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PEDAGOGICAL ISSUES OF DIAGNOSTIC ASSESSMENT PRACTICES ACCORDING TO COMPETENCY-BASED APPROACH: CASE OF PHYSICS TEACHING

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Abstract- The diagnostic assessment seems to be essential for both students and teachers. In fact, to build the school knowledge it is necessary to know the representations of students and the misconceptions that can be barriers to learning. Thus, we propose through this study, to identify the representations of students through diagnostic assessment in order to address the obstacles to learning. This work aims to seek the input of the diagnostic evaluation in the teaching - learning of physical science at the secondary qualifying in assessing the knowledge, know-how, reasoning, and the scientific approaches that allow students to reach the secondary qualifying school. This study was carried out at the beginning of school in 2017-2018 to 73 students in the beginning secondary education qualifying public and from the faith's teaching, public and private from a grid of assessment where the emphasis was placed on the learning areas of the physics that the student is supposed to master as well as the taxonomic levels related to the learning process. We have administered a paper-and-pencil of duration 60 minutes. The evaluation results allowed us to detect the problems of each student in a precise and methodical way, in using the proposed grid. We found a big part of students with many obstacles, especially with regard to the "analyze" skill. We conclude our work by an analysis of the causes of failure of some pupils. We propose how to work out the situation in order to decrease the negative effect.

Keywords: Diagnostic Assessment, Evaluation Grid, Physical Sciences, Skills, Representations, Learning Difficulties.

1. INTRODUCTION

The learning assessment of students is a central issue in the development of an education system. In fact, we cannot establish a learning plan without knowing the level of students targeted, and we cannot progress in the learning process without knowing the evolution of students during this way.

The Moroccan educational system has undergone deep changes. Its reform was undertaken with the promulgation in 1999 of the "National Charter of Education and Training", article 106 of which advocates the implementation of the competency-based approach. These directives recommend revising the evaluation system and bringing it into line with the skills-based approach, notably in the projects of the 2015-2030 strategic vision. Louis (2004, p. 2) defines learning assessment as: "A process that consists in gathering information about the learning achieved by the student, and interpreting it in order to make the best possible decisions about the quality of teaching and the student's level of learning".

Note that, in teaching, for reasons that we could detail, but which are not the subject of this article, the term assessment is often connoted "summative" assessment: the assessment helps to make a balance, quantified by a score, on a set of knowledge to acquire. At the end of this review, the student must make the effort to rework his duty to move forward, this remains entirely at its own expense... Our work aims to take advantage of this evaluation "quantitative" indispensable in our school system, to develop an individualized diagnosis, to assist the student in the exploitation of errors or penalties incurred, and thus in the development of remedies in the future. We enter here in the search of diagnostic tools that allow the teacher to suggest ways for the student to be evaluated usefully.

The diagnostic assessment seems to be essential both for students and for teachers. To build the school knowledge it is necessary to know the representations of students those misconceptions can be barriers to learning. We propose to identify the representations of students through diagnostic assessment in order to clarify the obstacles to learning.

- Our research questions are:

How to design assessments according to a competency-based approach? How to assess multiple skills during a diagnostic evaluation? What are the main characteristics of a great product or a great production that one wishes to evaluate? How to make the students part of this

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assessment? These assessments allow the student to answer the question: "Am I capable of...?"

The present work has for first objective to seek the input of the diagnostic evaluation in the teaching-learning of physical science at the secondary qualifying in assessing the knowledge, know-how, reasoning, as have the students arriving at the secondary calling. The second objective is the development of an evaluation grid. This last is a tool designed by members of the Group for Research and Innovation in the Teaching of Physical Sciences GRIESP; national group laded by the general inspectorate of the French National Education System, to analyze assessments. It has been tested to analyze exams (bachelor's degree) and races.

The grid of assessment we adopted, allows us to assess five skills: to appropriate; to analysis-reasoning; realization; validation and communication. We translated three-level of proficiency reached by the student in note encrypted. This grid builds on situations of learning. The emphasis has been placed on the learning areas of the physics (mechanics) that student is supposed to master as well as the taxonomic levels related to the learning process. The results of the diagnostic assessment allowed us to detect the problems of each student in a precise and methodical manner using the proposed grid.

