A Proposed Approach for Learner Evaluation in an Open Distance Environment

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Abstract: *The remote learning evolution and particularly the e-learning permits to more and more people access to education. One of the learning fields which are to be developed is the learner evaluation. The accuracy and the pertinence of the evaluation results can provide information which can be very exploitable by the tutor in order to let the latter help the learner who has some troubles. The evaluation can also be exploitable by the learner because it provides a feedback on what he has really understood. Within this context we are interested by two types of cognitive evaluations, the first one concerning the self-evaluation by questionnaires with multiple choices and the second one concerning the collective work evaluation. For the first case, the work consists to make the questionnaires with multiple choices intelligent, e.g., the questions which will be asked will progress in function of the learner's answers in order to identify the knowledge on which he has difficulties. In the second case, we will use a multi-agent system in order to achieve the evaluation of a group of learners working on the same project.*

Keywords: *Learner evaluation, open distance environment, knowledge, multi-agent system.*

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1. Introduction

We are potentially in the century where the right to education can be completely respected. Indeed the development of distance learning or e-Learning opens new directions for education [6, 7]. Even if you can't attend a course, the development of new learning web tools offers you the possibility to go beyond this problem. But works have to be done in distance learning for the teacher side (web-based learning environments design, web courses sharing, *etc*.) and for the learner side (adaptation of web-based learning environments, learners evaluation, *etc*.).

In our work we are aiming to give new means for the individual learner evaluation and then we will analyse the way to use the individual evaluations of a group of learners to make an evaluation of the whole group.

2. Related Work

2.1. The Different Evaluation Types

During their learning process, the students are exposed to several evaluation procedures designed by their teachers. This evaluation can be of different nature according to the aimed goal. For the teachers, the evaluation is an essential tool to check that the objectives they have defined have been reached by the learners. It allows them to give a "mark" or "grade" to the work made by the learner.

In a teaching approach, an evaluation of the acquired experience is necessary at different steps in order to modify the teaching objectives if needed. One can thus evaluate before, during and after a learning process. These evaluations will thus have different objectives according to the moment they occur. In the large, one distinguishes three great evaluation types [19]:

- The forecasting evaluation whose aim is to test if the learner possesses the needed prerequisites to pursue a given curriculum. This type of evaluation is therefore generally used at the beginning of a new course, or at the end of the previous one.
- The summative or attesting evaluation which leads to certify a module or a curriculum, generally to obtain a grade. It is used when we need to (attest that learners have reached a certain level).
- The formative evaluation which can occur in any step of a learning process and whose purpose is to guide the learner and to position the knowledge obtained (or performances accomplished) by the learner in comparison with a determined learning objective. The main interest of this kind of evaluation is to get an early diagnosis of the difficulties encountered by the learner during his learning process. This allows the teacher to analyze and to interpret the results in order to find the probable causes of these difficulties in order to adapt or to control the learner's course. This is the remediation phase.

2.2. Various Tools and Evaluation Methods

There is a great choice of question types that can be used in an evaluation, among which we can distinguish [3, 18, 19]:

- The closed questions (questionnaires with multiple choices ((QMC) or Quiz, EQMC or EQuiz, short answer question, boolean question, association or pairing question,…) where the learner has to choose his answer(s) from a given list;
- The open questions where the learner answers with its own words and which are therefore more complicated to implement.

The closed questions are easier to implement and are corrected in an objective manner. They are especially useful in situations where we want to test learner's knowledge on a given restricted subject.

The open questions are used when the learner has to show personal decision-making, creativity or communication. Their analysis is much more subjective and they are therefore more complicated to correct. The answer can be neither "completely true", nor "completely false". It will thus be necessary to define some evaluation criteria that can accept some distance between the ideal solution, given by the system, and the learner's one.

