

The Initial Conceptions of Students in the Teaching Practice of Life and Earth Sciences Teachers in Morocco

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Abstract. This study aims to describe the learning environment that can influence the construction of scientific concepts among Moroccan students. It focuses on the role of students' initial conceptions in the teaching practice of Life and Earth Science (LES) teachers in Morocco. To conduct this study, we performed a quantitative analysis of collected data using a multiple-choice questionnaire, which aimed to understand the characteristics of the target group and the techniques employed to gather students' initial conceptions of the ecosystem, as well as their declared and actual teaching practices. To compare our results, we considered two contexts: rural and urban, where the teachers operate. The analysis of the obtained results revealed that a majority of the surveyed teachers start by identifying students' initial conceptions before approaching the teaching process. Additionally, the study found that debate and diagnostic testing are the most commonly utilized techniques for identifying and addressing students' initial conceptions of the ecosystem. Furthermore, this analysis revealed that teachers do not take students' conceptions into account when preparing the ecosystem learning sequence.

Keywords: Actual practice, declared practice, ecosystem, initial conceptions, Life and Earth Sciences (LES), the learning environment.

Introduction

Recognizing the critical role of education, the Moroccan government considers it a fundamental lever for achieving the Sustainable Development Goals (SDGs). Consequently, significant efforts have been made to enhance the quality of the educational system. Initiatives such as the GENIE program and the Strategic Vision of the 2015-2030 reform exemplify the commitment of Moroccan authorities in this regard. However, national and international studies on the learning of Life and Earth Sciences in Morocco [1] [2] reveal a low level of scientific proficiency among secondary and high school students. These studies underscore the deficiencies in Moroccan students' grasp of scientific concepts in this field.

In response to this concerning situation, Moroccan education authorities have taken measures to improve the educational system's quality. In line with these efforts, the Moroccan government has introduced an action plan for educational reform spanning from 2022 to 2026. This program is centered around three main pillars: teachers, students, and academic institutions. These pillars serve as the foundation for enhancing the quality of education in Morocco. Research on science didactics emphasizes the significance of constructivist pedagogy, wherein teachers draw upon learners' prior knowledge to construct their lessons. Consequently, knowledge is co-constructed through interaction with students. In light of this, several studies [3]–[13] have focused on analyzing teaching practices to comprehend the rationale behind teacher actions in the classroom.

While there has been extensive research on teaching practice worldwide, few studies have specifically examined the teaching practice of Life and Earth Sciences teachers in Morocco. Thus, our study aims to address this gap by specifically investigating the role of students' initial conceptions in the teaching practice of Moroccan Life and Earth Sciences teachers. Our objective is to enhance science education by elucidating the relationship between students' initial conceptions and the teaching practice employed by Moroccan teachers.

Our research aligns with the broader endeavor to improve the performance of the Moroccan educational system. Accordingly, our main goals are to evaluate and analyze the reported teaching practice of Life and Earth Sciences teachers in Morocco, with a particular focus on students' initial conceptions of the ecosystem concept. We aim to explore how teachers address their students' initial conceptions in their pedagogical practice and how this interaction influences the teaching of the ecosystem in Life and Earth Sciences classes.

To accomplish our study objectives, we conducted a quantitative analysis of data collected through a multiple-choice questionnaire. This questionnaire targeted Life and Earth Sciences teachers from various regional educational and training academies in Morocco, aiming to gain a deeper understanding of the emergence and techniques employed in capturing learners' initial conceptions of the ecosystem, as well as teachers' declared and actual practices. Through the analysis of the teaching practice of Life and Earth Sciences teachers in Morocco, we can elucidate the learning environment that potentially shapes the construction of scientific concepts among Moroccan students, with the ultimate aim of enhancing science education [14]. Additionally, this exploratory study sheds light on the diverse techniques employed by Life and Earth Sciences teachers to address their students' initial conceptions. These findings can serve as a foundation for further research aiming to identify effective classroom practices. The decision to consider students' initial conceptions of the ecosystem concept stems from its significance in nurturing citizens who possess an awareness of environmental preservation, a strong scientific foundation, and the capacity to make informed decisions regarding the environment and sustainability.

