International Journal of Science and Research Archive
eISSN: 2582-8185
Cross Ref DOI: 10.30574/ijsra
Journal homepage: https://ijsra.net/

(RESEARCH ARTICLE)

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The teaching-learning of physics and chemistry as an experimental science: points of view of trainee teachers in Morocco

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International Journal of Science and Research Archive, 2024, 13(02), 2793–2796

Publication history: Received on 28 October 2024; revised on 10 December 2024; accepted on 12 December 2024

Article DOI: https://doi.org/10.30574/ijsra.2024.13.2.2438

Abstract

This study gives some points of view of trainee physics-chemistry teachers in Moroccan secondary education about the teaching and learning of science as an experimental science.

The methodology followed is based on a questionnaire distributed to 48 trainee teachers. they declared the necessity of applying the experimental approach to teaching physical sciences.

Keywords: Approach; Experience; Science; Physics; Chemistry

1 Introduction

Currently and for some time, "traditional" learning methods have been called into question: less "by rote", fewer so-called lectures or even frontal courses. It is therefore learning methods that are more beneficial to the student, learning that would allow the individual to understand better, to learn better...

The new desire to teach therefore had to find new tools, new means, to achieve the set objectives.

The student, placed at the heart of the education system, will also be placed at the heart of his learning, to become an actor in his own right. Encourage questioning, introduce experience as much as possible into the course, favor the scientific approach to allow the student to construct their own logical reasoning, which will lead them to the answer: this is indeed a change important in the teaching method.

There seems to be a malaise in the teaching and learning of physics-chemistry: this discipline is recognized by the learners as difficult, the teaching approaches used are cumulative, the pupils and even the students memorize more than they do not understand and have difficulty relating the different theoretical elements, a problematic use of symbolism, and a certain dissatisfaction of teachers (*BHATTACHARYYA & BODNER,* 2005; *BOWEN*, 1990; *FERGUSON & BODNER*, 2008, *LADHAMS ZIEBA,* 2004).

The experimental method as we know it today is based on the experimental approach developed by *CLAUDE BERNARD* (1966), described in his work Introduction to Experimental Medicine published. This method is characterized by a guided path whose stages are defined by the famous "O.H.E.R.I.C.". The most important steps in this process are:

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1.1 Starting situation

It is about relying initially on the interests of the students, starting from their questions, their desire to understand the world, what we can call a "triggering factor". It is up to the teacher to provoke questioning through a discovery phase, an observation or an introductory questionnaire.

The ideal would be to be able to seize the slightest opportunity to encourage spontaneous questioning in order to encourage student support and trigger real motivation to get involved in a process of solving a scientific problem.

The role of the teacher is to help all students take ownership of the problem and with this in mind, proposing a "triggering" situation often reinforces motivation, gives meaning and encourages the development of a real problem. scientist.

1.2 Formulation of a problem

It is important for a teacher to encourage the emergence of students' representations in order to have access to them because:

- they constitute an inventory of knowledge.
- the confrontation of these representations in the group enriches the exchanges and their reflection.
- one of the challenges of the experimental approach is to confront these representations with reality.
- we cannot learn without deconstructing our own representations.
- In particular, it is a question of using them to bring out contradictions and questions which will put students before a problem to be solved requiring the issuance of hypotheses.

1.3 Emission of hypotheses

The scientific problem raised and formulated by the students requires and calls for a solution. This solution is not immediately accessible to them, it is built gradually.

To do this, students must first assume the solution and make hypotheses about the problem to be solved.

1.4 Experimentation:

Hypotheses, to be validated, rectified or rejected, must be tested experimentally. It is experience that will judge the relevance and validity of a hypothesis. This phase of manipulation allows a confrontation with reality which can lead to a contradiction between "thought" and "experience", likely to cause the student's representations to evolve.

1.5 Results and Interpretations

This stage of interpretation of the results leads to marking the end of the research by justifying the approach undertaken and the solutions proposed, as it can suggest other research and new hypotheses.

1.6 Conclusion

The results interpreted, the solutions found still only have a circumstantial value to this or that particular phenomenon analyzed in class. It is therefore appropriate, in this final stage, to give meaning to the conclusions drawn which must respond to the initial problem and to generalize them to other related situations.

In this approach, the issuance of hypotheses and experimentation occupy important places because they invite the student to analyze, reason and test their ideas during a double confrontation: with other students and with reality.

