

The evaluation in the physical sciences in the Moroccan secondary school curriculum: the case of experimental skills

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Abstract

Evaluation is a task of great importance in the service of the teaching/learning that allows us to check whether or not specific educational objectives have been achieved. As far as Moroccan education is concerned, assessment focuses on the level of mastery of specific skills on the part of learners at the beginning, during and at the end of the year, as well as at the end of each period of learning. Our present research is interested on the evaluation of experimental skills in the physical sciences as part of the Moroccan educational system. To validate the hypotheses, we developed a questionnaire that was distributed to a sample of physics–chemistry secondary school teachers in Morocco. The majority of the teachers have reported several constraints, including a lack of material necessary to plan and implement the work practices needed to provide an adequate education in terms of experimental activity in the field of physics–chemistry.

Keywords: Evaluation, teaching–learning, skills, physics and chemistry.

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1. Introduction

Evaluation is a value judgement of the teaching–learning process. It is used to examine the degree of fit between a particular area of knowledge and the objective set, with a view to making a decision.

In Morocco, as at the international level, the traditional, essentially dogmatic, approach to learning in the physical sciences is being challenged. It is therefore one of the methods that is supposed to be more effective that the Moroccan educational system wishes to disseminate in order to allow the learner to better understand and learn.

This goodwill encourages us to find new tools, new ways to achieve the objectives and be able to assess the degree of assimilation.

Our work is therefore part of the framework of research related to the teaching of physical sciences and, specifically, ‘...the evaluation of the physical sciences as part of the programme of secondary education in Morocco: the case of experimental skills’. However, in addition to their attraction for the students themselves, experimental activities are privileged moments that allow the learner to practice the experimental approach, to be critical, to make assumptions, to design experiments, to interpret results, ...

2. Problematic and research context

In the physical sciences, we often hear that the students have engaged in learning but are unable to apply that learning. They are unable to capture the statements knowing that ‘Nothing will WORD MISSING? of itself. Nothing is given. Everything is built’ (Bachelard, 1999).

With the use of excessively deductive and dogmatic approaches and reasoning on the part of teachers, Moroccan education with regard to the physical sciences is formalised and mathematical, and therefore, loses its experimental character. However, physical science is characterised, above all, by its use of experimentation, an activity which is at the heart of the science of nature (Shapin, 1996).

However, an experimental evaluation with regard to physics–chemistry is needed in order to test the methodology and the ability to engage in experimental reasoning as far as accurate knowledge, qualitative understanding, the accuracy of numerical application, the imagination and the creativity of the students is concerned.

The importance of practical tests insisting on the need to preserve the experimental character of this teaching and on the interest of favour to an inductive learning.

In addition, the objective of this study is to determine how the evaluation of the experimental activities can be of service to learning in the physical sciences. Moroccan education of physical sciences responds- T-it to the renewal of education, especially in terms of the assessment of skills in the experimental sciences such as physics–chemistry, that educational policies have stipulated as having to be in place.

Our main hypothesis is that physics–chemistry teachers do not evaluate the experimental skills of their learners.

3. The educational evaluation

The process of assessment is ‘...an approach very familiar to the educational system, and, in particular, its main actors, the teachers. Throughout the year, teachers assess their students and, at the end of the year, the latter sit examination (...). Through these assessment approaches, these written and oral tests, these reviews, it is not only the students who are assessed, but also, at least indirectly, their teachers and, more generally, the system as a whole. The reflection on the marking, its multiple meanings, its appropriateness, its adequacy with its object, etc.—what is called the

docimologie—is old' (Thelot, 1993, PAGE?). It is a registrant, traditionally, in a perspective involving judgement which does not always imply an improvement in the results of the learners, and which does not allow assessment to play a positive role in the process of learning.

To adapt to the different contextual issues and situations, various models of educational evaluation have evolved over time, taking into consideration the evolution of theories of learning (Akrim, Figari, Mottier-Lopez & Talbi, 2010).

It is as well as beyond the judgement, in the case of unsatisfactory results, the proposal of a course of action that is appropriate to the situation in question is important in terms of achieving the desired educational objectives. It is also the case that *'...over years the framework of the evolution of the notion of evaluation in education, that is to say in a very general framework, the advent of the paradigm 'Measure–Assessment–Decision' has provided a certain perspective of which we must be aware: According to this assessment design, the main target of any evaluative approach is a decision and no longer a simple judgement. We could then talk of an evaluation which, in a certain sense, is opposed to the perspective of the evaluation—judgement or of the assessment—contemplation'* (Scallan, 1991, PAGE?).

This new design with regard to the process of evaluation marks a significant evolution in the history of teaching–learning, with the emergence of active pedagogies. The school must therefore put into practice new forms of assessment focused on the development of skills, during and at the end of the year, as well as at the end of each period of learning. This type of assessment must be based on appropriate measurement instruments in order to ensure objectivity (Akrim, El Jamali, El Bousaadani, Radid & Talbi, 2006).

4. The assessment in the physical sciences: the case of Moroccan education

In Morocco, as in any educational system, reform is always a subject of political and pedagogical debate. However, with the publication of the National Education and Training Charter (edited by the Special Commission of Education and Training, 1999) and the emergency plan (developed by the Moroccan Ministry of National Education, Higher Education, Executive Training and Scientific Research, 2007, 2009–2012, 2015), which specify the principles of education–learning, and by adopting a skills approach, the Moroccan educational system has experienced a recasting of these modalities. This recast, unlike traditional methods, has allowed educators to integrate assessment into the learning process.