2.3. Evaluation Grid

For De Peretti *et al.* [9], the evaluation does not relate only to checking a knowledge acquisition, it can be also used to observe the behaviour, the quality of a working method… for that, we can distinguish several indicators or criteria which will be part of an evaluation grid. The result rising from the evaluation grid will be used to indicate if the learner has reached the learning objectives. Design of an evaluation grid is difficult and tricky because it depends on many factors. There is no universal solution; the teacher has to build his own grid and to define adapted criteria. But, if we cannot generalize their construction, we can nevertheless define generic models which will be able to facilitate it.

3. Individual Learner Evaluation

3.1. Evaluating the Learner

First of all we are interested in the cognitive evaluation of learners. The main goals of the evaluation are to provide to human tutor the level of each learner (to be able to better help them), to provide to the learner the way to be aware of what is understood (especially for self evaluation), and finally to allow the system to adapt the contents and the user interface to each learner depending on their level of understanding [15]. Since we are working with web-based learning environment, part of our work is to improve QMC. We use dynamic QMC that can ask new questions depending on the answers of the learner. We call this kind of questionnaires, "intelligent" QMC. To create this kind of questionnaire we chose the "curriculum" representation of the course [10]. We chunk the course into Knowledge Units (KU) and we organize them hierarchically. Each KU contains information about the part of the course it belongs to, and the list of KUs to which it is linked. We use two types of links, a link between a KU and its list of prerequisite KUs, and a link between a KU and its list of accessible KUs. For a k1 knowledge unit, the prerequisite KUs are the knowledge that can facilitate the comprehension of k1; and so the accessible knowledge are the KUs that will be easily learnt due to the comprehension of k1 as shown in Figure1.

The KU can have different levels of granularity. We defined four levels of granularity; a first level for Thematic Knowledge (KUt), this level represents the key concepts of the course. A second level for Intermediate Knowledge (KUi), this level represents the subdivision of the key concepts. A third level is defined to identify particular knowledge. By Particular Knowledge (KUp), we mean knowledge that gives complementary information but is not necessary for the comprehension of the concept. And then there are the Atomic Knowledge (KUa), which constitutes the intermediate knowledge and the particular knowledge. The atomic knowledge is needed for the entire comprehension of the intermediate or particular knowledge that it composes.

To sum up, at the high level we have thematic knowledge that contain intermediate knowledge and, sometime, particular knowledge. These two last knowledge, are finally constituted by atomic knowledge. After the definition of all the knowledge units, we organise them into a graph as shown in Figure 1. This graph will be used later to manage the questions of the QMC. All the questions of the QMC are predefined with their propositions. Each proposition is defined to give the better knowledge level to the learner depending on his answer. In this way each proposition reflects a level of assimilation of the knowledge. So the difficulty is not only to ask the more pertinent question but also attribute the better level to each proposition, and thus to define the more pertinent propositions.

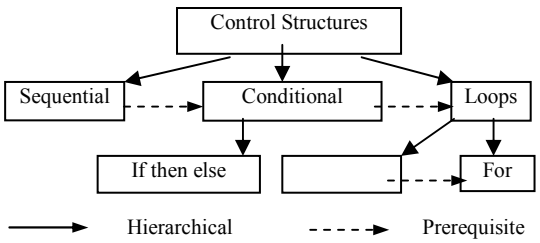

Figure 1. Graphical description.

Each answer of the learner is analysed and if the answer of the learner is wrong, the system will run over the graph of knowledge to ask new questions about the prerequisite knowledge. This procedure will continue until there is a good answer or if there is no more prerequisite knowledge. This procedure permits the use of dynamic QMC that can be used to improve the self-evaluation.

To continue with self-evaluation, we are also interested in the know-how evaluation as shown in Figure 2. For the moment, we are working on a computer science lecturer, about algorithmic and pascal programming [2]. A mini pascal compiler will be developed soon and inserted into the system. This pascal compiler will also integrate a production evaluator in the way to evaluate the know-how of the learner.

