Dynamic assessment approach for science subjects, modeling the performance of the learning operation

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***Abstract*—We are interested in the dynamic assessment progression of scientific subjects through an intelligent approach, which will allow the teacher to manage his learning method as the session progresses. Indeed this approach allows the creation of a more effective motivating environment for any exchange between the participants in classroom. As the session progresses, the teacher assesses the students' achievements through evaluation components of scientific subjects, namely: Course questions, Examples, Application exercises and Deepening exercises. Thus, the teacher has information about the progress, the difficulties encountered by the learners and the necessary remedies which must be brought up in a timely manner. In our research, we study an approach of dynamic assessment progression for scientific subjects according to the components mentioned above. We model the dynamic assessment progression by functions, taking necessary intervention actions according to the students performance. The results of this study show that the dynamic assessment approach used, by taking into account the actions, allows the teacher to make good decisions and instantly adjust his teaching method. This assessment approach also allows each student to improve their learning according to their abilities, which promotes intrinsic motivation.**

***Index Terms*—Digital assistance system, Dynamic assessment, Information and communication technology in education (ICTE), Innovative learning**

I. Introduction

Several researchers are interested in the use of technological and didactic means in different phases of teaching to innovate the learning operation. Kenn Fisher [1] proposed methods which allow the insertion of technological means in the learners educational environment in order to ensure the success of any learning operation. Marcel Lebrun et al. [2] have provided three educational tools that allow teachers to lead their sessions with insurance. According to the SAMR [3] model (Substitution, Augmentation, Modification, Redefinition), the first is the education system (content of knowledge and learning) and the second is the use of technologies. For the third, it focuses on the skills employed according to the Lemke and Coughlin model "Entry, Adaptation and Transformation" developed in [4]. Yelena V. Yakovleva and Natalya V. Goltsova presented the pedagogical and psychological conditions of information and communication technology for the development of learning motivation in nursery schools [5]. Currently, the skills are enriched since the students entourage is developed in an important way, and in order to allow the learners to be in satisfaction situations in class, several researchers are interested in involving various aspects of the scientific research development in several fields, notably in education [6]–[9]. They proposed new pedagogical approaches that meets the requirements of progress existing in various fields and which motivate the learners. Other researchers are interested in the pedagogical interactions between actors, technological tools and computer procedures existing in the work environment [10]–[12]. The learner's environment has become rich both by various interactions and advanced technological means. So the use of technological means in the learning operation becomes an intrinsic motivation of the learner to develop his learning level. In this sense, we cite the research which evoked the enriched and expected skills in this immense technological revolution [13]–[15].The interaction between advanced teaching tools (software) and learners is of great importance for the success of a teaching objective [16], [17]. This research focused on the evaluation of the relevant means for a judicious contribution of technological tools and procedures in the learning operation. Several fields have been influenced by the application of artificial intelligence thanks to the astonishing development of scientific research. The research carried out, using artificial intelligence, in the field of education focuses on personalized and dynamic learning. scientific research, computer programming, technological tools, pedagogical approaches have enabled learners to obtain qualified education meeting individual needs [8], [9], [16], [18]–[20]. Recent research [20]–[23] has focused on the use of artificial intelligence in the functioning of student assessment at the end of the session. The dynamic evaluation of the content, as the session progresses, offers the possibility of alleviating the difficult situations encountered by the learners. This promotes equity between learners to acquire the different knowledge each according to his abilities. We also cite the research [24] which proposed an innovative pedagogical approach using artificial intelligence to assess scientific learning skills. the research carried out in [25] revolves around the summative scientific skills assessment through an innovative strategy which allows the teacher to measure the amplitude of scientific skills and to support his students in order to improve their capacities in this type of skills. we evoke the work [26] which uses the artificial intelligence based on the decision tree to allow the teacher to adjust his teaching for the scientific subjects concerning the assessments components. This allows the teacher to make the right decision at the appropriate time. In our research, we were interested in an extension of the work [27] which is centered on the evaluation components of science subjects through an intelligent system. In this research, we have modeled the actions taken as a function of the pupils performance. We also modeled the students performance in the deepening exercises component according to the session success. We have highlight the importance of being interested in adjusting the learning operation in the first phases of assessments before arriving at the deepening exercises. This article is organized as follows. Section 2, which presents the research method, is divided into three subsections dealing the interaction description that occurs between the stakeholders in a class and the existing advanced didactic means. The concepts of the components of the scientific subjects evaluation which is proposed in our research. The description of the test scoring and the algorithm used. Section 3 focuses on measuring the performance of our assessment approach by modeling the actions to be carried out in relation to the students performance in assessment components. In section 3, we offer the results and interpretations of the used approach. At the end we give a conclusion.

II. Research Method

We will propose a dynamic assessment approach as the session progresses by adopting remedial actions based on the students' results in each test component. To know the importance of the actions taken during the dynamic evaluation on the performance of the learning operation, in first, we modeled the accumulation of actions according to the students results. Secondly, we also modeled the performance of the learning operation in relation to the actions taken. This will allow the teacher to know, as at he session progress, the evaluation of the expected objective achievement and to regularize, if necessary, his teaching method . Our approach is based on the following steps: Describe the types of interactions that can occur between stakeholders in a classroom. We also define the conception of assessment components for science subjects. We provide the algorithm that governs this intelligent system approach. We study the functions that modeled the actions taken and the students performance according to their results. So, describe the performance amplitude of this approach on the learning operation.