This article is structured into six sections. We commence with a general introduction, followed by a presentation of our study methodology, outlining our approach to collecting reported teaching practices of Life and Earth Sciences teachers in Morocco. After providing a comprehensive overview of the obtained results, we will proceed to open the discussion and invite further suggestions

METHODOLOGY

Advancements in science didactics research have led to an expansion of theoretical and methodological frameworks [15]. Consequently, different methodological approaches coexist, leading to debates regarding their relevance and validity based on their alignment with quantitative or qualitative paradigms [16]. In this study, we employ a quantitative approach to investigate teachers' self-reported teaching practices. To collect data, we utilize a questionnaire as the primary data collection tool. The questionnaire is anonymous and consists of multiple-choice questions focused on teaching practices, initial conceptions, and methods for identifying them in the classroom.

In line with an ecological perspective aimed at reducing paper consumption, we opt for online administration of the questionnaire using the Google Forms tool. The questionnaire is distributed to groups of Moroccan Life and Earth Sciences (LES) teachers, comprising more than 100 members. Over a one-month period, we receive 40 responses from a representative sample that encompasses diverse school environments, including both rural and urban settings. It is important to note that our sampling approach is random and does not claim to represent the entire target population of LES teachers in Morocco. As an exploratory study, our objective is not to generalize the results. Consequently, the collected data are processed and analyzed using IBM SPSS Statistics 26 software

1. POPULATION CHARACTERISTICS

In our survey, we received 40 responses from the participating teachers, with the following distribution of seniority: (see Table 1).

- 17.5% of the participating teachers had a seniority of less than 5 years.,
- Another 17.5% of the participating teachers had been in the teaching profession for a duration ranging between 5 and 10 years.
- 32.5% of the participating teachers had a seniority between 10 and 15 years.
- The remaining 32.5% of the participating teachers had a seniority exceeding 15 years.

Table 1: Teacher seniority

	Number	Percentage	Valid percentage	Cumulative percentage
[0-4]	7	17,5	17,5	17,5
[5-9]	7	17,5	17,5	35,0
[10-14]	13	32,5	32,5	67,5
[15- plus [13	32,5	32,5	100,0
Total	40	100,0	100,0	

2. Data analysis

2.1. THE EMERGENCE AND TECHNIQUE OF COLLECTING LEARNERS' INITIAL CONCEPTIONS OF THE ECOSYSTEM: (FIGURE 1)

The analysis of data collected from the study provides valuable insights into how teachers identify learners' initial conceptions of the ecosystem. Firstly, a significant majority of participating teachers (95%) indicated that they are accustomed to identifying learners' initial conceptions. Conversely, a small percentage of teachers (5%) reported that they do not engage in the identification process.

Among the techniques employed by teachers to identify learners' initial conceptions, organizing debates during triggering situations emerged as the most prevalent approach, as reported by approximately 70% of the participants. This indicates that teachers recognize the value of engaging students in active discussions to uncover their pre-existing ideas and conceptions. Additionally, 60% of the surveyed teachers reported using diagnostic assessments as a technique for detecting their students' initial conceptions. This approach allows teachers to gather specific information about students' understanding of the ecosystem.

Interestingly, individual question-and-answer sessions were mentioned by 22.5% of participating teachers as a method for identifying learners' initial conceptions. This personalized approach enables teachers to directly interact with students and probe their conceptual understanding. Furthermore, within the survey, an additional 22.5% of teachers, particularly those with less than 9 years of teaching experience, emphasized the importance of observing the emergence of learners' initial conceptions through debates. This highlights the role of classroom interactions in uncovering students' preconceived notions.

Lastly, it is noteworthy that 42.5% of the surveyed teachers, who possessed more than 10 years of experience, indicated that they employed either diagnostic assessments or debates as techniques to detect their students' initial conceptions.