As well, the article is organized in the following manner: In a first part, we present the theoretical study of this work, the problem and the research questions. A second part will be dedicated to the methodology of our work to know the presentation skills of knowledge and know-how of a diagnostic test and the presentation of the evaluation grid as an assessment tool. The results of our study are described in a third part. In this part, we show a way to objectively the results of the evaluation of diagnostic test by the traditional method pursued by the majority of teachers and those using the method skills by using the evaluation grid. In the last part, we conclude by a large interpretation of our results.

Definitions and Objectives of the diagnostic evaluation According to a number of researchers (Allal, 2007; Cardinet, 1975; Figari, 2001; Roegiers, 2004; Scallon, 2004; Tardif, 2006), the learning evaluation is seen as a complex process that involves the teacher making a professional judgment on the competencies developed by students, with a view to making a pedagogical or administrative decision, and communicating this judgment to different recipients.

• Purpose of the evaluation:

"Assess is easy; when one has specified the objective which pursues; when one has given the evaluation criteria" (Meyer and Simo nard, 1990, p. 92). The diagnostic evaluation is the assessment at the beginning of a learning journey. It aims to assess the concepts that will be used in the sequences of learning to come, and allows the teacher to take accurate information about the state of students' knowledge. He can then adjust his teaching according to the results obtained by the class returning completely on a concept that is not acquired.

• The diagnostic assessment is important at three levels:

- For institution, it helps to place the student in a group level;
- For teacher, it allows him to set the goals and formulate the educational project;
- For the learner (who needs to know about his condition), it allows him to manage his own learning, which represents a great step towards a self -responsibilities.

2. THEORETICAL PART

2.1. Assessment of Learning

2.1.1. Role of Assessment in Teaching/Learning Process

Assessment, as a fundamental component of the teaching/learning process, aims to collect precise data on learners' knowledge and skills. This process, while tailored to specific educational contexts, aligns with a universal framework designed to support student progress, ensure the quality of learning, and provide a deep basis for pedagogical decision-making.

2.1.2. Global Practices in Diagnostic Assessment

Diagnostic assessment practices vary significantly around the world, with education systems such as those in OECD countries, Finland, and Singapore offering rich and diverse examples. These systems emphasize a formative approach, incorporating diagnostic tools from the early stages of learning. For instance, in Finland, diagnostic assessments are designed to guide teachers in adapting their pedagogical methods to the specific needs of learners (OECD, 2020). In Singapore, the focus is on an integrated pedagogy where assessments not only identify gaps but also stimulate learning through participatory approaches and collaborative projects (Tan, et al., 2016).

These models highlight the importance of assessment rubrics in diagnosing learning progress. Rubrics help pinpoint specific gaps while providing teachers with precise indicators to adjust their pedagogical interventions (Andrade, 2019). Recent research shows that the systematic use of rubrics enhances not only the accuracy of diagnoses but also students' motivation to address their shortcomings (Brookhart, 2018).

2.1.3. Competency-Based Education and Diagnostic Assessment

Competency-based approaches, widely adopted internationally, prioritize the development of practical skills at the core of learning. These educational models aim to ensure that each learner achieves a defined level of proficiency in specified competencies. Diagnostic assessments play a crucial role in this process by evaluating the level of mastery in specific skills, identifying gaps between expected objectives and actual performance, and designing targeted improvement plans.

The integration of diagnostic assessments into competency-based education relies on robust theoretical frameworks. Bloom's taxonomy, for example, provides a foundation for structuring educational objectives and analyzing learners' outcomes at different cognitive levels (Anderson and Krathwohl, 2001). Additionally, socioconstructivist theories, such as those of Vygotsky, emphasize the importance of assessment as a tool to guide learners within their "zone of proximal development" (Vygotsky, 1978). Thus, diagnostic assessments go beyond measuring performance to become a lever for developing complex skills through targeted interactions and collaborative learning.

2.2. Skills in Educational Engineering

2.2.1. Definition and Importance of Pedagogical Competencies

Pedagogical engineering is a rapidly evolving field, requiring precise competencies to effectively design, implement, and evaluate educational programs. Recent studies (Guerra, et al., 2021; Smith, 2019) have identified key competencies essential for excellence in this domain, including:

- Mastery of digital assessment tools, such as online platforms for tracking skills.
- The ability to analyze complex data to adapt teaching practices.
- An in-depth understanding of learning theories, including constructivism and student-centered approaches.