A. Interaction Description

we present in the figure Fig. 1 the conception of this dynamic evaluation through the intelligent system. Indeed, the teacher offers the content of each assessment component to the students and the latter respond through technological tools (computers, tablets, etc.). The system collects and processes student performance, displays results and instantly offers solutions to problems encountered by learners. The teacher collects the results and their interpretations as the session progress through a data schow placed in front of him. At the end of all the sequences, a very precise assessment is proposed by the system to improve the learning operation during the next sessions. The teacher may also be interested in improving other skills related to communication and personality development. The educational animation in classroom by this approach is

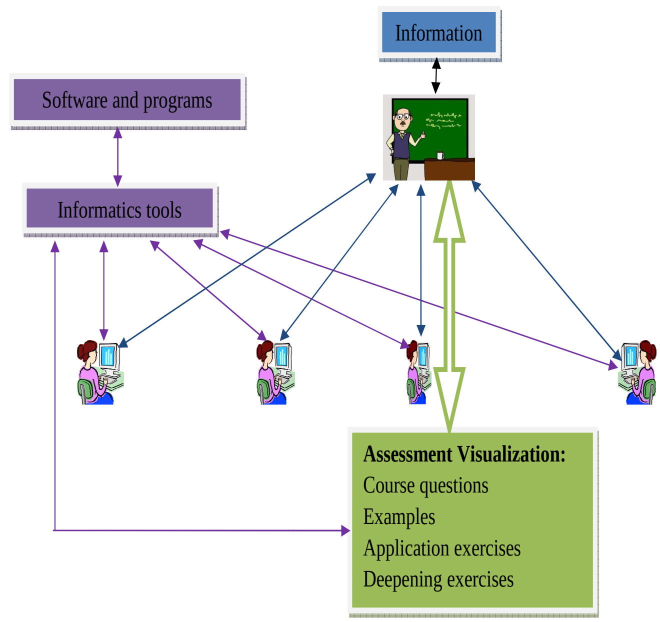

Fig. 1. Dynamic assessment using artificial intelligence.

done with the support of advanced didactic means concerning scientific subjects. Thus, we propose the main components of this interaction and their conceptions.

- Information: the teaching prepares the necessary information which is in the form of knowledge and skills according to very specific aspects. These last take into account variables characterizing the context of the program and the learner's environment. Thus, the teacher must specify the scope of this information and its content. To achieve his objective, the teacher must also prepare evaluation phases of this information which is supposed to be transmitted to the pupils, namely the course questions, the examples, the application exercises and the deepening exercises.
- Computer tools: these are the advanced didactic means that are useful in a session of learning scientific subjects, namely: computers, tablets, a data show allowing the projection of the evaluation results as and when the session progress. item These are the computer programs and software that are used for a specific learning session. These are computer procedures that retrieve the students results, process them, analyze them and display the assessment components by proposing solutions adapted to the possible problems encountered by the pupils.
- Evaluation visualization: it is the operation of processing the pupils results, their interpretation and which can be instantaneous and retrieved by the teacher during the

session. He can also provide us with an evaluation at the end of the session and recommendations for further improvements. This operation also allows us to interpret the results of the pupils throughout the school year for a permanent follow-up of the class level.
- Methodology: This is the procedure and the manner through which the teacher must animate his session by adopting a structured pedagogical approach. He must prepare the content to be transmitted and the transition phases by specifying the course questions, examples, application exercises and deepening exercises. The system processes the students' performances and instantly offers a precise diagnosis of the test components at the end of the session. In case of insufficiency, solutions are proposed by the system to resolve the learning difficulties identified as the session progresses.

B. Assessment component concepts

The teacher must prepare the assessment components for the science subjects which are the course questions, examples, application exercises and deepening exercises, see Fig. 2. The teacher must also adopt an approach to transmit information by specifying the evaluation phases and the educational interactions approach between the class stakeholders through the intelligent system see Fig. 2. To achieve the objective of the assessment of science subjects, we present the concepts and dimensions of this assessment components.

- Course questions: these are questions which aim to ensure that the information to be transmitted is understood. These questions can be at specific times which are fixed by the teacher. The effects of the evaluation of this component are very important to consolidate the learning thereafter.
- Examples: these are educational situations to ensure that the area of the previous information is anchored. Their objective is to ensure the understanding degree of the definition and properties of the information to be transmitted.
- Application exercises: these are pedagogical situations which implement the information transmitted in cases which do not present enough difficulties. their objective is to ensure the assimilation degree of this information towards its application.
- Deepening exercises: these are pedagogical situations which use the transmitted concept and which require additional reflection. Their objective is to ensure the correct assimilation of information. This type of exercise presents an additional difficulty compared to application exercise. Solving these exercises may use other informations to achieve the objective.

C. Description of the tests notation and the algorithm used

Let N be the number of students in a class. Each student has the choice between several answers. Consider the following notation: 1 if the answer is correct and 0 if the answer is false

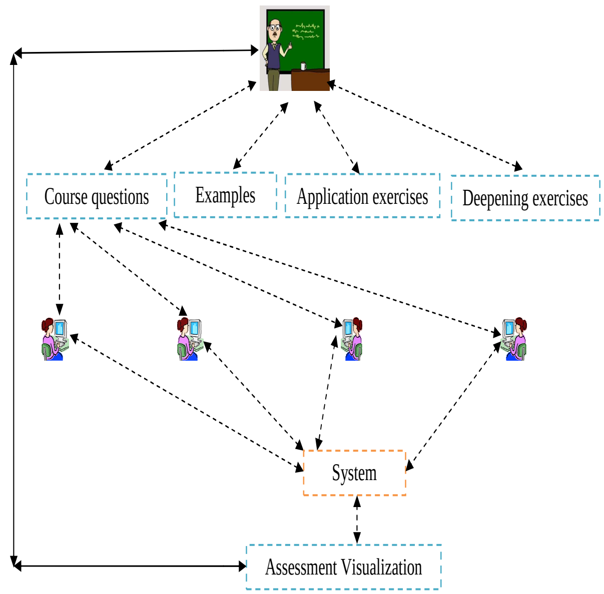

Fig. 2. Teacher interaction and dynamic assessment of various tests.

or if the student has not answered the question. Let us set the set of all the component tests by,

$$Test = \{C_1, C_2, C_3, C_4\}, \quad (1)$$

where C_1: Course questions , C_2: Examples, C_3: Application exercises and C_4: Deepening exercises.