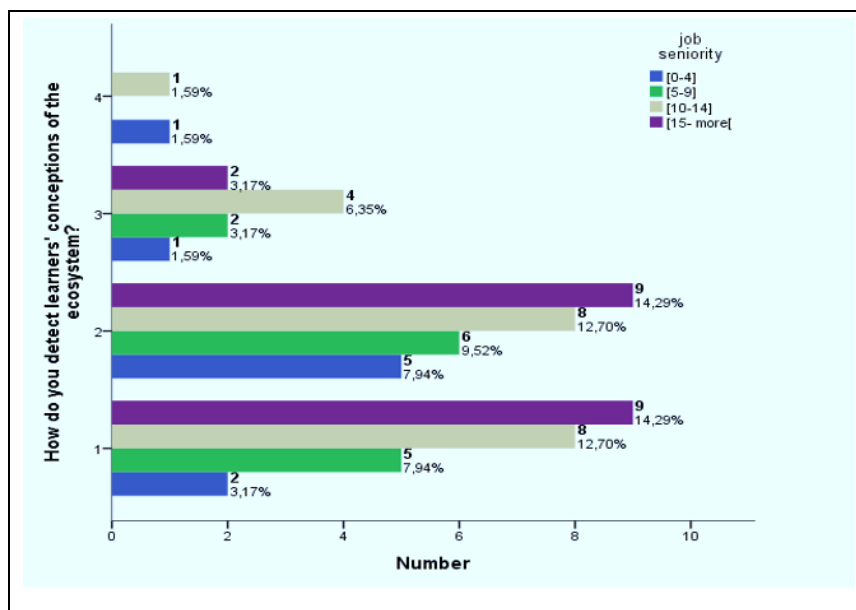


Figure 1. The emergence and technique of identifying learners' initial conceptions

1. Diagnostic assessment at the beginning of the unit;
2. At the end of a debate about a triggering situation;
3. Individually, through answers to the teacher's questions;
4. Disregard for learners' conceptions in the context of new learning.

2.2. TECHNIQUES EMPLOYED BY TEACHERS TO GATHER LEARNERS' INITIAL CONCEPTIONS OF THE ECOSYSTEM BASED ON WORKPLACE

In relation to the technique employed by teachers to gather learners' initial conceptions of the ecosystem, Figure 2 provides a breakdown based on the teachers' workplace. Among the participating teachers, 33.3% of those working in urban areas and 6.35% of those in rural areas reported utilizing the technique of organizing a debate during the triggering situation to identify their students' initial conceptions.

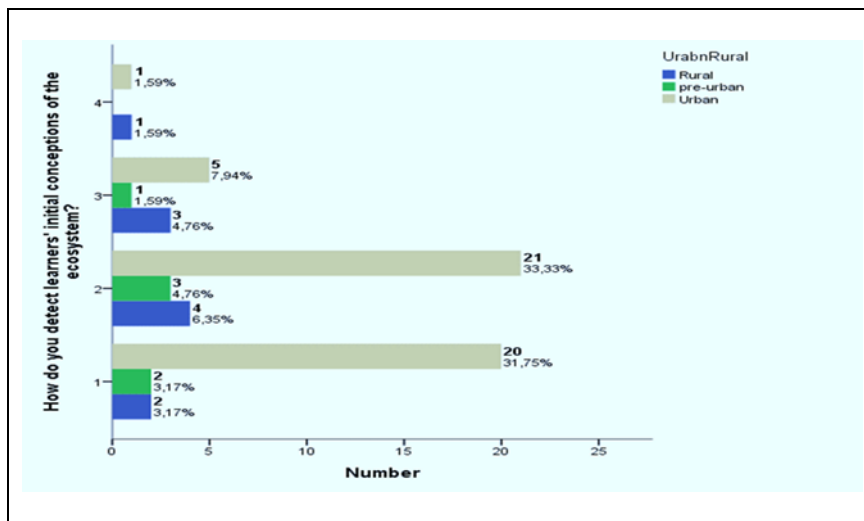


Figure 2. Techniques Employed by Teachers to Gather Learners' Initial Conceptions of the Ecosystem Based on Workplace

1. Diagnostic Assessment at the Beginning of the Unit
2. End-of-Debate Assessment About a Triggering Situation
3. Individual Assessment Through Answers to the Teacher's Questions
4. Disregard for Learners' Conceptions in the Context of New Learning