2.3. Key Approaches to Defining Competencies

2.3.1. Domain-Based Approach

This approach segments pedagogical engineering into specific areas (e.g., design, evaluation, and remediation) and details the competencies required for each domain (McKenney and Reeves, 2019).

2.3.2. Empirical Approach

Grounded in field observations, this method identifies competencies used in real-world situations, highlighting unmet needs in current training programs (Ritzhaupt, et al., 2020).

2.4. Cognitive Levels Mobilized by Assessment Methods

The cognitive levels engaged in assessments are based on taxonomies that classify the mental processes involved in learning. Bloom's taxonomy (1956), revised by Anderson and Krathwohl (2001), remains the key reference framework, defining six levels of learning:

1. Knowledge: Ability to recall and recognize facts.
2. Comprehension: Ability to organize and interpret information.
3. Application: Problem-solving by applying concepts in concrete contexts.
1. Analysis: Breaking down elements of a problem and identifying relationships.
2. Synthesis: Creating new ideas or solutions.
3. Evaluation: Critical judgment based on defined criteria.

This taxonomy is particularly relevant for structuring diagnostic assessments in competency-based approaches. For example, rubrics allow each question to be linked to a specific cognitive level, ensuring that diagnostics cover the entire range of targeted competencies.

2.5. Contributions from Recent Models

Recent works, such as those of Marzano (2017) and Scallon (2018), provide expanded perspectives on aligning diagnostic assessments with modern pedagogical frameworks. These models incorporate affective and metacognitive dimensions, emphasizing the importance of measuring not only what learners know but also how they learn and engage in the skill acquisition process.

3. RESEARCH METHODOLOGY

This study, conducted during the 2017-2018 school year, focused on a sample of 73 students enrolled in the beginning of qualifying secondary school. These students, from public and private institutions, were subjected to a 60-minute paper-and-pencil diagnostic test. The main objective was to assess their skills in physics, based on a detailed assessment grid developed specifically for this study. This grid aimed to evaluate the fundamental learning areas of physics and the taxonomic levels associated with the acquisition process.

The participants were divided into three Common Core Technology classes with French option (BIOF), in a public establishment of the Regional Academy of Education and Training (AREF) of Casablanca-Settat. The test questions were assembled according to specific skill areas, allowing a global and structured assessment of the students' abilities. The diagnostic assessment focused on the mechanics module, assigning the answers levels of success coded from A (Assured) to D (Very little developed).

The methodology was divided into two main phases:

1) Phase 1- Traditional assessment: The copies were corrected according to a standard scale, leading to a traditional numerical mark.

2) Phase 2- Assessment by skills: The same copies were corrected using a skills-based assessment grid. Each student thus received an overall profile by skill area, accompanied by a mark reflecting these results.

This methodology made it possible to structure the results into four analysis themes:

1. General information about learners.
2. Descriptive presentation of the results obtained with the classic evaluation method.
3. Comparison between the two evaluation methods.
4. Analysis of results by skill blocks using the assessment grid.

4. RESULTS AND DISCUSSION

The data collected were analyzed and represented in the form of graphs and tables, using Excel Software. This section details the results obtained for each theme, comparing them with previous studies.

4.1. Theme 1: Information and Conditions on Learners

The study population is made up of 73 students in the institutions of the academy of regional education and training (AREF) Casablanca-Set tat. This sample is briefly described according to the type and the home institution (private or public) in Figures 1 and 2.

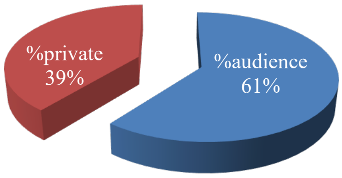

Figure 1. Distribution according to the home establishment

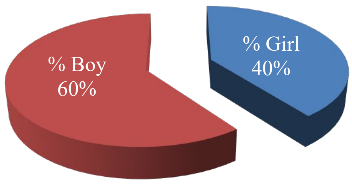

Figure 2. Distribution by gender

The sample studied includes 60% boys and 40% girls. Furthermore, 61% of students come from public institutions, while 39% come from private institutions. This distribution highlights an over-representation of the public sector in this study, in line with the general distribution of students in Casablanca-Settat region. These results are similar to those obtained in other research, such as the work of the OECD (2018), which highlights a heterogeneity of performances between genders and types of establishments in the Moroccan education system. Students in private schools, in particular, often have access to educational resources and supervision more favorable to their success.

