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Science teaching in primary school in Morocco: the challenge and the prospects. (Scientific activity as a model).

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Summary of work

We are convinced that we are contributing to the implementation of the recommendations of the (2015-2030) reform of the Higher Council for Education, Training and Scientific Research (CSEFRS) for the advancement of the education and training system in Morocco. The achievement was made possible by sharing documents and holding hearings so that the results of the survey carried out between April 2021 and March 2023 show how science is taught.

Starting from the fact that science and technology are considered insufficient in modern primary schools in the modern primary school, it also shows the low presence of these disciplines (Science and Technology) in the initial training and professional development of teachers throughout their careers.

The aim of this report is to provide an overview of the state of science and technology teaching in primary schools, as well as the current situation and the initial and in-service training of teachers of these disciplines, the constraints of its evolution, its consequences, and finally to look to the future (2030 horizon).

The three main explanations for the situation observed are (as follows):

- Ministerial directives play an important role in the teaching of French, Arabic and mathematics... However, these rules are limited in relation to the objectives of the common core of knowledge, skills and culture.
- Teachers are generally not sufficiently qualified to teach science as most of them have come from non-scientific backgrounds.
- Teachers are faced with problems of the number of sections allocated, the lack of equipment and laboratories (specialised rooms).

The main conclusions drawn from the data collection and analysis are presented here formulate recommendations for the public authorities to remedy a situation that is seen as worrying for the future of young pupils, and to promote scientific literacy among citizens living in a world where science and technology are increasingly important.

1- Teaching scientific activities in primary school.

The work emphasises the importance and the need to generalise teaching by placing the focus on experimental sciences, computing and technology as well as improving its quality from an early age. This education must be used as an experimental and practical basis and should not be separated from the teaching of mathematics. For example, relying on examples and concepts from science and technology in the teaching of mathematics and language to reinforce and enhance “fundamental” knowledge. And in order to prepare children for a scientific and technological world, it is important from primary school onwards:

- to acquire a solid knowledge of science and technology.
- to structure relevant knowledge, develop a critical mind and set up a scientific method.
- to build on environmental themes and use an interdisciplinary approach.
- to reinforce very concrete fun activities at pre-school and primary level while, at the same time, avoiding conceptual abstraction.
- to propose a vision based on an active pedagogy that develops teaching by highlighting scientific principles, scientific methods and scientific subjects or knowledge.

2- Initial training of future teachers.

According to the hearings and analysis of the survey results, a small percentage of the days devoted to initial teacher training in science and technology, and therefore for all areas of teaching that are devoted to trainees.However, training many young Moroccans in science is essential if we are to cater for society's needs and expectations, as well as the scientific and technical benefits. The role and professional skills of teachers are essential for improving science in the domain of children's education. It is suggested that science and technology be considered as important challenges in the initial training of future teachers and in the early years of their careers by:

- improving teachers' skills and teaching practices.
- offering training adapted to the profile and needs of candidates for a teaching career, in particular a training in the sciences adapted to those with a literary background.

3- For in-service training

Generally speaking, the system of in-service training for teachers in the national education should move away from being dirigiste and become a model for professional development throughout each teacher's career, providing them with the professional skills necessary to adapt constantly to changes in the education system and to support pupils.

In addition, continuing training is essential to complete initial training, which is often incomplete; it allows scientific knowledge and skills to be updated; and it uses complementary tools, such as educational animations and district training courses to keep pace with advances in knowledge and technologies.

Finally, in-service training makes it possible to integrate teacher training into a perspective of professional and personal development:

- Training teachers in the major issues of the day such as sustainable development, climate change, nature conservation...
- Creating a digital culture so that teachers and future teachers can follow distance or autonomous courses throughout their careers.

4- At the level of in-class support

Collective life, the sharing of teaching practices and subject didactics are underdeveloped among primary school teachers, and they say little about the difficulties they encounter in class. It is important to make teachers aware of their crucial role and their involvement in the strategic vision of school reform in Morocco, which consists in passing from a society that consumes knowledge to one that produces and disseminates it. The implementation of an active pedagogy for teaching science, with principles, methods and knowledge must be explained:
To benefit from the scientific expertise of one of the teachers, introduce time for shared work (co-teaching), use, as far as possible, the school's resources and those of neighbouring schools. Develop local school/company/NGO relations to help the school in its science and technology activities, and thus become more open to the local area.

Summary.