The experimental approach arouses everyone's interest through the central place it gives it in the search for knowledge and its maintenance throughout the reasoning. The group's involvement in the course is amplified.

The experimental work is led by the student, who constructs his reasoning with his own knowledge: this method further questions the students' acquired knowledge.

The experimental work, if carried out by the student, allows them to construct their reasoning with their own knowledge: this method further questions their acquired knowledge. He must be considered a real actor and his participation in all processes will be encouraged; in particular by his encouragement to carry out laboratory

experiments himself and to touch very closely, and at the appropriate time, the difficulties to be overcome to promote good learning (*E.H. TOULI, M. RADID and M. TALBI*, 2011).

2 Methodology

To answer the questions asked, and to have an idea of the application of the experimental in the learning of physical sciences and thus of the constraints linked to carrying out experiments in class with students, we have developed a questionnaire of 12 questions for a sample made up of 48 Physics and Chemistry trainee teachers in Morocco.

3 Results and interpretations

For our sample:

- 62.50% of trainee teachers admit that it is impossible to teach physics and chemistry without carrying out experiments.
- 68.75% of trainee teachers note that it is insufficient to teach physics and chemistry by describing experiments.
- 31.25% of trainee teachers are for the participation of students in conducting the experiment with the teacher.
- 56.25% of trainee teachers think that the teacher must know the results of the experiment before carrying it out.
- 60.42% of trainee teachers think that the teacher must ensure the success of the experience in front of the students.

To maintain his image of credibility among students, 31.25% of trainee teachers affirm that the teacher should cheat and rig to get good results from the experience.

- 25.00% of trainee teachers note that a failed experiment is a reason to refute an explanation model.
- 32.89% of trainee teachers know the stages of the experimental approach.

For the most difficult stage of the experimental approach according to the teachers in the sample:

- for the observation stage: 2% of trainee teachers find it difficult.
- For the hypothesis stage: 12% of trainee teachers find it difficult.
- for the experience phase: 30% of trainee teachers present difficulties in this stage.
- For the results phase: 4% of trainee teachers find difficulties in this stage.
- For the interpretation phase: 14% of trainee teachers present difficulties in this stage.

4 Discussions

On an educational level, the experimental approach makes it possible to develop a multitude of qualities and investigations. It is possible to categorize these various objectives into two groups: attitudes and approaches.

Attitudes:

- want to ask questions (curiosity),
- have self-confidence,
- be critical (critical thinking),
- be creative (creative imagination),
- want to look for yourself,
- want to communicate,
- want to work in a group,
- master the concepts that manage the operation of a device.
- articulate experimental practices and appropriation of more theoretical knowledge.
- memorize (because we remember better when we do).

Procedures:

- know how to undertake an activity to answer your own questions, those of your classmates,

- know how to state your own formulation of the problem,
- know how to formulate several hypotheses,
- know how to spot a size,
- know how to imagine an experimental device,
- know how to look for indicators,
- know how to consider the causes of errors,
- know how to observe, take measurements, investigate,
- know how to read the results of an experiment,
- know how to translate the results into a graph, know how to argue,
- know how to discuss the contributions of one's experimentation and compare it with those of others.

However, the experimental approach presents certain constraints linked to its application. These are not really negative points induced by this more scientific conception of the course but rather points requiring particular attention or investment from the teacher, in particular: the time consumed by such a teaching method,

- management in large numbers of people of the greater freedom necessarily granted to students. The number of people can also prove to be an obstacle to the implementation of an investigation process,
- Such an approach in fact implies exchanges between students and between the class group and the teacher, and it is all the less easy to manage these exchanges as they concern a large number of people,
- the necessary care to be given to the choice of the problem situation which must be precise and clearly bring out the false representations present among the students.

5 Conclusion

From this study, we can conclude that the trainee teachers in our sample see that physical sciences are experimental sciences to be taught by carrying out experiments, which allow students to be active and more motivated within the class by their involvement. In addition, setting up an experience chosen by the students is more attractive than one proposed by the teacher.

The trainee teachers also reported that the most difficult stages of the experimental approach to involve the students more are the hypothesis emission, the carrying out of the experiment and the interpretation of the results, since the teacher must face numerous difficulties encountered by students due to their immaturity, more often than not, and their communication problems.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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