4.2. Theme 2: Descriptive Presentation of the Results Obtained by Classical Evaluation

In order to measure the learning skills of the students in the diagnostic test, we studied the distribution of their test scores. There are continuous variables, represented by histograms. We represented the scores by amplitude class two. This helps to better clarify the trends.

4.2.1. Analysis of Classic Student Assessment Results

The results (Figures 3 and 4) show that 72.6% of students obtained an average greater than or equal to 10, while 27.4% did not reach this value. These data indicate that more than a quarter of students endure significant learning difficulties in physics.

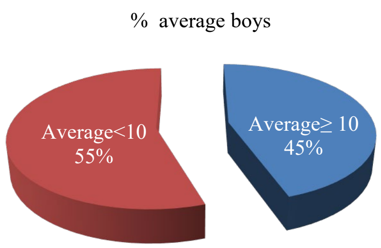

Figure 3. Distribution of score

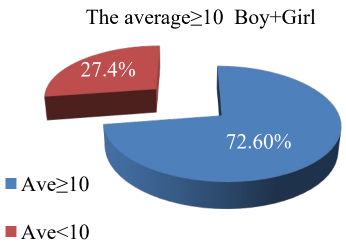

Figure 4. Average student score

4.2.2. Distribution of the Results According to Gender

We have two groups of students to assess, group of girls and group of boys. We compared the notes of these groups of students who are part of our studied sample. Girls, with a median of 14.16 and a mean of 12.94, outperform boys, whose median is 12.88 and mean of 12.60 (Figures 5-7 and Table 1). These results confirm the same findings of several studies (OECD, 2018), which show a similar trend towards better performance of girls in scientific subjects, although they are often perceived as more difficult.

Table 1. Statistical comparison of the scores of girls and boys

Population	Median	Average
Boys	12.88	12.60
Girls	14.16	12.94

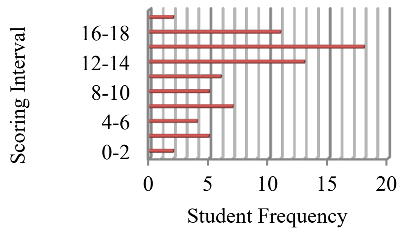

Figure 5. Percentage average boys

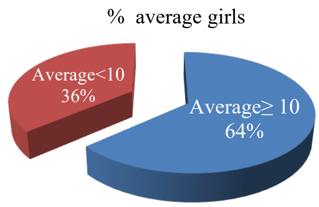

Figure 6. Percentage average girls

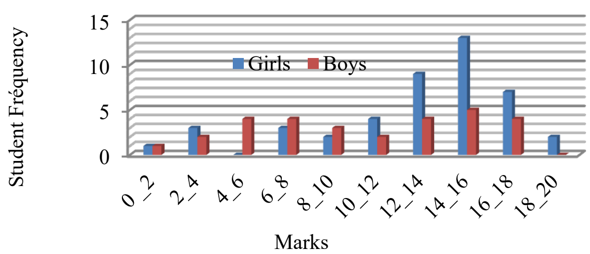

Figure 7. Distribution of the marks according to the gender

4.2.3. Comparison of the Results According to the Nature of Home Institution

We have two groups of students to evaluate: the students from public institutions and those from private institutions. We have compared the student's scores as a function of the two types of institutions school of origin (Figures 8-10 and Table 2). Students in private schools perform better, with 66.6% exceeding the average of 10, compared to 42.5% for those in public schools. These results corroborate the observations of Karim and Raouf (2023), who showed that the teaching conditions and resources available in private schools promote better academic success.