The preservation of a specific universal heritage is a major cultural issue in the teaching of sciences and mathematics, which means that the necessary scientific foundations must be established from the very start of learning.
The 'reality on the ground' is different, according to the analysis of the data collected as part of this work. It should be noted that the curricula are only partially followed and professional skills are often ignored. Few children are exposed to the overall coherence of science teaching. This deficit is neither currently compensated for by adequate initial training nor by in-service training commensurate with what is at stake, nor is it compensated for by the allocation of special rooms for science teaching...
Faced with these realities and challenges, this report aims to identify the current causes and to propose solutions to remedy this worrying situation in order to provide a vision and suggestions to encourage those involved in the education system to reflect further on the reforms under way in Morocco, and to achieve the objective of "moving from a society that consumes knowledge to one that produces and disseminates it" as the CSEFRS reminds us [2].
Key words: scientific activity. Reforms. Science and Technology.

1- Introduction

All children are active and interested in all types of mental and physical activity. They care about people and things around them such as animals and different means of transport, and look at and question natural phenomena.
Curiosity is triggered in them and is linked to the enrichment of language and develops naturally. It is interesting to note that the different educational approaches proposed by Maria Montessori and Célestin Freinet, the École Nouvelle movement and the Langevin-Wallon plan at the time of the Liberation, and lastly Stanislas Dehaene [3], have led to the conviction that young children have a high potential for learning science and technology. In

order to develop their curiosity and facilitate the acquisition and appropriation of scientific knowledge and scientific skills, which will form the basis of the whole of the pupil's education, cognitive construction of abstract concepts deserves a better place in teaching and education. [4].

2- Scope for (educational and thematic) reflection.

In primary education, the school year comprises at least thirty-four weeks full of effective activity, corresponding to a volume of approximately 1000 to 1200 hours.
This work focuses on the pre-school and primary education programmes, which are limited and require around 8 years of training [5] to provide pupils with the resources they need to learn and develop. Science education must go beyond formal schools. It must also take into account social and family environments as well as institutions such as educational and sports clubs, holiday centres, theatres, museums, etc. Any reform of this type of education must be based on broad communication with society, the media and so on. It is vital to continue improving science teaching in Morocco because many jobs in the future will be STEM jobs [6], and that our education system, at the elementary level in particular (maths, reading and science) is "at the bottom of the pack" in international comparisons, and that progress in science, technology, engineering and mathematics (STEM) at several levels is essential to building an inclusive society. Finally, in order to move forward with this reflection, it is preferable to focus our investigation on several areas where there is a lack of evidence for discussion. Firstly, this work shows the current state of science teaching in primary schools. It is crucial to establish a solid rationale for the importance of a teaching discipline, and to determine the precise reasons why a specific mastery of scientific knowledge is required, as well as the qualitative aspects of science teaching in Moroccan primary schools. And, new projects need to be created.

3- Pupils' performance and interest in scientific activities in primary schools.

After years of progress, a reintroduction of scientific activity in primary schools has been observed, but in recent years, this teaching has been in declining [7]. The level of pupils' knowledge in these areas is stable, and there is a general stability at the end of primary school (CE6).However, current school curricula set goals for science teaching that meet the needs of the modern world.
A large number of teachers said in the survey that pupils enjoy learning science lessons at school, and that they pay attention during experiments, but are less motivated when studying documents.

4- The condition of premises where science is taught at primary level

Ministerial directives specify the objectives set out in the common base of knowledge, skills and culture in primary school curricula. The teaching is given at regular intervals in accordance with school curricula at the primary and high-school level. Pupils are expected to explore the world and ask questions. Observation, manipulation, and progressive teaching are used in the early stages of learning. Digital education has not yet been integrated into

the teaching of science and technology in primary schools as well as in teacher training with the aim of supporting the pedagogical approach, and remedying the lack of resources (materials or experimental equipment) and facilitating group work by learners. Finally, it should be noted that digital education is not a solution, but it does offer new opportunities that will improve teaching methods, open up disciplines to one another and stimulate students' interest.

For this reason, we must continue to ensure that the education system draws on its resources, makes effective use of digital tools and makes the most of its potential resources, makes effective use of digital tools and promotes the development of digital literature in education.

5- Obstacles to teaching scientific activity of adequate quality and duration.

