to determine which are the mostly consulted knowledge. For example,

at the beginning of a new course, such a re-classifying could be made. This updates the knowledge.

In the bibliographical research we carried out, no learning environment was detected up to date with the characteristics of the proposed one (among others: Liaw (2001), Yildirim, Ozden & Aksu (2001), Merrill & ID2 Research Group (1998), Stiles (2000), de Benito (2000), Pazos, Azpiazu & Silva (2002)). Detected problems are that many times there seems to be an overload of information and the environments are not centered on the student. None manages knowledge explicitly (except for Pazos et al. (2002)).

In comparison with the architecture of IEEE P1481.1/d9 (2001) the fundamental contributions of this model are: the KM module, the definition of the learning resources structure, and the incorporation of the entity professor. In relation to the pattern of Gil (2000), the KM module is added. Guinea (2000) recommendations are followed since it is active learning. The student can access multiple learning resources and he can make the decisions (Salinas (1997)).

### IMPLEMENTATION AND EXPERIMENTATION

The model was implemented in Java. The developed environment, PLE:ASE (“Programming Learning Environment: an Approach to Software for Education”) was applied and evaluated in a basic course of Object Oriented Programming for 1<sup>st</sup>. year students of System Engineering at ORT Uruguay University.

Hypothetically, the environment helps to:

- Understanding teaching: detecting the understanding of a problem situation;
- Search for new ways to solve problems: to identify a problem situation, conceptualize it, use it as a model and advance towards its solution;
- Knowledge transfer: the student can solve a given test taking elements of other tests by applying analogies, inferences, deductions, etc.

The independent variable is the use the environment. The dependent variables that indicate if the treatment had some effect are:

- understanding of the problem
- ways to solve a problem
- knowledge transfer

The possible cases are shown in Table I Groups and Treatments:

Group	Treatment
I) Control (8 students)	<i>a) Taking the usual course (with theory and practice classes)</i>
II) Training (19 students)	<i>a) Taking the usual course (with theory and practice classes) and b) theory training for problem solving and KM</i>

III) Training and environment (21 students)	<i>a) Taking the usual course (with theory and practice classes),</i> <i>b) theory training for problem solving and KM and</i> <i>c) using the environment</i>
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Table I Groups and Treatments

All of the students were randomly distributed in the 3 groups and the treatment to each group was also randomly assigned. The original sizes of the groups were fixed by the University. Two tests were presented to each student, both with 3 problems. The first test was taken at the beginning of the course, the other at its end. Both tests were graded using ordinal scales.

The samples were compared with Mann-Whitney test and Kruskal-Wallis test (Mason & Lind (1998), Mendenhall, Wackerly & Scheaffer (1994)). At the beginning of the course, no significant differences were found. At the end, indeed significant differences (significance level = 5%, 10%) were detected in problem solving ways and knowledge transfer between Group II and the other groups.

Also, the marks difference was calculated for each student and problem. As shown in Table II. Experimentation results, numbers were:

	Understanding teaching	Searching for new ways	Knowledge transfer
I: Control group			
Improved	50,0%	25,0%	37,5%
Stayed equal	25,0%	37,5%	37,5%
Worsened	25,0%	37,5%	25,0%
II: Training			
Improved	21,1%	47,4%	15,8%
Stayed equal	52,6%	26,3%	47,4%
Worsened	26,3%	26,3%	36,8%
III: Training and environment			
Improved	28,6%	81,0%	38,1%
Stayed equal	52,4%	9,5%	61,9%
Worsened	19,0%	9,5%	0,0%

Table II. Experimentation results

Through these data we may infer that:

- No benefit was detected as to problem understanding in groups II and III. Moreover, it is a better choice not to use anything (group I).
- The students of group III show a remarkable improvement in the number of ways for solving a problem. They can find, apply and show more ways. An improvement (though poorer) is found in group II as compared to group I.
- Group III students improve their ability to transfer knowledge and none gets worse.

Briefly, the use of the environment allowed the students to enlarge or improve their problem resolution methods and their capacities to carry out the transfer of knowledge.

## CONCLUSIONS

An *original* model is presented, which is different to all those analyzed, *applicable* because its viability has been demonstrated through the system PLE:ASE, *effective* according to the results of the experimentation and *based on the KM*, because it is allowed to explore, evaluate and manage knowledge actively.

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