Each component of the tests includes a number of questions or teaching situations that the learner must answer. Therefore, for each component of the tests, we calculate the average of the correct answers for each student.

We note for any integer i in $[1, N]$ and for any integer j in $[1, 4]$, $n_{i,j}$ the mean of a student i in the test component C_j, therefore,

$$\forall i \in [1, N], \forall j \in [1, 4] \quad n_{i,j} = \frac{N_{c,i,j}}{N_{t,j}}, \quad (2)$$

where $N_{c,i,j}$ is the number of correct answers for student i in the tests component C_j and $N_{t,j}$ is the total number of questions in the tests component C_j.

For each tests component C_j, let us note N_j the total number of correct answers of all the pupils, thus,

$$\forall j \in [1, 4] \quad N_j = \sum_{i=1}^{N} n_{i,j} \quad (3)$$

The teacher adopts a process to animate his session by choosing very specific activities. These may contain explanatory questions, examples of introduction of illustrations and educational exchanges between the participants in the classroom. At the beginning, the teacher offers the learners course questions, which will be evaluated by the system, to ensure that the information is well understood. To evaluate the questions of the course, an algorithm is applied, see Fig. 3. In the sequence of questions in the course, the teacher suggests well-studied questions and evaluates this step. If $N_1 \geq \frac{4}{5}T$, then the teacher is sure that his students are in possession of the information considered. Thus, he can move on to another learning phase by offering examples. Otherwise, see Fig. 3, depending on the result obtained, the teacher returns to the previous step to briefly reach the blocking situation by explaining the course or by proposing other course questions. In practice, the correction of difficult situations is done in a thoughtful way, taking into account the final objective and the time constraints to achieve this objective during a session. In the sequence of examples,

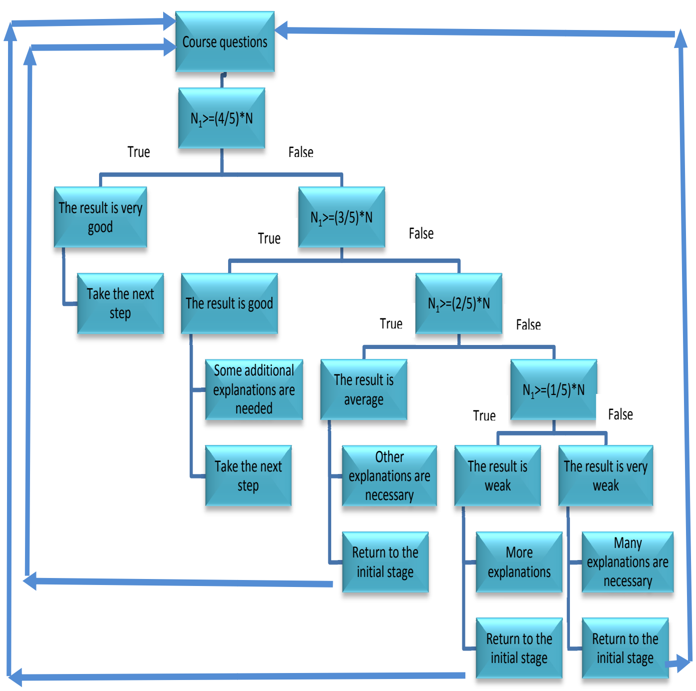

Fig. 3. Algorithm for dynamic evaluation of course questions test using the intelligent system.

the teacher proposes examples and he proceeds in the same way as for the course questions in other words, he can return to later phases to unblock the insufficiency detected in the pupils, see Fig. 3.

In the sequence of application exercises, the teacher suggests exercises that directly use the content of the session, and he proceeds in the same way as before, see Fig. 3.

In the sequence of deepening exercises, the teacher suggests a exercises that require the learner to deepen their thinking in order to use the transmitted information during a session.

In order to evaluate the session in a global way, the teacher takes into account all the evaluations of the tests components mentioned above for the scientific subjects. We propose the algorithm described in Fig. 4, so we note the set of states by $S = \{C_1, C_2, C_3, C_4, S_5\}$, where

- C_1: Course questions
- C_2: Examples
- C_3: Application exercises
- C_4: Deepening exercises
- S_5: Achieving the objective

We note the set of actions by $A = \{a_0, a_1, a_2, a_3, a_4\}$. From the step n, the actions are defined as follows:

- a_0: Stay at step n, ↻.
- a_1: Go to step $n+1$, $\rightarrow$.
- a_2: Return to step $n-1$, $\leftarrow$.
- a_3: Return to step $n-2$, $\leftarrow\leftarrow$.
- a_4: Return to step $n-3$, $\leftarrow\leftarrow\leftarrow$.