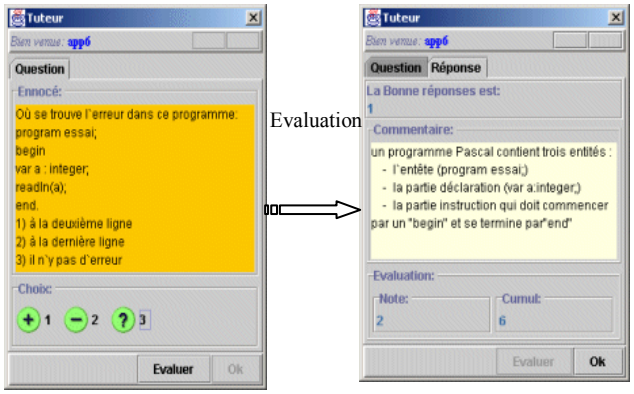

Figure 2. Evaluation of learner.

In our work we are also interested in the motivation of the learners. A first work was done with the creation of a sort of role playing game as shown in Figure 3. In this game the learner embodies a hero who must act or move through a hostile world. Each movement of the hero costs points of movement. In this version of the game the learner must answer questions to gain points of movement. The game is divided into chapters that correspond to different parts of the course. The questions are adapted to the part of the course associated. The limitation of this version of the game is that the evaluation mode is not integrated in the story of the game. There are no direct relations between the questions and the influence of the answer into the story (only more movement points).

3.2. Learner Model Design

The adaptation to learner performance is very crucial within this architecture. It will determine whether learner perform well or not after using the system. learner comprehension regarding to the material presented will be tested based on the objective questions. The result from the test will be the input for the system to analyze the learner's level.

The process started after a learner managed to complete test or exam question. At the beginning phase (first time logged in), all learners will be treated in beginner category where the system do not have full understanding of the learner's knowledge in the subject being taught. Based on the determined score, learners are stereotyped according to following categories: novice, intermediate and/or expert [4].

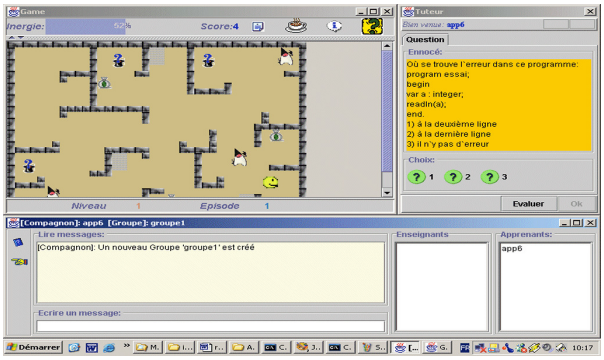

Figure 3. Interface learner.

After the learner gets a result from the test, if there are any changes between the score scheme, the system will overwrite the initial categorization and update it into the learner database. The system will tell the learner the progress, and it will decide whether the learner should be promoted to the next level or not. If the learner cannot manage to achieve the goal, the system will disallow the learner to proceed to higher level. However, the system will provide the learner with easier test combined with suitable instructions. Figure 4 shows the illustration of learner model design.

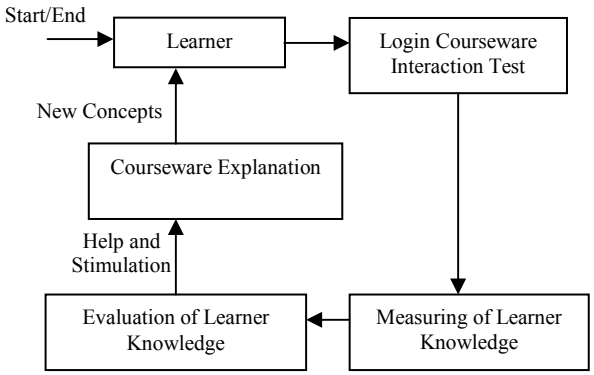

Figure 4. Learner model design.