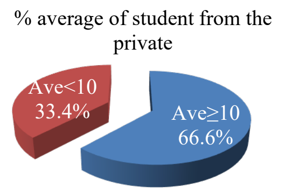

Figure 8. % Average of students from the private

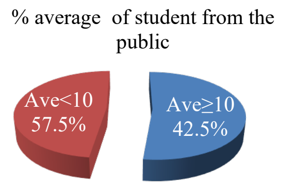

Figure 9. % Average of students from the public

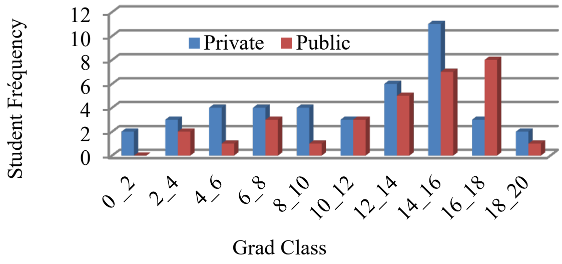

Figure 10. Distribution of marks according to the type of institutions

Table 2. Statistical comparison of marks according to type of institution

Type of institution	Median	Average
Public	13.61	12.75
Private	13.88	12.94

4.3. Theme 3: Comparison of the Results Given by the Method of Traditional Evaluation and the Method of Assessment by Competency

The classical assessment tends to overestimate students' skills, with an average of 12.92 compared to 8.79 for the skills-based assessment (Figure 11). The standard deviations (Table 3) of the two methods (4.54 for the classical method and 4.26 for the skills-based method) remain close, indicating comparable variability between the two approaches. These results are in line with the work of Y. Karim, et al. (2023), who highlight those traditional assessments focus mainly on knowledge memorization, without taking into account the actual acquisition of skills.

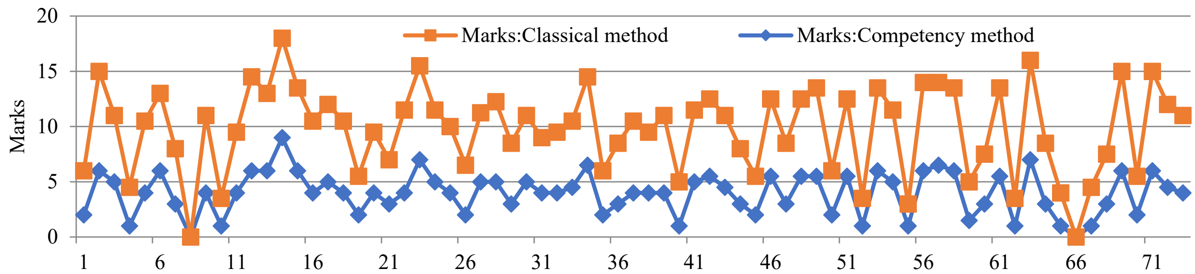

Figure 11. Comparison of the results of the two methods

Table 3. Statistical comparison of results of two methods

	Average	Variance	Standard Deviation
Classic Marks	12.92	20.65	4.54
Rating by Competence	8.79	18.16	4.26

4.4. Theme 4: Analysis of the Copies Corrected by Block Skill According to an Evaluation Grid

Description of the evaluation grid of competencies, we firstly established a list of items observable (Table 5) that express the elements of answers to the diagnostic test. For each question of the test, we assigned a level of control, or acquisition by, A: Insured or B: Acceptable or C: Less-developed or D: Very little developed) for each student.

The information that this grid helps the teacher to better perceives the competences of the student and gives the learner a tool to take consciousness of what appears acquired and what remains to acquire.

Each skill is rated separately. The mark obtained in each competence depends on the rating of 0 to 3 (A=3; B=2; C=1 and D=0) is assigned to each criterion predetermined. We determined the global profile (example of Table 5) acquisitions of each student from the evaluation grid by applying the following indicators:

- The level of success A corresponds to the overall profile of more than 75% in the case where the competence of the student meets clearly the requirements.
- The level of success B corresponds the overall profile between 50 and 75% in the case where the competence of the student meets minimally the requirements.
- The level of achievement C corresponds to overall profile between 25% and 50% in this case the competence of the student is below the requirements.
- The level of success D corresponds to overall profile of less than 25% in this case the competence of the student is significantly below requirements.

Next, we have assigned a relative weight for each skill, to move to the number note as it was called the Skill Score as shown in Table 4.