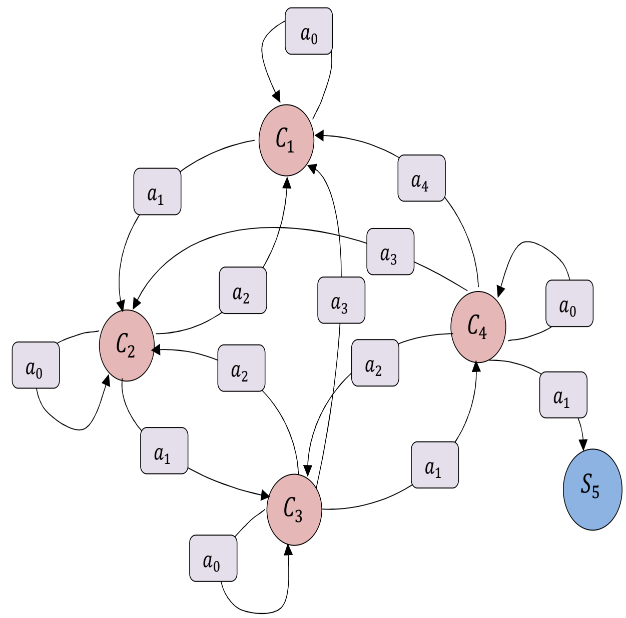

Fig. 4. Algorithm for dynamic evaluation of different tests using the intelligent system.

We propose the algorithm cited in Fig. 4 based on the algorithm cited in Fig. 3. The operation of this algorithm is well explained in TABLES I, II, III and IV.

TABLE I
ALGORITHM FOR C_1

Value of N_1	$N_1 < \frac{3}{5}N$	$\frac{3}{5}N \leq N_1$
Action	a_0	a_1

TABLE II
ALGORITHM FOR C_2

Value of N_2	$N_2 < \frac{2}{5}N$	$\frac{2}{5}N \leq N_2 < \frac{3}{5}N$	$\frac{3}{5}N \leq N_2$
Action	a_2	a_0	a_1

TABLE III
ALGORITHM FOR C_3

Value of N_3	$N_3 < \frac{1}{5}N$	$\frac{1}{5}N \leq N_3 < \frac{2}{5}N$
Action	a_3	a_2
Value of N_3	$\frac{2}{5}N \leq N_3 < \frac{3}{5}N$	$\frac{3}{5}N \leq N_3$
Action	a_0	a_1

TABLE IV
ALGORITHM FOR C_4

Value of N_4	$N_4 < \frac{1}{5}N$	$\frac{1}{5}N \leq N_4 < \frac{2}{5}N$
Action	a_4	a_3
Value of N_4	$\frac{2}{5}N \leq N_4 < \frac{3}{5}N$	$\frac{3}{5}N \leq N_4 < \frac{4}{5}N$
Action	a_2	a_0
Value of N_4	$\frac{4}{5}N \leq N_4$	
Action	a_1	

III. EVALUATION PERFORMANCE

The teacher evaluates the tests components for the scientific subjects namely C_1, C_2, C_3 and C_4, according to the results obtained, he proceeds to possible remedies by returning to later phases in order to support the students learning without re-evaluating the previous components.

A. Study of the actions progress

To make an overall evaluation of the students' acquisitions to reach S_5, we will adopt the rating of the actions carried out by evaluating the components C_1, C_2, C_3 and C_4 see Table V - Table VIII.

TABLE V
ACTIONS PROGRESS FOR C_1

Value of N_1	$N_1 < \frac{3}{5}N$	$\frac{3}{5}N \leq N_1$
Action	a_0	a_1
Notation	0	1

TABLE VI
ACTIONS PROGRESS FOR C_2

Value of N_2	$N_2 < \frac{2}{5}N$	$\frac{2}{5}N \leq N_2 < \frac{3}{5}N$	$\frac{3}{5}N \leq N_2$
Action	a_2	a_0	a_1
Notation	-1	0	1

In order to know the progress of student acquisition in a session learning science subjects, we consider the real function f defined on $[0, N]^4$ by,

$$f(x, y, z, t) = \varphi_1(x) + \varphi_2(y) + \varphi_3(z) + \varphi_4(t),$$

where φ_1, φ_2, φ_3, φ_4, are the real functions defined on $[0, N]$ by,

$$\varphi_1(x) = \begin{cases} 0 & \text{if } 0 \leq x < \frac{3}{5}N \\ 1 & \text{if } \frac{3}{5}N \leq x \leq N \end{cases} ,$$

TABLE VII
ACTIONS PROGRESS FOR C_3

Value of N_3	$N_3 < \frac{1}{5}N$	$\frac{1}{5}N \leq N_3 < \frac{2}{5}N$
Action	a_3	a_2
Notation	-2	-1
Value of N_3	$\frac{2}{5}N \leq N_3 < \frac{3}{5}N$	$\frac{3}{5}N \leq N_3$
Action	a_0	a_1
Notation	0	1

TABLE VIII
ACTIONS PROGRESS FOR C_4

Value of N_4	$N_4 < \frac{1}{5}N$	$\frac{1}{5}N \leq N_4 < \frac{2}{5}N$
Action	a_4	a_3
Notation	-3	-2
Value of N_4	$\frac{2}{5}N \leq N_4 < \frac{3}{5}N$	$\frac{3}{5}N \leq N_4 < \frac{4}{5}N$
Action	a_2	a_0
Notation	-1	0
Value of N_4	$\frac{4}{5}N \leq N_4$	
Action	a_1	
Notation	1	

$$\varphi_2(x) = \begin{cases} -1 & \text{if } 0 \leq x < \frac{2}{5}N \\ 0 & \text{if } \frac{2}{5}N \leq x < \frac{3}{5}N \\ 1 & \text{if } \frac{3}{5}N \leq x \leq N \end{cases} ,$$

$$\varphi_3(x) = \begin{cases} -2 & \text{if } 0 \leq x < \frac{1}{5}N \\ -1 & \text{if } \frac{1}{5}N \leq x < \frac{2}{5}N \\ 0 & \text{if } \frac{2}{5}N \leq x < \frac{3}{5}N \\ 1 & \text{if } \frac{3}{5}N \leq x \leq N \end{cases}$$

and

$$\varphi_4(x) = \begin{cases} -3 & \text{if } 0 \leq x < \frac{1}{5}N \\ -2 & \text{if } \frac{1}{5}N \leq x < \frac{2}{5}N \\ -1 & \text{if } \frac{2}{5}N \leq x < \frac{3}{5}N \\ 0 & \text{if } \frac{3}{5}N \leq x < \frac{4}{5}N \\ 1 & \text{if } \frac{4}{5}N \leq x \leq N \end{cases} .$$