According to the analysis of the survey results, only 70% of school teachers say that they cover all the areas and cover the entire scientific activities in the current curricula. There are a variety of reasons for this. According to the results of recent surveys of Moroccan primary schools, an initial assessment shows that initial assessment shows that:

- science syllabuses are not respected (for 30% of teachers).Teachers only allow a few periods to present lessons on scientific activities, while the other hours are devoted to mathematics (in the private sector), Arabic, history or geography (in the public sector).
- The number of classes assigned to the primary school teacher (in rural and sometimes pre-urban areas) makes it more difficult to cover all the subjects, especially the scientific activity.
- Because of the lack of equipment (for 65% of teachers), and the absence of special rooms (for 80% of teachers) which can make a spectacular leap forward in quality and quantity, experimental sessions are practically cancelled.
- The hourly volume is insufficient (for 60% of teachers);

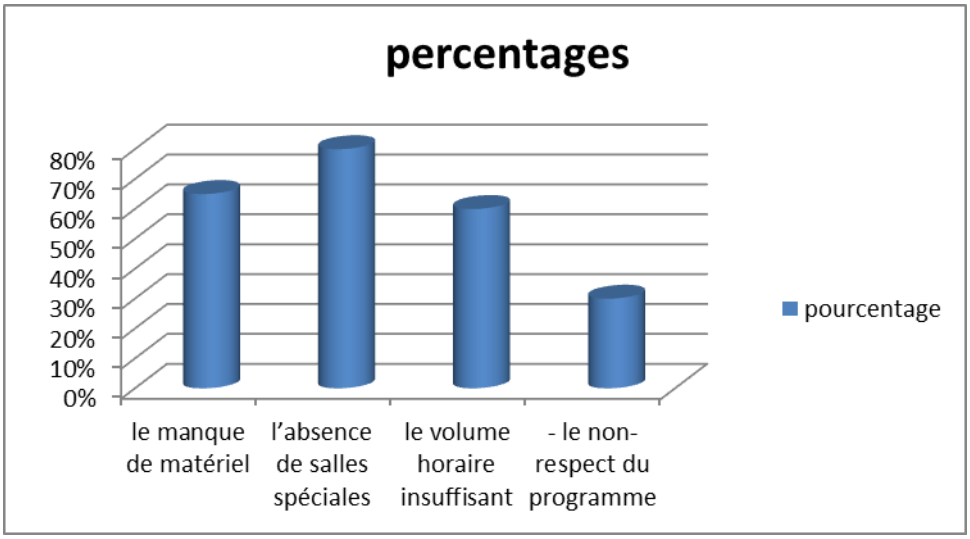

Figure: Types of difficulty and their percentage

"Teachers make choices because they don't have enough time for scientific activity"."Primary school teachers often feel that other things are more important"."The pressure to learn reading, writing and arithmetic is more and more increasing, which leads them to divide up the learning process into different subjects."

"There is less time available to deal with all the subjects because of this organisation." (Type of hearing)

6- Additional challenges focused on certain scientific areas.

If we look in more detail at the evaluation of the shortcomings in the implementation of the programme of scientific activity, it is clear that not all the areas of scientific activity are handled fairly.
It has been found that differences in the treatment of curriculum topics stem from teachers' perceptions of complex topics rather than the actual complexity of the topics. The modelling and scientific descriptions of complex systems are extremely difficult and require the same pedagogical knowledge and skills as in other areas. [8]

7-Why teach scientific activity in primary school?

In order to train future enlightened and aware citizens, all pupils must be introduced to the scientific approach from their first years of schooling and acquire the fundamental knowledge and skills in science and technology.
The strategy of developed countries has long focused on advances in science, technology, engineering and mathematics, which improves a country's ability to produce better and smarter goods, to improve healthcare and develop cleaner goods, more efficient national energy sources, environmental conservation...It will be essential for the country to maintain its pre-eminent position in the world as a leader in STEM fields, but the evidence shows that current educational pathways are not leading to a sufficiently large and well-trained STEM workforce to achieve this goal. Therefore, it is essential that the country increases the engagement of STEM subjects and encourage many more students to excel in STEM subjects. [9].

8- Fundamental concepts of science and their application in teaching.

In order to train enlightened citizens who are aware of how science is constructed, as well as to develop scientific vocations in the future, all pupils must be introduced to the scientific approach, develop their methodical thinking, acquire fundamental basic knowledge and skills in science and technology from their earliest years of schooling. The key element of science teaching at primary level is the scientific approach. This should always form the basis of all classroom science teaching. It involves the general scientific approach, which is organised as follows:
1. I ask a question.
2. I put forward a hypothesis based on my knowledge.
3. I plan and carry out an experiment.
4. I draw up a report (observations and conclusions).
The scientific approach can vary, and there are 4 types of approaches based on the general approach:
- the investigative approach.
- the analytical approach.
- the popularisation approach.
- the design approach.

a- Which science?