Table 4. Example of assessment grid

Skills	Question N°	Weight	Success Criterion corresponding to level A	Level Validated				Translation encrypted	Profile total
				A	*B*	*C*	*D*		
Appropriate	1-a	2	Determination of the nature of the movement			X		3/9 =33%	*C*
	1-b-2	1	Convert the mean speed			X			
Scan-reasoning	2-a-1	0.5	To deduce the nature of the movement from a graph				X	0/4.5 =0%	*D*
	2-b-1	0.5	From the graph, determine the speed,				X		
	2-b-2	0.5	From the graph, determine the length				X		
Realize	1-b-1	1	Calculation of the average velocity,	X				3/10.5=28%	*C*
	(2-b-3)	0.5	From the data of the speed and duration of movement to deduce the distance traveled				X		
	3-a	1	Calculation of the distance of a vehicle from the speed and time				X		
	3-b	1	Calculation of the stopping distance from braking distance				X		
Complete	2-a-2	0.5	Justify the result				X	0/1.5 =0%	*D*

Table 5. Conversion note encrypted

Sum of the Coefficients	Score Max	Raw Score/27	Competence Score /20
9	27	6.5	4.81

4.5. The Rate of Responses According to the Levels of Success

From the results of the evaluation grid of competencies for each student in the sample studied, we calculated the rate of responses of each level of success. We see from the Figure 12 that the percentage of responses for level *A* is 13% and that of level *B* is 28%, so one can say that a majority do not have the necessary expertise in the physical sciences to follow the course of the Trunk Common. Hence, the need for remediation and lesson planning to come, taking into account the difficulties detected.

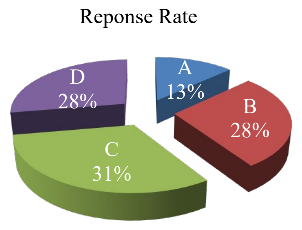

Figure 12. Rate of responses according to the levels of success

4.6. Analysis of Copies Corrected by Block Competence

The results of the evaluation grid of competency allowed us to calculate the percentage of the passing score for each skill. In what follows, we will analyze the results for each Block of Competence.

- "Appropriate" skill

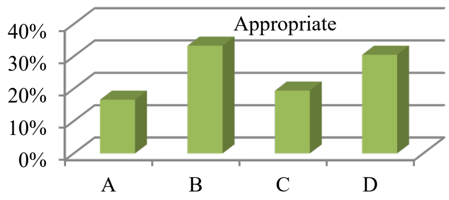

Figure 13. The skill "Appropriate"

Only 30% of students (Figure 13) achieve a satisfactory level (*A* or *B*), with the others having difficulty identifying the nature of the movement or converting units of speed.

- "Analyze-Reason" skill

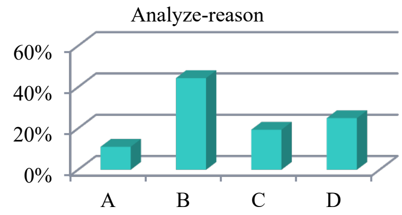

Figure 14. The ability to "Analyze-Reason"

The majority of students (75%) are at level *D* (Figure 14), showing an inability to interpret graphs or determine physical variables.

- "Achieve", "Validate" and "Communicate" skills

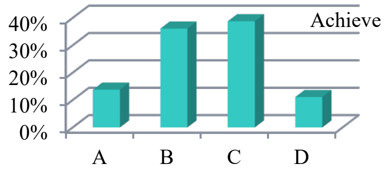

Figure 15. The competence to "Achieve"

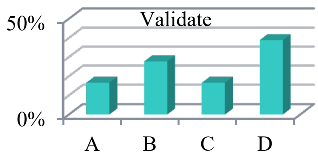

Figure 16. Competence "Validate"

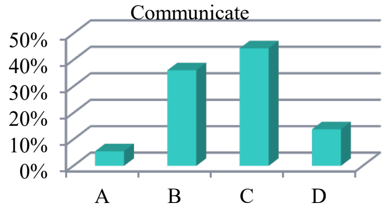

Figure 17. The competency "Communicates"

Achievements (Figures 15-17) are also poor in these areas, with less than 15% of students achieving level *A*. These shortcomings reflect an inability to apply physical concepts or formulate clear scientific conclusions.