The functions φ_1, φ_2, φ_3 et φ_4 are represented in the figure 5 and which are constant over intervals and increasing. The figure 6 shows that the remedial decisions, taken by the teacher according to the results of C_1, C_2, C_3 and C_4,can take more choices. We start with two cases for C_1 and in the end with five cases for C_4. The values of the function f determine the student acquisition evolution degree in a subject science . So f characterizes the success degree of the approach used by the teacher. We let us obtain the following relations:

$$\min_{(x,y,z,t)\in[0,N]^4} f(x, y, z, t) = -6 \quad (4)$$

$$\max_{(x,y,z,t)\in[0,N]^4} f(x, y, z, t) = 4 \quad (5)$$

The table IX offers the categories of progression in the acquisition operation during a learning session scientist.

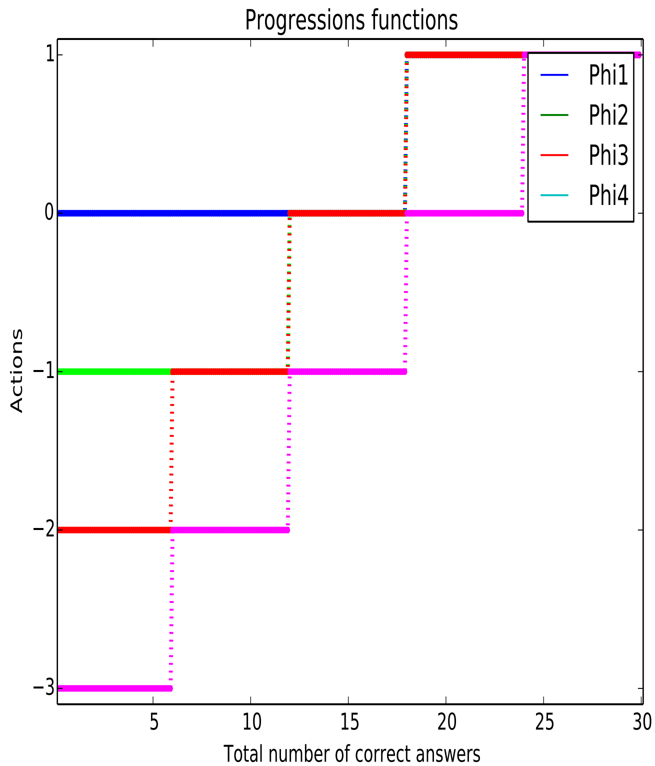

Fig. 5. Graphic representations of φ_1, φ_2, φ_3 and φ_4

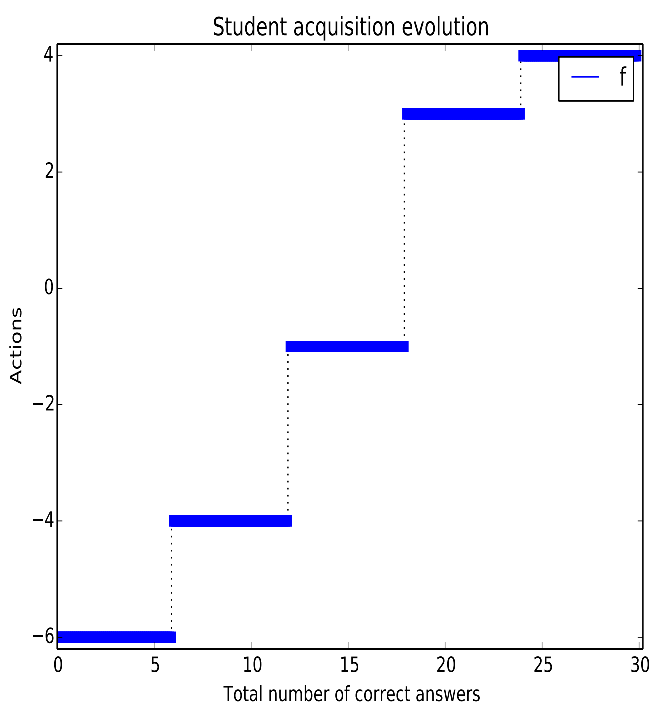

Fig. 6. Graphic representation of f

TABLE IX
EVALUATION BASED ON ACTIONS CARRIED OUT

Assessment intervals	[-6, -4[	[-4, -2[	[-2, 0[
Appreciations	Many difficulties	Difficulties	Average
Assessment intervals	[0, 2[	[2, 4]	
Appreciations	Fairly good result	Very good result	

B. Temporal study of the approach

We were interested in the added time for an evaluation component of science subjects. Indeed, we considered that the actions carried out by the teacher to remedy a difficult situation in a component require a time t. We assume that the value t is the same for each remediation of a test component. The teacher assesses the components of the scientific subjects tests namely C_1, C_2, C_3 and C_4. In order to support the learning students and depending on the results obtained, the teacher proceeds to possible remedies by returning to later phases without reassessing the previous components. To do this remediation, we suppose that the teacher concedes the same temporal amplitude for each remediation operation. In order to achieve the objective S_5, we will adopt the temporal support scoring approach for the components C_1, C_2, C_3 and C_4, see Table X - Table XIII. The teacher must take into account the time allocated for the entire session