As the jurisdiction based on the mobilisation, integration and implementation of a diversity of resources in order to respond to a given problem situation, programmes and teaching guidelines of secondary education in Morocco in terms of the physical sciences, declare that the assessment in physics–chemistry must focus on the following:

- The appropriation of information while sorting, selecting which is useful to an observation, a text or a conventional representation; and adopting a critical attitude.
- The achievement of an experimental device, an experience, a diagram, ... while applying an appropriate point of view, speaks some gestures techniques, respecting health and safety rules.
- By adopting an approach-based explanation for the exploitation of information extracted from the data.
- The assessment of the validity and a critical analysis of results, and even the making of proposals to improve a particular approach or a given model.
- The communication of the results in a synthetic and structured manner using suitable vocabulary.
- The development of knowledge and autonomy as a result of working alone or in a group.
- The experimental activities are part of the work which can be evaluated in the physical sciences throughout the school year. This can be done for each assessment by choosing a number of

competencies already worked out to point to the progressive successes of learners. In addition, we can carry out summative evaluation using a grid.

5. Methodology

In order to respond to the questions raised in terms of the subject of our study, we developed a questionnaire that was distributed to 45 secondary physics and chemistry teachers in Moroccan high schools and colleges in Casablanca, in order to obtain their points of view concerning the evaluation of experimental skills in the physical sciences, and as well with regard to the constraints related to the carrying out of experiments in the classroom by their students.

6. Analysis of the results, comment and recommendations

It was noted that:

- 73.3% of the respondents indicated that evaluation must be based on learning objectives, according to the importance and the content of each part of the programme.
- 60% indicated that the most important aspect of the physical sciences is knowing how to apply the laws and mathematical relationships.
- 95% reported that the teaching–learning of physical sciences remains inadequate in the absence of the ability to carry out the necessary experiments.
- 90% do not engage in the evaluation of experimental skills in experimental sciences.
- 79% see the assessment of experimental skills; allows the mastered the scientific approaches.
- 64.5% say that group work, during the work practices, allows the teacher to evaluate the level of autonomy and initiative as skills required in the physical sciences.

All these observations, among others, show that teachers are aware of the importance of the evaluation of experimental skills on the part of learners in the physical sciences. At the same time, they have reported several constraints related to the application of an experimental approach, and subsequently the assessment of learning among others including the time they must spend for introducing such an approach in the classroom, the workforce of learners ‘...the number of students... in the same class may also prove to be a barrier to the implementation of such an approach, the lack of material, ...’.

They know very well that physics–chemistry is a science that relates to an understanding and description of the reality of the world which surrounds us, with the help of increasingly universal and efficient laws, and back and forth inductive and deductive reasoning between theoretical modelling and experimental verification. Introducing the students to the scientific approach allow him to acquire skills, among others experimental skills, which allows him to implement reasoning to identify a problem, formulate hypotheses, confront the experimental findings, and exercise its critical spirit. To allow this to happen, it must be possible to mobilise his knowledge, to find, extract and to organise useful information, in order to arrive at relevant assumptions. He must also be able to reason, argue, demonstrate and work as a member of a team. In presenting the approach followed and the results obtained, the student is involved in the activities of written and oral communication that are likely to improve his mastery of language skills.

However, the teaching of physics and chemistry ensures the importance of the place of the laws and models that can be used to describe and predict the behaviour of nature. Consequently, it allows the progressive construction and mobilisation of the corpus of scientific knowledge, by developing skills resulting from an initiation to the practices and methods of the experimental sciences and an awareness of their genesis.

The experimental approach, associated with a questioning perspective, contributes to the training of the spirit and to the acquisition of specific skills. Experimental activity offers the possibility to the

student of responding to a problem situation by the development of a protocol, its realisation, the possibility of confrontation between theory and experiment, leading to the exploitation of results. It allows him to confront performance with reality. It develops the spirit of initiative, curiosity and critical sense. It is inseparable from pedagogical practice in conditions that are essential to genuine experimentation and safety. In addition, the student must be able to develop and implement an experimental protocol in order to check its assumptions, write the results... and the corresponding observations, conduct and analyse the measurements, estimate the accuracy and write the results in the most suitable way. Knowing the conditions of the validity of a model allows the student to determine the possible forms and reinvent it... The learning process should emphasise that greater rigor and accuracy are at the heart of the teaching of physics and chemistry.

In effect, the physical sciences are among the experimental sciences which require special notes at the level of teaching/learning. Learning in Morocco on the part of high school and college students remains inadequate as can be seen by the existence of several constraints, related mainly to lack of necessary equipment to achieve practical work and experimental activities, and by the fact that the assessment of the competencies of our learners remains incomplete.

7. Conclusion

The carrying out of experiments in the physical sciences is a task of great importance that involves both teacher and students. It allows the learner to be active and more motivated within the class due to his involvement in manipulation in respect to a given protocol; and to even choose the suitable experience. In addition, the assessment of the physical sciences may be used to support learning by allowing the teacher to check the achievement or otherwise of specific educational objectives, and to encourage the evolution of experimental skills which constitute the essential attitudes to be developed in the learner.

Despite the constraints and the fact that there is little work done to assess the necessary experimental competencies, Moroccan physics–chemistry teachers can benefit from continuous training or research on the topic, and can even take the initiative by introducing experimental activities that require few means.

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