

# Integration of a Diagnostic Module into an Intelligent Tutoring System

Najoua Hrich  
Abdelmalek Essaadi University,  
Faculty of Sciences, LIROSA  
Tetouan, MOROCCO

Mohamed Khaldi  
Abdelmalek Essaadi University  
Ecole Normale Supérieure (ENS),  
LIROSA Tetouan, MOROCCO

Mohamed Lazaar  
Abdelmalek Essaadi University  
National School of Applied Sciences  
LIROSA, Tetouan, MOROCCO

---

**Abstract**— *this paper presents a new approach for online tutoring adapted to the needs of each learner through a system to overcome the encountered difficulties. The purpose system considers that the diagnostic assessment doesn't make sense only by the use of its results to determinate the right level of learner's knowledge. The original idea of our approach lie in the integration of a diagnostic module, which assign dynamics profiles to different learners. To do this, theoretically, we will be based on:*

- *The pedagogy of error considering the error as a better tool for teaching.*
- *The differential pedagogy that enables all learners to develop optimally.*

*Technologically, we will use the concepts and methods of the multiagents approach for the design of our environment. In the system to develop, the Supplementary tutoring could become an essential asset in a strategy of change towards a true differentiation. It will build customized learning situations for each type of learner.*

**Keywords**— *pedagogy of error, differential pedagogy, intelligent tutoring system, multiagents system, ontologies, learner profile*

---

## I. INTRODUCTION

At the exit of the school, the remedial courses are in continuum with the public school. It even constitutes a learning way which replaces it, and which is perceived like essential by the majority of learners and their parents because of the adverse conditions of public school which the most significant are: the excess of students in classes, and also the limited situation of the teacher in the curriculum as well as the number of hours allotted there. Supplementary tutoring includes two different activities: the most widespread is that of the private Supplementary tutoring in school subjects, the other one is the support online [1].

### A. Private Supplementary Tutoring

As Glasman (2004) defined it, the private supplementary tutoring are courses given on a purely paying basis outside school hours in academic subjects that students learn in school [2]. They are given by people receiving benefits who can be teachers or students, doing individually, or a part of a commercial structure which remunerates them or puts them in relation with customers. These courses are given in individual form, or small groups of students at providers' or students' homes or at the premises of a specialized company. In the reality lived at the Moroccan public schools, these courses are given, in most of the time, in the form of group made up of almost all students of the class who come to the sessions of tutoring each with his objective: some to overcome their difficulties and others just to have a high mark. And therefore, the teacher is under the same adverse conditions as in the classical courses: the problem of the overcrowded classes persists, and it's difficult for the teacher to choose the right learning strategy as well as to provide support adapted to the needs of the learner.

CONSEQUENTLY, LEARNERS WITH LEARNING DIFFICULTIES DO NOT OVERCOME THEM.

### B. Support Online (Online Accompaniment)

On the Internet, all learners registering on a support site online perform the same exercises whatever are the encountered difficulties, their level, and their learning style. In a situation of a misunderstanding or an error, the learner has to repeat the same exercise without knowing the origin of his error, or to check the solution or move on.

#### 1) Perception of Moroccan learners about different aspects of tutoring [1]

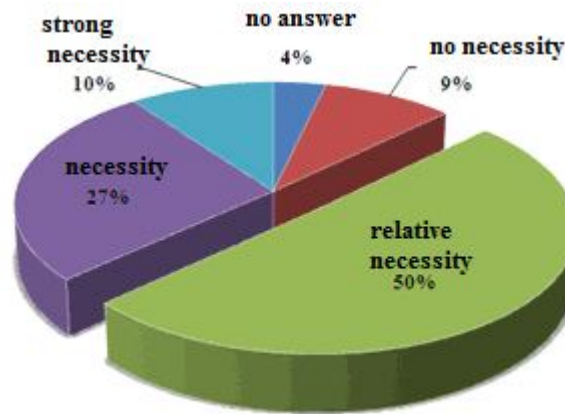
This study aims to determine the perception of Moroccan learners on the various aspects of private tutoring in secondary level: its necessity, motivations...