TABLE X
POSSIBLE TIME ADDED FOR C_1

Value of N_1	$N_1 < \frac{3}{5}N$	$\frac{3}{5}N \leq N_1$
Action	a_0	a_1
Notation	1	0

TABLE XI
POSSIBLE TIME ADDED FOR C_2

Value of N_2	$N_2 < \frac{2}{5}N$	$\frac{2}{5}N \leq N_2 < \frac{3}{5}N$	$\frac{3}{5}N \leq N_2$
Action	a_2	a_0	a_1
Notation	2	1	0

TABLE XII
POSSIBLE TIME ADDED FOR C_3

Value of N_3	$N_3 < \frac{1}{5}N$	$\frac{1}{5}N \leq N_3 < \frac{2}{5}N$
Action	a_3	a_2
Notation	3	2
Value of N_3	$\frac{2}{5}N \leq N_3 < \frac{3}{5}N$	$\frac{3}{5}N \leq N_3$
Action	a_0	a_1
Notation	1	0

In order to know the additional time that is designed to support students in difficult situations and for the good temporal management of our dynamic evaluation approach, we consider the real function τ defined on $[0, N] \times \mathbb{R}$ by,

$$\tau(x,t) = \Big(\psi_1(x) + \psi_2(x) + \psi_3(x) + \psi_4(x)\Big)t,$$

TABLE XIII
POSSIBLE TIME ADDED FOR C_4

Value of N_4	$N_4 < \frac{1}{5}N$	$\frac{1}{5}N \leq N_4 < \frac{2}{5}N$
Action	a_4	a_3
Notation	4	3
Value of N_4	$\frac{2}{5}N \leq N_4 < \frac{3}{5}N$	$\frac{3}{5}N \leq N_4 < \frac{4}{5}N$
Action	a_2	a_0
Notation	2	1
Value of N_4	$\frac{4}{5}N \leq N_4$	
Action	a_1	
Notation	0	

where ψ_1, ψ_2, ψ_3, ψ_4, are the real functions defined on $[0, N]$ by,

$$\psi_1(x) = \begin{cases} 1 & \text{if } 0 \leq x < \frac{3}{5}N \\ 0 & \text{if } \frac{3}{5}N \leq x \leq N \end{cases},$$

$$\psi_2(x) = \begin{cases} 2 & \text{if } 0 \leq x < \frac{2}{5}N \\ 1 & \text{if } \frac{2}{5}N \leq x < \frac{3}{5}N \\ 0 & \text{if } \frac{3}{5}N \leq x \leq N \end{cases},$$

$$\psi_3(x) = \begin{cases} 3 & \text{if } 0 \leq x < \frac{1}{5}N \\ 2 & \text{if } \frac{1}{5}N \leq x < \frac{2}{5}N \\ 1 & \text{if } \frac{2}{5}N \leq x < \frac{3}{5}N \\ 0 & \text{if } \frac{3}{5}N \leq x \leq N \end{cases}$$

and

$$\psi_4(x) = \begin{cases} 4 & \text{if } 0 \leq x < \frac{1}{5}N \\ 3 & \text{if } \frac{1}{5}N \leq x < \frac{2}{5}N \\ 2 & \text{if } \frac{2}{5}N \leq x < \frac{3}{5}N \\ 1 & \text{if } \frac{3}{5}N \leq x < \frac{4}{5}N \\ 0 & \text{if } \frac{4}{5}N \leq x \leq N \end{cases}.$$

So, for all (x, t) in $[0, 30] \times \mathbb{R}$,

$$\tau(x,t) = \begin{cases} 10t & \text{if } 0 \leq x < \frac{1}{5}N \\ 8t & \text{if } \frac{1}{5}N \leq x < \frac{2}{5}N \\ 5t & \text{if } \frac{2}{5}N \leq x < \frac{3}{5}N \\ t & \text{if } \frac{3}{5}N \leq x < \frac{4}{5}N \\ 0 & \text{if } \frac{4}{5}N \leq x \leq N \end{cases} \quad (6)$$

We assume that the class contains 30 students, we get, for all (x, t) in $[0, 30] \times \mathbb{R}$,

$$\tau(x,t) = \begin{cases} 10t & \text{if } 0 \leq x < 6 \\ 8t & \text{if } 6 \leq x < 12 \\ 5t & \text{if } 12 \leq x < 18 \\ t & \text{if } 18 \leq x < 24 \\ 0 & \text{if } 24 \leq x \leq 30 \end{cases} \quad (7)$$

The figure 7 shows the temporal amplitude that can occur in a session of learning science subjects. The time allocated to each remediation of the evaluation components is assumed to be the same.