3.3. Instruction Design

Instruction design implemented in the system will allow the generation of strategies to acquire learner's attention to ensure easy understanding of the learning material. The strategies are various [1, 5]. It can be the combination of many strategies or only a strategy to stimulate learner understanding.

Figure 5 shows a tutoring strategy based on sub goals specified in the system process. Each sub goal will determine whether the goal can be achieved or not. By taking into account knowledge based information

and the learner status, the predefined instruction can be located for the learning strategy.

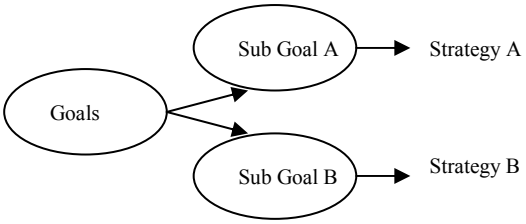

Figure 5. Tutoring strategy.

3.4. Architecture Design

The system is being developed using the guidelines developed by [6, 8, 10, 12, 13]. The guidelines state that to apply adaptive concept in developing educational website, the following element need to be considered:

- There must be a method to retrieve user information;
- Provide short prerequisite information;
- The website being developed must permit more than a way of lesson presentation;
- The link must be structured so it will guide the user on the navigation;
- Provide guidelines for novice user;
- Use hyperlinks to provide details for advanced user as a way to adapt for their need.

Figure 6 shows the architecture of our system presented with combination of WWW environment.

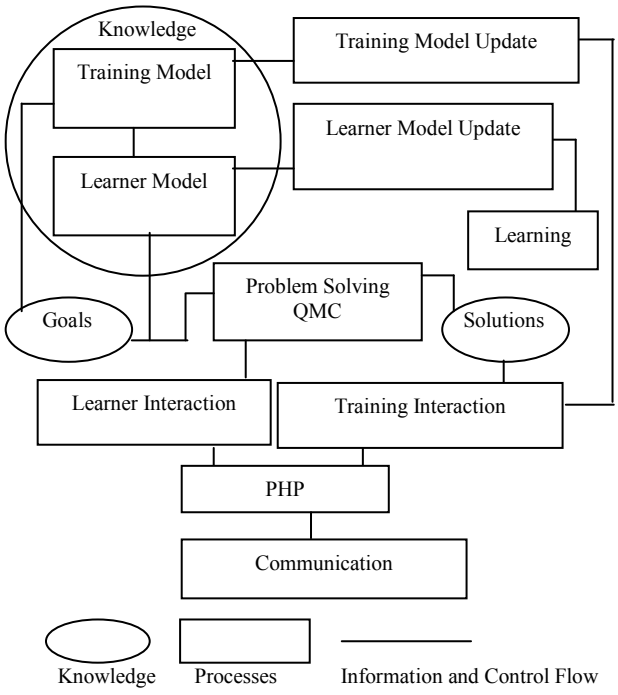

Figure 6. Architecture design.

The process begins when a client starts sending requests to the server, for instance at first the learner have to get an access to the system by using authorized data. Then the data will go across network where the system server is located. The server will then start to process the data. At the backend of the server, the data will be compared with data available in the database. PHP connected with the database will be compared with the data by executing a server scripting program. When the data is validated, PHP will store a user ID for the session to allow the categorization of the data related to each learner. The session will end when the learner decides to exit the system (logout), at the end, the session data will be deleted from system. In selecting the course, PHP will use the session data to determine the type of course to be delivered based on the learner category (beginner, intermediate, expert).

Currently, the system is being used in two experimental groups of students chosen randomly. The number of students is 20 for each group. We set up this experiment to achieve two principal goals. First, we wanted to validate the proposed approach for learner evaluation in an open distance environment. Second, we wanted to check the usability of the environment.