2.3. DECLARED AND ACTUAL PRACTICE

The examination of teachers' declared and actual practices in preparing learning sequences yielded noteworthy findings, as depicted in Figure 3. When queried about their initial step in preparing the learning sequence, 39% of the surveyed teachers indicated that their preferred approach involved planning the sequence and scripting the lesson. In contrast, 31% of the teachers reported commencing their preparations by determining the unit's objectives. Furthermore, 25% of the teachers stated that their preparations initiated with identifying the essential scientific concepts and formulating them at an appropriate level. Interestingly, a small percentage of teachers, specifically 6% of the participants, mentioned commencing their preparations by collecting their students' initial conceptions.

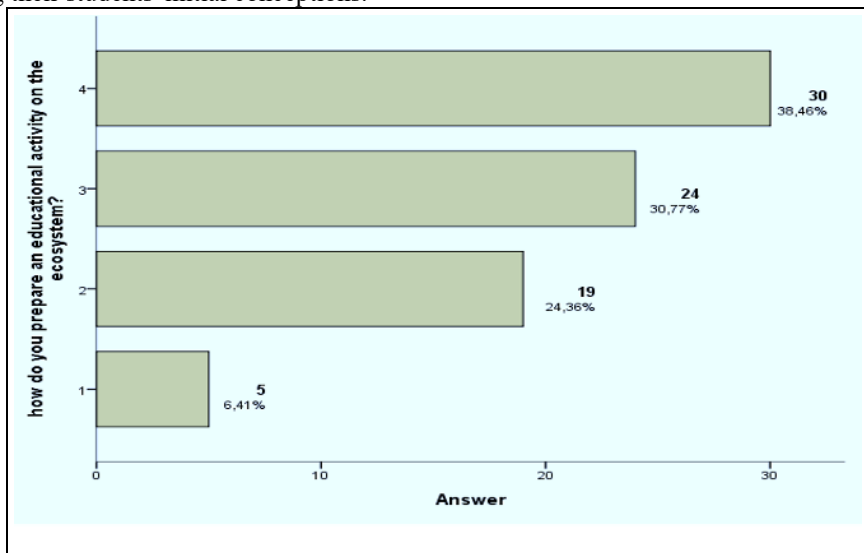


Figure 3. Declared Practice

1. Initiation by Identifying Initial Concepts
2. Initiation by Identifying Essential Scientific Concepts and Levels of Training According to Learners' Needs
3. Initiation by Determining the Unit's Objectives
4. Initiation by Planning the Sequence and Scripting of the Lesson

RESULT AND DISCUSSION

This study explores teaching practices regarding secondary school students' initial conceptions of the ecosystem. The statistical results obtained from the questionnaire indicate that a majority of the participating teachers, accounting for 95.2%, collected their learners' initial conceptions. This finding suggests that teachers recognize the pre-existing understanding of the ecosystem among their students prior to formal education. These results align well with the findings of Astolfi [17].

Regarding the techniques employed to elicit students' initial conceptions, 45% of the surveyed teachers reported using the debate approach during triggering situations, while 38% utilized diagnostic assessments. Additionally, 14% mentioned employing individual question-and-answer sessions. These findings highlight the significance of classroom debates in identifying initial conceptions, contrasting with the limited effectiveness of diagnostic and individual oral tests. Indeed, classroom debates serve as a critical stage for the emergence of students' conceptions, as they foster the deconstruction of preconceived notions and create space for new knowledge [18]. The limited use of individual oral techniques in identifying initial conceptions could be attributed to constraints such as large class sizes, which often exceed 35 students in qualifying secondary classes in Morocco, as well as time constraints and curriculum demands.

The relationship between the technique used by teachers to identify initial conceptions and their years of experience indicates no significant correlation, as both experienced and novice teachers employ similar techniques for this purpose (see Figure 1).

Regarding the influence of the work environment on the technique employed to identify conceptions, the results remain inconclusive, despite the advantageous role of debate as a technique implemented in both urban and rural areas (see Figure 2). The findings suggest that although teachers are able to identify their students' initial conceptions in the classroom, they do not consider them when preparing the learning sequence. This could be attributed to a shift in focus during the preparation phase, where teachers prioritize planning and scripting teaching content or emphasizing the objectives of their teaching units (see Figure 3). Consequently, students' conceptions may remain reinforced and unaddressed, as they are not taken into account by teachers in the instructional planning process.