The values of the function τ determine the extra support time that can exist in a science subjects session. Thus τ characterizes the additional time proposed by the teacher in order to remedy the difficult situations encountered by the students. We obtain the following relations: for all real t,

$$\min_{x \in [0,N]} f(x,t) = 0 \quad (8)$$

$$\max_{x \in [0,N]} f(x,t) = 10t \quad (9)$$

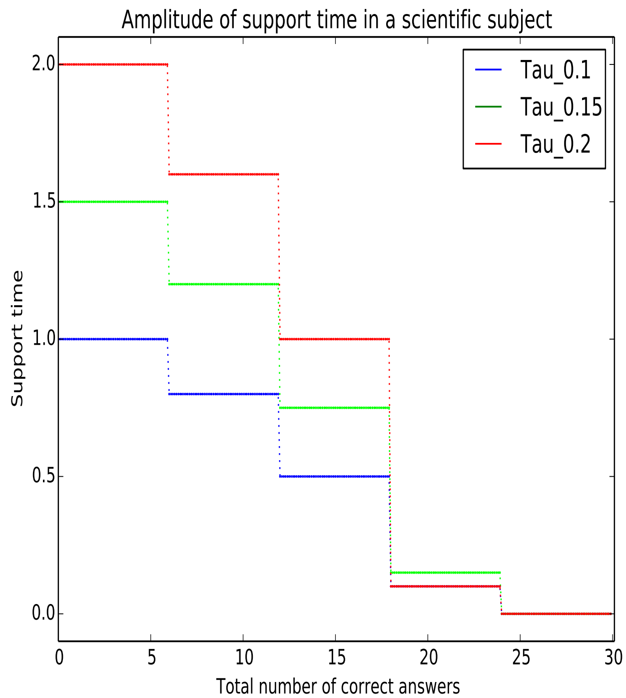

Fig. 7. Graphic representation of τ

τ is a decreasing function, as long as the results are insufficient, the teacher's support time becomes important and influences the objective achievement. Thus the teacher must well manage his intervention time to overcome the difficulties encountered by his students, see figure 7.

The table XIV proposes the possible temporal categories of student support in our evaluation approach and the associated interpretations for the scientific subjects.

TABLE XIV
TEMPORAL CATEGORIES OF OU APPROACH

Time intervals	[0, 2t[	[2t, 4t[	[4t, 6t[
Appreciations	Many difficulties	Difficulties	Average
Time intervals	[6t, 8t[	[8t, 10t]	
Appreciations	Fairly good result	Very good result	

C. *Test components scores*

It is assumed that the teacher, when the result of a tests component is not satisfactory, he returns to the previous steps without doing the evaluation of components again. In this case, he is content to to explain more or to give additional examples or application or deepening exercises.

To give more precision on the performances of the students,

we introduce the scores of the test components evaluations. Thus, we propose an evaluation approach to characterize the degree of scientific notion acquisition.
We consider the real function φ defined on $[0, N]^4$ by,

$$\varphi(x, y, z, t) = \Big(\varphi_1(x)+1\Big)x + \Big(\varphi_2(y)+2\Big)y + \Big(\varphi_3(z)+3\Big)z + \Big(\varphi_4(t)+4\Big)t \quad (10)$$

Let N_1, N_2, N_3 and N_4 be the tests results of C_1, C_2, C_3 and C_4 respectively with the actions carried out by the teacher during a scientific session. We determine the practical values of the minimum and maximum of the function φ, we have, so,

$$\min_{(x,y,z,t)\in[0,N]^4} \varphi(x, y, z, t) = N_1 + N_2 + N_3 + N_4 \quad (11)$$

$$\max_{(x,y,z,t)\in[0,N]^4} \varphi(x, y, z, t) = 2N_1 + 3N_2 + 4N_3 + 5N_4 \quad (12)$$

We can from the values of the function φ know how to evaluate the progress in the acquisition of scientific learning and consequently to evaluate the method used by the teacher.
So, for all (N_1, N_2, N_3, N_4) de $[1, N]^4$,

$$\varphi(N_1, N_2, N_3, N_4) = \Big(\varphi_1(N_1) + 1\Big)N_1 + \Big(\varphi_2(N_2) + 2\Big)N_2 + \Big(\varphi_3(N_3) + 3\Big)N_3 + \Big(\varphi_4(N_4) + 4\Big)N_4 \quad (13)$$

Let

$$m = \min_{(x,y,z,t)\in[0,N]^4} \varphi(x, y, z, t),$$
$$M = \max_{(x,y,z,t)\in[0,N]^4} \varphi(x, y, z, t)$$

et

$$\sigma = \frac{N_1 + 2N_2 + 3N_3 + 4N_4}{5}.$$

Let us set for all natural number k such that $0 \leq k \leq 5$, $m_k = m + k\alpha$.
The table XV indicates the assessments relating to the results obtained from all the evaluation components.

TABLE XV
ASSESSMENT CATEGORIES IN OU APPROACH

Assessment intervals	$[M_0, M_1[$	$[M_1, M_2[$	$[M_2, M_3[$
Appreciations	Many difficulties	Difficulties	Average
Assessment intervals	$[M_3, M_4[$	$[M_4, M_5]$	
Appreciations	Fairly good	Very good	

Several cases can be assumed, depending on the results of the pupils in the components of the science subjects tests. We deal with the particular case where the first tests C_1, C_2 and C_3 are quite satisfactory, namely $\frac{3}{5}N \leq N_1$, $\frac{3}{5}N \leq N_2$ and $\frac{3}{5}N \leq N_3$, in this case we study the possibilities of achieving the objective S_5. Thus we find the real function ψ in a single variable defined on $[0, N]$ by,

$$\psi(t) = \varphi(N_1, N_2, N_3, t) = 2N_1 + 3N_2 + 4N_3 + \Big(\varphi_4(t) + 4\Big)t \quad (14)$$

In our case, we have $2N_1 + 3N_2 + 4N_3$ is a constant so, we consider the function θ defined on $[0, N]$ by,

$$\theta(t) = \Big(\varphi_4(t) + 4\Big)t = \begin{cases} t & \text{if } 0 \leq t < \frac{1}{5}N \\ 2t & \text{if } \frac{1}{5}N \leq t < \frac{2}{5}N \\ 3t & \text{if } \frac{2}{5}N \leq t < \frac{3}{5}N \\ 4t & \text{if } \frac{3}{5}N \leq t < \frac{4}{5}N \\ 5t & \text{if } \frac{4}{5}N \leq t \leq N \end{cases} \quad (15)$$