4. From Individual Evaluation to a Global Evaluation

In the future, we will concentrate our research on the evaluation of a group of learners in the case of collaborative works. We define a collaborative work as a work that can be separated into multiple tasks. A learner will be in charge of a task, and all the other tasks are dispatched to the rest of the group of learners. The tasks are specially cut out to have dependant results; then the problem is the evaluation of the global work. Our idea is to evaluate individually all the learners and then to regroup all these individual evaluations to make a global evaluation. We are proposing Multi-Agents System (MAS) architecture [16]. In these MAS we will use two different sorts of agents.

The first one is the Cognitive Agent (CA). This agent retrieves all the individual evaluations, and then makes statistic manipulations to give a global evaluation of the work. We are also interested in the global evaluation of the group, considered as a whole entity. Another agent could be useful for such an evaluation.

For the moment our system will contain only one CA as shown in Figure 7, which is enough to make statistic operations. A possible approach is to use a community of CA when working on the know-how evaluation. This idea is based on the work of Moulin [14] on the categorisation of students' deductions, and the work of Leman [11] on the inspection of parallel hypothesis. To sum up the idea of these two studies, to give the best evaluation on the learner intention, the agents will discuss the learner intention using their

own opinion. At the end of the discussion, one agent will stand out and his opinion will represent the learner's intention. The intention identified, the system can more easily evaluate the know-how of the learner.

The second sort of agent of our system is the Personal Agent (PA). The PA is present locally with each student to assist, to help and to evaluate him. It will manage the student model (save or read learner's preferences, marks …), and will use it to change its behaviour. It is also in charge to communicate the evaluations to the CA, and to manage the communication between "his" learner and the others. The communication between the learners is made through the PA. By this way we will be able to spy the real work made by the student, and we will evaluate the level of help he needs.

Finally we plan to use the global evaluation to precise the learner evaluation; looking for typical mistakes or critical comportments.

On top of the cognitive evaluation and the know-how evaluation, we are also interested in the "psychological" condition of the learner. By "psychological" condition we mean the motivation, or the self-confidence of the learner. Relating to Piché [17], the use of disturbing agent can improve the factors of self-confidence, performance and motivation of learning. So we will give to the PA the ability to be a disturbing agent during the evaluation phase of the learner (give bad advices to answer a question). Of course, the goal is not to disgust the learner by a lot of bad advices; the agent will also adapt the frequency of bad advices by balancing it with good advices.

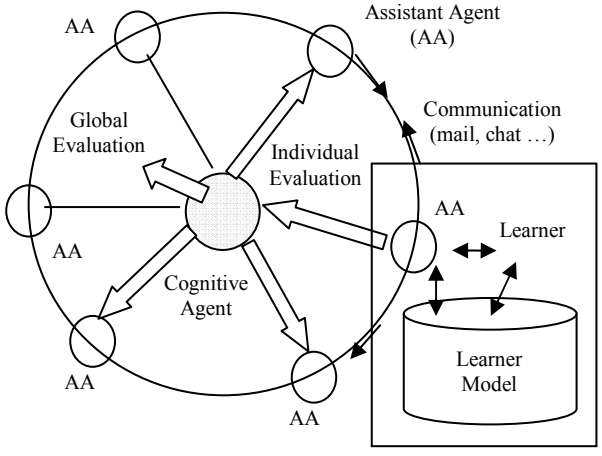

Figure 7. Multi-agent system organization.

5. Conclusion

We saw that our actual work concerns the cognitive evaluation of the learner. This evaluation is dedicated to the individual learner but will be extended for a group evaluation. Our approach is to use multi-agents system to evaluate the learners, and then use these evaluations to make a global evaluation. With our "intelligent" QMC we will make an "efficient" evaluation by identify the non assimilated knowledge. Therefore, the more efficient our individual evaluation will be and the easier our global evaluation will be.

Later, in order to motivate the group of learners, we will explore the use of entertaining aspects in the evaluation. Why not using the role-playing games and a virtual world to organize our collaborative works?

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