RECOMMENDATIONS

To better integrate students' initial conceptions into their teaching practices, science and technology teachers are encouraged to consider the following suggestions. These include fostering a better understanding of scientific concepts and facilitating the evolution towards more accurate scientific conceptions (see Figure 4).

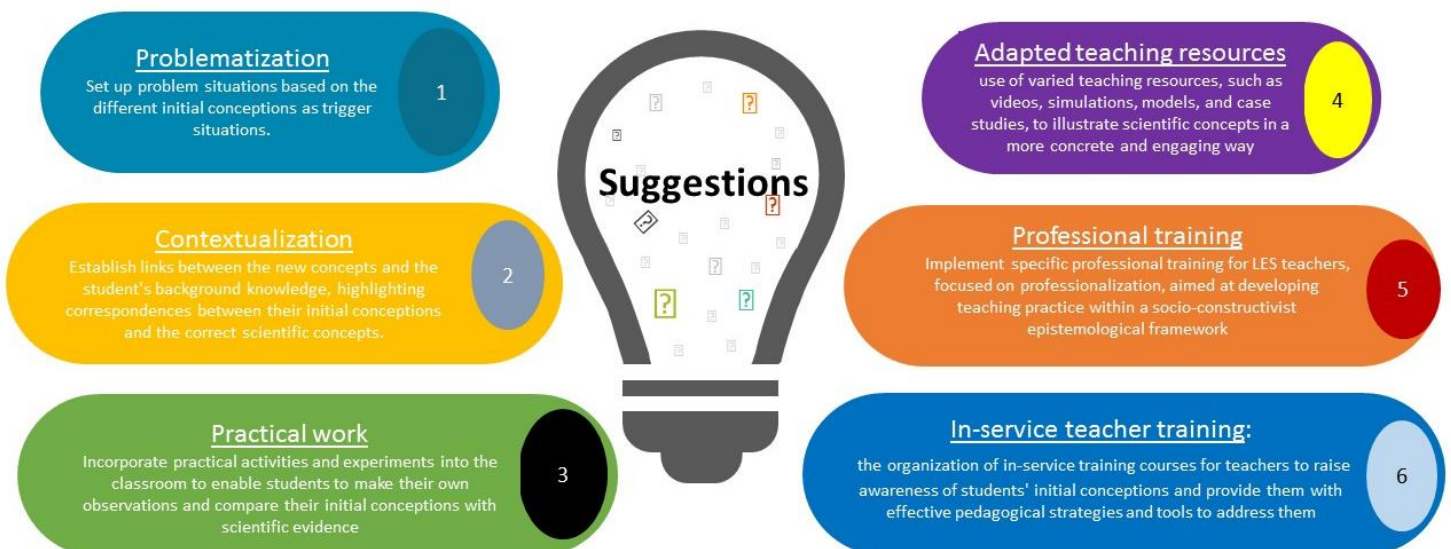


Figure 4. Recommendation

CONCLUSION

In conclusion, the findings of this study indicate that the majority of Moroccan LES teachers are aware of and detect their students' initial conceptions before delving into the concept of the ecosystem. This highlights the teachers' recognition of the significance of initial conceptions in the process of knowledge construction. Notably, the identified techniques for detecting and addressing students' initial conceptions include debate and diagnostic testing. However, it is evident that students' initial conceptions are not adequately considered when preparing the learning sequence, indicating a disparity between declared teaching practice and actual implementation, despite teachers' awareness of the pedagogical value.

Moving forward, this research serves as a foundation for further investigations into the analysis of classroom observations. Future studies could delve deeper into analyzing classroom interactions and instructional strategies to gain a more comprehensive understanding of how teachers address students' initial conceptions. Additionally, it is important to emphasize that incorporating students' initial conceptions of the ecosystem into teaching practice plays a crucial role in fostering environmentally conscious citizens capable of making informed decisions and preserving the environment.

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