We present in this part some results of this study:

- The necessity of supplementary tutoring

The results are as follows:

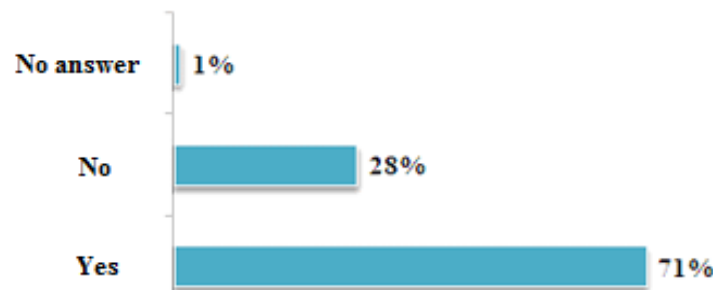
- 4% of students did not answer this question. For the others, we have only 9% of respondents indicate that tutoring is not necessary. On the other hand, we have 37% of learners who think that tutoring is necessary (necessity and strong necessity), and 50% indicating a relative necessity.



Graph 1. Necessity of supplementary tutoring

The need of tutoring is felt as a necessity for the most of learners.

- Use the Internet for supplementary tutoring



Graph 2. Using Internet

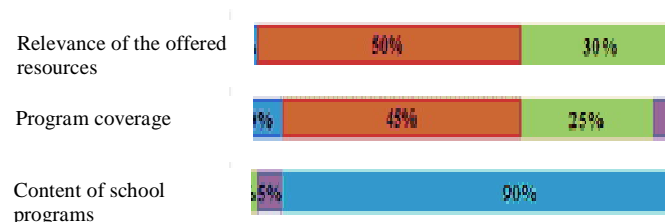
Generally, 71% of respondents use the Internet for school support. This is of course a step forward, but with significant variations depending on the level of students.

## 2) EVALUATION OF MOROCCAN TUTORING WEBSITES

The present evaluative study concerns some Moroccan websites that defined as tutoring systems. This study is referred to the socio-constructivist and interactive model of Jonnaer, and it is based on various criteria [1].

We quote among others:

- CONTENTS

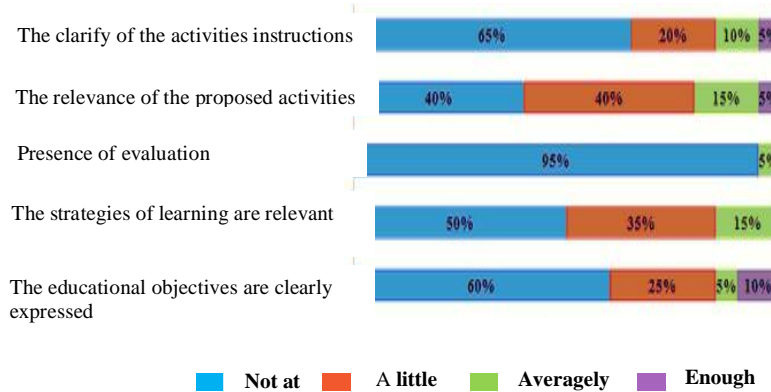


The graph underlines that the contents recover for the most

■ Not at all   
 ■ A little   
 ■ Averagely   
 ■ Enough   
 ■ Perfectly

Graph 3. Contents

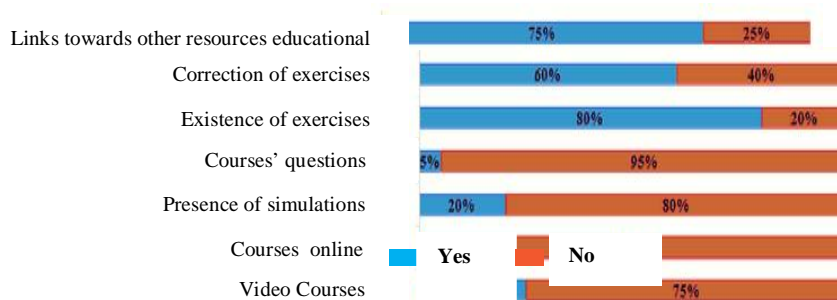
**PEDAGOGICAL STRATEGIES**



Graph 4. Pedagogical strategies

According to the graph, the instructions of activities are not clear in the most of cases, the proposed activities are little relevant, and there are no evaluations in the majority of the cases (95%). Besides the strategies of learning are little relevant, and the educational objectives are not clearly expressed.