This is primarily a qualitative science methodology that does not rely on mathematical formalisms. At primary school, children count objects, take measurements and modify parameters, but never formulas parameters, but never formulas, even the simplest ones. Science teaching, for its part, focuses on more ambitious objectives. The aims of nursery school are the following:

- Differentiating between thoughts and observed events is not enough to explain the phenomena observed.
- More scientific reasoning has taken over from cause-and-effect reasoning.
- Contributing effectively to the construction of an appropriate syntax by including vocabulary (use of "because, for...").

b- Improve scientific reasoning skills.

Pupils, indeed, need to be taught fundamental concepts in order to understand scientific reasoning; they need to find regularities and understand cause-and-effect relationships: For example, to test a hypothesis, children need to be rigorous. A good understanding of fundamental scientific concepts will help pupils to make the difference between observation and interpretation. Finally, the pupils' points of view need to be taken into account as it can be hard to take into consideration the reasoning processes of pupils, since every child can express the substance of their thinking at primary school in a number of ways: in these experiment notebooks, verbally during discussions with their classmates in groups.

c- Science and language.

Science has its own vocabulary, a scientific lexicon, which can be used to describe its methods, concepts and knowledge."Science is married to language, and Lavoisier, writing a treatise on chemical nomenclature, and therefore on language, Lavoisier accidentally discovered that he had been working on science, just like the man who first observed and gave names to the chemical substances he used and named birds and trees in all their diversity" [10].In fact, the sciences provide an ideal framework for developing pupils' language skills, and address other subject areas (such as mathematics).It’s a crucial component highlighted in the principles [11]. Moving from hand to dough.

-*At nursery school*: Most of the time, children are required to take part in 'workshops' where they learn scientific terms, adjectives and verbs...The choice of words in science requires precision. Learning about science and technology at school" [12].

Children love to draw, so it is important to build on this skill in order to gradually produce drawings that are directly related to the objects or phenomena being studied. In fact, once children are at ease with drawing, they are ready to draw a map or a diagram.

- *At primary school*: According to educational research, which suggests that scientific vocabulary should be explicitly taught to students (through definitions) in a variety of contexts such as the commented reading of scientific texts, the discussion between students or the implementation of investigative activities? Science activities help children to practise and master the language as they begin to write.

d- The aim.

Thanks to a better explanation of the meaning of scientific words or expressions and an effective implementation of the experimental approach in primary school, the general aim is to help teachers to improve learners' understanding of science and technology.
The specific aims are to help teachers to:
- make connections between pupils' experiences and scientific phenomena;
- provide an explanation of words or expressions related to the teaching of science and technology at primary school;
- carry out experiments effectively.

Conclusion

As the CSEFRS [1] points out, Morocco intends to "move from a society that consumes knowledge to one that produces and disseminates it". In order to reinforce this ambition, certain ministerial notes need to be re-evaluated
so that they state that the teaching of scientific activities is intended to provide vocational training and "utilitarian" preparation for integration into an industrialised society. In addition, it is also intended to teach a general culture, knowledge and techniques of analysis and reasoning which contribute to the training of the citizenship. The learning of scientific concepts thus involved the presentation of 'information' and ‘predetermined explanatory models', occasionally including demonstrations and focusing on the "right questions" as proposed in the curriculum [16].As a result, should we adopt an approach that is the most common in science teaching? In terms of “explanatory lessons" that serve to «show the science» rather than to "bring out the questions and support children in their process of constructing scientific conceptions”.

The issue of practice in teaching and learning, especially in science, has always been challenge for Moroccan schools. Theory has occupied a comfortable place for a long time and continues to occupy this place in the teaching and learning of science. An analysis of the official science curriculum for primary school shows that the study of documents is more important than the status of scientific experiments, which prompts us to consider the content of scientific activity. There is a variety of knowledge on how to move forward, such as collaboration among companies, local and regional authorities and education experts, which can make a difference. By presenting a strategic plan that paves the way for sustainable improvement helps national investment in STEM education programmes and make a difference for many more students and educators [3], so that the goals, priorities and a new framework for collaboration and programme improvement need to be identified.
The main conclusions drawn from the data collection and analysis presented here, will undoubtedly contribute to a major development in the teaching of scientific activity. These proposals require a clear political will, in terms of both the size of the budgets allocated to implement the various reforms, and the need to see them through to the end by ensuring consistency in all the choices made.

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