• Comparison with other studies

The observed results are consistent with OECD research (2018), which shows that Moroccan students often have significant gaps in science, particularly in analytical and practical skills. Furthermore, research by

• S. Fathi and A. Atibi (2022) significantly highlights the importance of an assessment anchored in the principle of conceptual change. This type of approach makes it possible to better understand students' gaps by identifying initial misconceptions and promoting their restructuring through adapted teaching strategies. Similarly, the work of

• Karim and Raouf (2023) highlights the relevance of a skills-based assessment. This approach, focused on learners' actual achievements, is essential for detecting specific shortcomings and proposing targeted teaching solutions. These studies converge on the need to reform traditional assessment practices in order to promote deeper and more sustainable learning.

5. CONCLUSION AND PERSPECTIVES

The reform of the "pedagogical renewal" establishes explicitly the assessment of skills as the central component of the new learning device. The evaluation is designed as a lever in order to both help the student to learn and to help the teacher to guide him in his approach. It is therefore both a tool of regulation of learning, and an instrument of adjustment to teaching: "the student does not learn in order to be evaluated, but it is assessed to learn better".

According to this study, we have shown that we cannot develop the learning without the diagnostic assessment and without knowing the weaknesses of our plan, our tools, our means and our methods, so there is no learning without assessment and vice-versa. Teachers should, therefore, before updating the learning plan, choose their methods and means, make a diagnostic assessment.

The evaluation scheme we have proposed is in the form of a grid. Using the latter, it is then determined for each criterion of evaluation at what level of competency corresponds to the copy. It allows teachers to probe and to discover the underlying skills in the students and allows students to discover the necessary skills to succeed. The information of this grid does not help the teacher to note quantitatively, but to perceive better the skills of the student that are not directly related to the content taught.

This provides the student with a tool to take consciousness of what appears acquired and what remains to acquire. In analyzing the results of the diagnostic test, we find that the method of assessment by jurisdiction allows precision exact des gaps in students following each type of skill.

The weak results of pupils can be explained by the following causes:

- The method of learning's that are based on logic of knowledge is cumulative, rather than those based on the competitive essences such as «ownership", "analyze-think", "realize", "validate" and "communicate ".
- A confrontation of the content of theoretical science especially appeals to the memory.
- Has the assessment considered by the teachers as a measure of knowledge only without any measure skills.
- To students who perceive physics as a difficult matter, and then a demotivation to the physical sciences.

To overcome these difficulties, the priority objective should be oriented to:

- The formation of the teachers on the different approaches to assessing competence-based learning.
- Personalized instruction based on teaching active methods.
- To stimulate the student more quickly self-sufficient in their learning.
- Arouse the motivation of students in their learning by increasing the activities in the classroom. These should be based on different approaches such as the investigative approach.

The evaluation with the 'competency -based approach helps ensure a better legibility and a greater transparency of student achievement; the evaluation then wins in clarity and reliability.

Proposed solutions:

Solutions can be considered to circumvent these problems. For example, the establishment of technical-pedagogical training for teachers on the integration of ICT in teaching practices could improve learning and assessment in physical sciences. ICT would really be a quality teaching tool to integrated into the teaching of physics; ICT regularly used in the teaching of physics would be content presentation software (MS Power Point, Libre Office Impress, Sway, etc.).

3D modeling tools can help learners better to understand the principles of physics through interactive assessments. The work of Y. Karim, K. Raouf, H. Nebdi in 2023 showed that the use of information and communication technologies (ICT) can also enhance the teaching and learning of scientific subjects. This contribution helps to improve the conditions of pedagogical use and to stimulate learners to become more integrated and engaged into the construction of their learning. This is tested in person and is based on activities and practiced with digital resources and tools (simulations, PowerPoint, presentations, quizzes, videos, etc.).

This study highlights the critical importance of competency-based assessment, which helps to better identify students' gaps and adopt appropriate pedagogical approaches. Disparities between genders and types of institutions highlight the need for educational policies aimed at reducing inequalities and promoting academic excellence.

The results of this study are part of a broader reflection on the reform of school assessment in Morocco, in order to guarantee more equitable and quality learning for all.

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