**• PEDAGOGICAL RESOURCES**



Globally, the studied websites present partially the required elements.

Graph 5. Pedagogical resources

The studies presented above show that:

- Most of learners use Internet to overcome their difficulties.
- The existing systems are not adaptive.

We suggest in our research to present an online support system that will help the learner to overcome difficulties, to know the origin of his error, and after adapt to him the adequate learning situation.

The benefit from support online adapted to the learner's needs is: [3] [4]

- To be followed throughout his schooling.
- To optimize his chances of success.
- To have a real transmission of the knowledge with various methodological tools and different learning strategies.
- To profit of a personalized school accompaniment which makes it possible to cope with the intensity of the curriculum, to remain in the rhythm and to even take the advance.
- To offer a school accompaniment which rests on a flexible and evolutionary pedagogy: flexible because the tutoring agents are listening of the requests of their learners, and evolutionary because the interest is to make learners more autonomous and more resistant to the stress.

**II. PEDAGOGY OF ERRORS**

In education, as in life, the error is mainly perceived negatively, it is disappointing and expensive.

The failure can be seen as the result of errors so the error is taken as an index of failure.

Classical education did everything to banish the error in all components of the activity of students and teachers.

This is also to avoid the mistakes that we develop knowledge and technology, and that teaches them. [5]

Yet in all modern theories of knowledge construction, a psychological or epistemological theory, from Poincare to Skinner, to Piaget and to Bachelard, and in various forms, the role of the error in the adaptation, and therefore in learning, has been reported as fundamental. The game of trial and error leads to an empirical adaptation to the conditions and ensures the acquisition. [6]. It is difficult to speak of evaluation without naming error, which by its omnipresence in the academic discourse justifies the first.

In our research we will take into account that:

- The error status is inseparable from the educational- learning process;
- The error analysis is complex;
- The error is essential to learners' progress.

TO ACHIEVE OUR GOAL WE WILL PROPOSE TO CONCEIVE AN ENVIRONMENT THAT ENABLES US TO:

- Analyze students' errors;
- Prevent , predict , exploit them;
- Identify known obstacles related to knowledge present in a teaching content and learning situations to overcome those obstacles.

### III. DIFFERENTIAL PEDAGOGY

The differential pedagogy is a process that involves implementing a diverse set of resources and learning strategies to enable heterogeneous learners to achieve, by different routes, their objectives.

There are four forms of differentiation [7]:

- To differentiate the content: What the student learns.
- To differentiate the structures (environment in which the trainings and the evaluations are done)
- To differentiate the process: This is to vary the means and learning situations taking into account the various Ways in which students' process information to support the intended learning.
- To differentiate the productions: Is to allow students to use different vehicles to show what they have learned or understood.

*In our proposal approach we will be based on the differentiation by process to adapt learning situations to learners' needs.*

### IV. MULTIAGENTS SYSTEMS

An agent can be a physical or virtual entity that can act, perceive its environment (in a partial way) and communicate with others, is autonomous and has skills to achieve its goals and tendencies. It is in a multi-agent system that contains an environment, objects and agents (the agents being the only ones to act), relations between all the entities, a set of operations that can be performed by the entities and the changes of the universe in time and due to these actions.

The main application of multi-agent systems can be listed as follows [8]:

- **Problem Solving:** As an alternative to centralised problem solving, either because problems are themselves distributed, or because the distribution of problem solving between different agents reveals itself to be more efficient way to organise the problem solving - it can be flexible and allow failures in the system - or because, in some cases, it is the only way to solve the problem.
- **Multi-Agent Simulation:** Simulation is widely used to enhance knowledge in biology or in social science and MAS gives us the possibility to make artificial universes that are small laboratories for the testing of theories about local behaviours.
- **Construction of Synthetic Worlds:** These artificial universes can be used to describe specific interaction mechanisms and analyse their impact at a global level in the system. The entities that are represented are usually called animats, since they are mainly inspired by animal behaviours (hunting, searching or gathering habits). The aim of this research is to have societies of agents that are very flexible and can adapt even in cases of individual failure. (For example, when robots are sent on an expedition and they are required to be very independent from the instructions they could receive.)
- **Collective Robotics:** Defining the robots as multi- agent systems where each subsystem has a specific goal and deals with that goal only. Once all the small tasks are accomplished the big task is too. Multi- agent systems approaches can also be used in the co- ordination of different mobile robots in a common space.
- **Kinetic Program Design:** multi-agent systems can also be seen as a very efficient modular way to program.

The multi-agents approach is a required approach for complex systems, their fully decentralized approach makes them particularly adapted for the type of our proposal system. And that allows us to work on the overall operation of a system by focusing on the entities that compose it and their interactions.

### V. EXTRACT OF PROPOSED SYSTEM

In this part we present the different agents to be integrated in our proposal system.

**For each learner connected to our system:**

An agent (error collecting) follows his activity, collects the errors he made, and will provide a list containing the errors to another agent in interaction with him (learner Agent), that will select the learner profile according to this list. Then, according to this learner profile the sequence agent offer the adequate learning sequence that will responds to the needs of our learner.

The figure1 presents an extract from the proposed system and the agents to be integrated, which ensures:

- The follow-up,
- The collection of the errors
- The proposal of the adequate learning sequence.

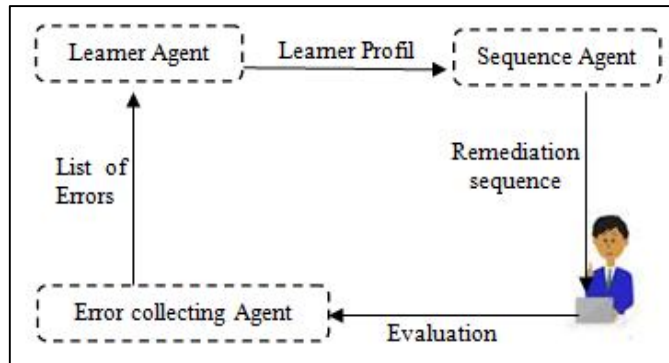


Fig 1. Extract From the Proposed System

### VI. ARCHITECTURE OF THE INTELLIGENT TUTORING SYSTEM (ITS)

An intelligent tutoring system is a system that provides direct customized instruction or feedback to learners without the intervention of human beings [9]. The usually accepted architecture of the intelligent tutoring system is composed of four different subsystems or modules: learner module, domain module, planner and tutor [10]. These four modules collaborate to supply a learning adapted to the specific needs for a learner. The figure2 presents the typical structure of an intelligent tutoring system (ITS)

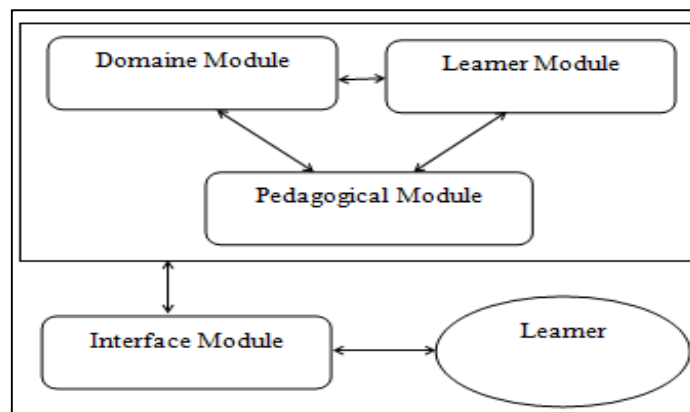


Fig 2. Architecture of the ITS

**A. Domain module**

The domain module contains the relative information with the materials taught. This information must be easy in order to be usable by the others modules of the intelligent tutoring system.

**B. Learner module**

As its name indicates, the learner module has to supply information about the learner. It therefore informs about the level of the subject' knowledge. According to the complexity of the module, it informs also on a number of features of this learner. The system's knowledge of the learner can be represented by various manners such as overlay model, semantic networks, learner profile, or models of fuzzy logic.