We assume that the class contains 30 students, we get, for all t in $[0.30]$,

$$\theta(t) = \Big(\varphi_4(t) + 4\Big)t = \begin{cases} t & \text{if } 0 \leq t < 6 \\ 2t & \text{if } 6 \leq t < 12 \\ 3t & \text{if } 12 \leq t < 18 \\ 4t & \text{if } 18 \leq t < 24 \\ 5t & \text{if } 24 \leq t \leq 30 \end{cases} \quad (16)$$

The function θ is piecewise defined and it increases over the interval $[0, N]$. The figure 8 shows that as long as the value of N_4 is large, the achievement of the goal S_5 becomes more important.

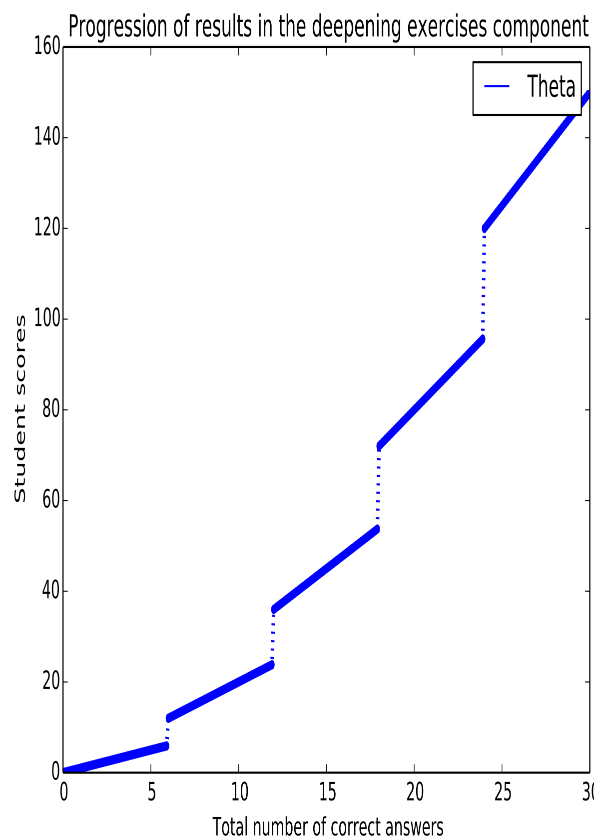

Fig. 8. Graphic representation of θ

IV. RESULTS AND INTERPRETATIONS

The approach evoked in our research allows the teacher to know the level of his students and it allows him to diagnose the difficulties encountered by the pupils and the actions that he must take to reach these difficulties. This assessment approach is based on an intelligent system that can be used for scientific topics as the session unfolds. The process proposes a succession of progressive phases in difficulty among the pupils, starting with course questions, examples, application exercises and ending with deepening exercises. This allows students to acquire the scientific knowledge targeted with an educational strategy based on the principle of equity between learners to acquire a higher learning level. The advantage of the system is that it offers solutions to the teacher in difficult situations, it is in the cases $N_1 < \frac{3}{5}N$, $N_2 < \frac{3}{5}N$, $N_3 < \frac{3}{5}N$ or $N_4 < \frac{4}{5}N$, see TABLES I, II, III and IV.The system proposes to the teacher in which type of evaluation test should intervene to remedy the difficulty encountered by the pupils.Teachers can adjust their teaching method as a session progresses by applying the actions a_0, a_1, a_2, a_3 and a_4 depending on student performance. The system thus provides recommendations to properly manage the session animation. The values of the actions are in the increasing direction with the good students performance, for this purpose, the convergence is more certain towards the objective S_5, see figure 8. The function θ is increasing according to the correct answers of the students in the evaluation component C_4, which shows that the achievement of the objective S_5 becomes more important. Thus the actions carried out by the teacher before arriving at the component C_4 allows the teacher to adjust his teaching and increase in a concise way the success of his method. This shows that it is indeed a dynamic and structured evaluation. The evaluation approach thus evoked, allows the teacher to improve his teaching method and improve his practical acts for the next transmissions of a concept. The teacher can also adopt a collaborative approach between learners by working in groups to allow a local exchange.

V. Conclusion

We have proposed a dynamic assessment approach for a science subject session using an intelligent system that helps the teacher make the right decision instantly. Thus, we presented an approach for evaluating scientific subjects based on actions to be carried out. The intelligent system, in relation to the performance of the students, proposes these actions to animate a session. The management of a scientific session depends on the nature of these actions, for this we have modeled these actions by piecewise-defined functions. Then, we linked the progression in the learning operation according to these actions. Similarly, we modeled the performance of the learning operation according to the management of these actions. Reports are presented as the session progresses, which allows the teacher to remedy difficult situations and adjust his teaching method. Through this assessment approach, learners will have the same chances to start the next learning phases. We can retrieve the results of the students according to all the evaluations carried out, so a database will be built which will be useful to follow the level of each student progress. In order to know precisely the results of the student, we can assess the performance of the students by distinguishing between false answers and unanswered questions. We can also adopt a personalized assessment for each student, so actions can be carried out according to the performance of each student. In perspective, we can propose other modeling of the component S_5 as a function of C_1, C_2, C_3 and C_4 and thus establish a performance function R as being a function of N_1, N_2, N_3 and N_4 and find the real values of N_1, N_2, N_3 and N_4 which maximizes the function R.

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