The most frequently representations used are [11]: overly Model, buggy Model and stereotypical model.

- The Overlay Model: This method appeared with the first educational systems which consider the learner module as a subset of the domain module that lacks information. In this case the purpose of learning is to get a perfect overlay model of the learner on the domain module
- The Buggy Model: This second method is an extension of the previous one. Introduced by [12], it consists of adding to data from the method overlay a list of errors made by the learner.
- The goal is then to consider these bugs and try to understand their origins
- The stereotypical model: In a stereotypical model properties and learner's knowledge are represented with combinations of values assigned to stereotypes such as beginner.

#### C. Pedagogical Module:

The pedagogical module use the data obtained of the learner module to make choices among the available learning elements proposed by the domain module. There still, the representation and the organization of knowledge in the domain module are dominating for the implementation of the pedagogical module.

#### D. Interface Module:

The interface module plays the part of interface between the system and the learner, this module has two objectives:

- Detection: it must make it possible to obtain information of the learner and to transmit it to the learner module to allow the update of this last.
- Action: it must apply by means of its graphic interface the decision taken in the pedagogical module is inspired for that by a strategy of learning.

## VII. PROPOSED APPROACH

The objective of this research is to propose an intelligent system of an online support adapted to the learners 'needs, according to the mistakes made by the learner after having carried out a series of exercises suggested by the system. After having carried out a diagnostic evaluation, the agents allow the location and ranking of the errors. According to the collected errors, the type of the pedagogical obstacle is determined, and after a specific training sequence will be started.

TO ACHIEVE OUR GOAL WE PROPOSE:

- A representation of the links between errors and pedagogical obstacles which cause them.
- A design of multiagents which ensures the follow-up, the collection of the errors and the proposal of the adequate learning sequence.
- Experimentation in a specific field.

#### A. Operating of our proposed system

We propose to present an online support system that will help the learner to overcome difficulties, to know the origin of his error by adapting to him the adequate learning situation.

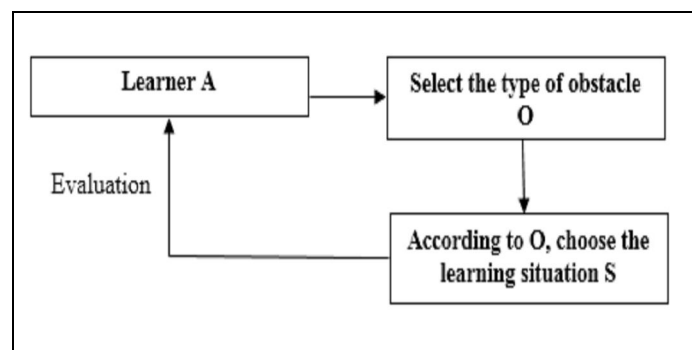


Fig 3. Operating of proposed system

#### B. Integration of the diagnostic module into an ITS

We propose to integrate a diagnostic model whose aiming is to carry out a learner's cognitive diagnostic.

To determine:

- What he knows,
- What he knows do,
- And especially, where he has difficulties.

And it is this highlighted that will allows our system to meet the specific educational needs of each learner who uses it.

The figure 4 presents the integration of our proposal diagnostic model into an ITS.



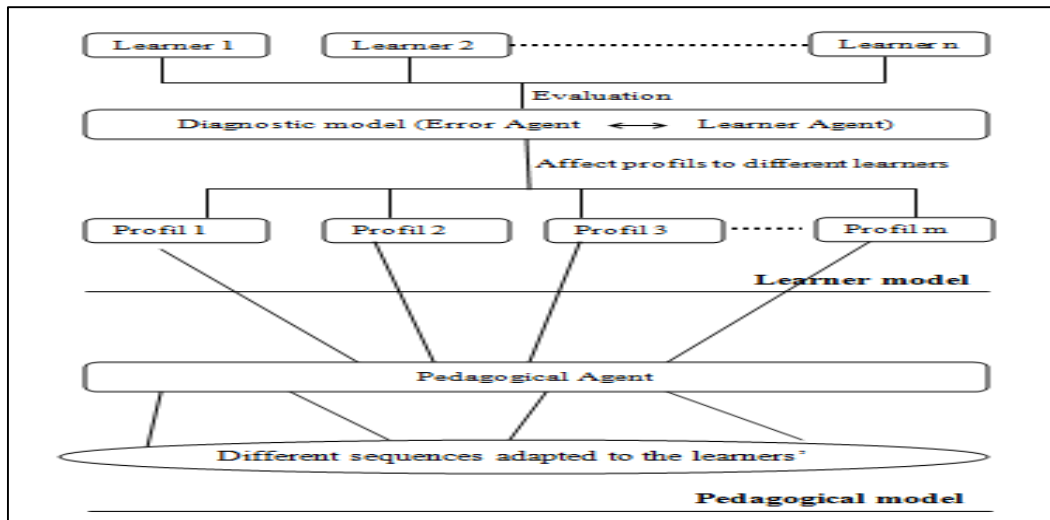


Fig 4. Integration of diagnostic module into an ITS

### VIII. CONCLUSION

In this article, we presented a proposition of an intelligent tutoring system for a Support Online which adapted to the learners needs according to the mistakes they made. We are focused on a diagnostic module integrating the different agents that will ensure the follow-up, the collection of the errors and the proposal of the adequate learning sequence. The paper introduced also the principle of an intelligent tutoring system, and the use of our diagnostic module in the learner module of an ITS, and the interaction between the learner module and the Pedagogical module of an ITS. The next step is to represent the links between errors and pedagogical obstacles which cause them that will be used as information to generate dynamic learners' profile.

### IX. REFERENCES

- [1]. Les élèves marocains et le soutien scolaire : recours au soutien privé et usage d'internet Ahmed Rhazal, Najiba El Amrani El Idrissi, Abdelkrim El Hajjami. <http://www.epi.asso.fr/revue/articles/a1401e.htm> Évaluation des sites marocains de soutien scolaire : Ahmed Rhazal, Najiba El Amrani El Idrissi, Abdelkrim El Hajjami <http://www.epi.asso.fr/revue/articles/a1311f.htm>
- [2]. Glasman, D. (2004). Le travail des élèves pour l'école en dehors de l'école. Rapport établi à la demande du Haut conseil de l'évaluation de l'école, France. <http://www.ladocumentationfrancaise.fr/rapports-publics/054000358/index.shtml>
- [3]. Rochex, J.-Y., 1999. Accompagnement scolaire et rapport au savoir. Ville École Intégration
- [4]. Perrenoud, P., 1991. Le soutien pédagogique, une réponse à l'échec scolaire? Service de la recherche sociologique: Faculté de psychologie et des sciences de l'éducation.
- [5]. Astolfi, J.-P., 2011. L'erreur, un outil pour enseigner.ESF éditeur.
- [6]. Brousseau, G., 2001. Les erreurs des élèves en mathématiques. Etudes dans le cadre de la théorie des Situations Didactique./Petix x 5–30.
- [7]. Ministère de l'Éducation, du Loisir et du sport. La différenciation pédagogique : théorie et applications. Groupe de travail sur la différenciation pédagogique en outaouais. Synthèse des travaux réalisés dans le contexte des priorités du Comité régional de coordination pédagogique (CRCP). Bibliothèque nationale du Québec, 2005, pages 24-28.
- [8]. Ferber, J., 1999. Multi-agent systems: an introduction to distributed artificial intelligence. Addison-Wesley Reading.
- [9]. Haddioui, I., Khaldi, M., 2012. Learner Behavior Analysis on an Online Learning Platform. International Journal of Emerging Technologies in Learning (iJET) 7.
- [10]. Blanchard, E.G., 2007. Motivation et culture en e- Learning. Université de Montréal.
- [11]. Lamia, M., 2006. Modelisation d'un systeme hypermedia adaptatif dynamique à base d'ontologie (hadyat). Université Badji Mokhtar de Annaba.
- [12]. Delestre N, " Un hypermédia adaptatif dynamique pour l'enseignement ", Thèse au laboratoire PSI de l'université de Rouen, 2000.