European Journal of Education Studies
ISSN: 2501 - 1111
ISSN-L: 2501 - 1111
Available online at: www.oapub.org/edu

DOI: 10.46827/ejes.v12i2.5844 Volume 12 | Issue 2 | 2025

CATEGORIZATION OF PRIMARY SCHOOL PHYSICS TEACHERS' DIDACTIC INTERVENTION

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Abstract:
Teaching the concept of matter in primary school is challenging because of the obstacles related to children's understanding of matter's nature. Through this research, we aim to better understand physics teachers' practices in primary schools to overcome those obstacles. Through a series of observations, we categorized teachers' didactic interventions according to two types: mediation and tutelage, based on the scientific method's phases, while teaching macroscopic characteristics of matter. Then, we perform a statistical test to define which criteria could influence their didactic choices. We could prove that the initial training is irrelevant in our case. However, the seniority can impact the type of intervention adopted to assist students. These results could help to optimize teachers' didactic choices and thus improve the effectiveness of their interventions.

Keywords: matter, mediation and tutelage, macroscopic characteristics of matter, scientific method, initial training, seniority

1. Introduction

Official texts and institutional discourse relating to education show a strong desire to base science teaching on the application of the scientific method. The aim of this method is, among other things, to teach pupils to observe and question certain phenomena in their environment and to formulate, argue, and test hypotheses to describe and explain these phenomena. As part of teaching based on the scientific method, teachers play a

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decisive role in making pupils aware of the ways of thinking-speaking-acting that are characteristic of scientific activity. This is why it is important to study the choices of didactic interaction that the teacher can make in class, in particular between tutelage and mediation (Carré & Weil-Barais, 1998), as well as the factors that might influence these choices. This interaction is, in fact, one of the most important issues that has been the subject of much study and research in recent years. Research has focused on the interactive dimension of the teaching-learning situation, but this work remains insufficient to describe the complex relationship between verbal exchanges and the construction of knowledge in the classroom. The categorization of the different teacher interventions according to the two modalities of tutelage and mediation makes it possible to describe the teaching practices implemented by the teacher to manage the didactic situation and influence the learner-object of knowledge relationship. The nature of the intervention chosen by the teacher depends on the nature of the didactic action implemented.

According to Weil-Barais and Dumas Carré (1998), tutelage is linked to task performance. Mediation, on the other hand, is determined by the relationship to knowledge. Within the framework of this research, we propose to answer the following questions:

- What is the dominant type of intervention among a sample of primary school physical science teachers?
- How does the teacher's didactic intervention vary through the advancement of the hypothetico-deductive scientific method's phases?

On the other hand, even if a single scientific approach is called for in the prescriptive texts throughout primary school and prescribed for all the scientific subjects taught, we can assume that its implementation presents specificities for each teacher to choose the interactions adopted. We can question how the seniority and/or initial training of teachers affect their intervention methods. Grandaty and Dupont (2008) postulate that the difficulties encountered by novice teachers in managing the unexpected in their pre-established scenario lead them to stick *to* this pedagogical scenario and avoid building a mediation system better adapted to the interactive situation. Haefner and Zembal-Saul (2004) note that training in the investigative approach has led future primary school teachers to become aware of the benefits of interactions that encourage pupil participation in scientific activities. This raises the question:

- How do teachers' seniority and/or initial training affect the way they work?

We chose to study teachers' interventions while teaching the concept of matter since understanding the concept of matter is essential to understanding theoretical chemistry (Ozmen, 2011). Teaching this concept of matter raises several difficulties (Krnel *et al.*, 1998; Nakhleh *et al.*, 2005; Sopandi *et al.*, 2017). Research has proven that teaching several concepts related to macroscopic properties of matter is challenging, considering students' beliefs about matter (Krnel *et al.*, 1998; Nakhleh *et al.*, 2005; Thomas & Mcrobbie, 2002).

In the Tunisian context, the official programs (2002) at the primary level emphasize the mediating role of the teacher who accompanies pupils: "*The teacher is the mediator*

between the learner and knowledge. It is the teacher who creates a climate conducive to learning" (p.6).

These programs introduce the macroscopic characteristics of matter (mass, volume, hardness, physical state) from the 1ère basic year (pupils aged 6). A chapter lasting around 4 hours and bearing the name of the subject is divided between the 1st and 2nd primary years (pupils aged 6 to 8).

According to the official curricula, the objectives of this chapter are:

- Compare the weight of two objects,
- Compare the rigidity of two objects,
- Identify the physical states of matter,
- Distinguish between the solid state and other states of matter, based on the relationship between container and shape,
- Distinguish a few properties relating to each of the physical states of matter (Ministry of Education).

Then, in the 3ème basic year (pupils aged 8 to 9), the learner must be able to specify the changes of state and the effect of temperature on these changes, in accordance with the skills set out in the official syllabuses. The time allocated to this learning activity is 2 hours. The objectives are:

- To indicate the physical state of any substance under normal conditions.
- Show the effect of temperature on the change of state of matter (Ministry of Education, 2002, p.119).

2. Literature Review

A few studies have been carried out with pupils and have revealed the existence of obstacles relating to the concept of matter: states of matter, physical quantities, the nature of some substances, etc. (Molvinger *et al.*, 2017; Piaget & Inhelder, 1941; Plé, 1997). Piaget and Inhelder (1941) document some of these obstacles. They show that children at an early age do not acquire the concept of conservation of matter and therefore cannot dissociate mass, volume, and quantity of matter. In the same context, it has been shown that children link the concept of solid with the concept of weight. For them, if a substance goes from a liquid state to a solid state, it becomes heavier (Driver, 1989; Krnel *et al.*, 1998). Learners also have difficulty distinguishing between the different physical states of matter. Some solids are misclassified as liquids. These are soft, malleable, powdery objects that have no shape of their own (such as modeling clay, sugar, etc.). Statistical studies show that a large proportion of twelve-year-olds are unable to classify soft objects and powders adequately (Stavy & Stachel, 1985). Some children invent a new category, intermediate between solids and liquids, for powders. Differences in perception and vocabulary lead children to think that ice, water and steam are three different substances (Johnson, 1998). However, the presence of air is rarely recognized by young pupils. Studies show that only 30% of pupils aged between 5 and 7 think that we are surrounded by air. This percentage rises to 77% for pupils aged between 9 and 11 (Krnel *et al.*, 1998). Plé (1997) for her part, analyses a network of obstacles linked to the concept of matter,

consisting of obstacles generated by common language, such as confusion (solid/solid), by the primacy of perception, such as confusion (air/wind), or by categorical thinking, such as confusion between matter and the state of matter (water/ice, water/water vapour). Other difficulties relating to physical gradations such as volume or mass, given their complex and polysemous nature, have been identified (Javoy *et al.*, 2018; Molvinger *et al.*, 2017; Passelaigue Theys, 2011).

All these specific features show that teaching the macroscopic characteristics of matter at the primary level is fraught with difficulties. To deal with these difficulties, the teacher plays an essential role. Through this role, the teacher can adopt different types of didactic intervention that can have a great influence on student learning (Arun, 2018; Fragkiadaki & Ravanis, 2021).

Classroom interaction aims to share the same meaning of reference in relation to the objects of knowledge (Morge, 2000). As Tardif and Lessard (2004) interactivity is the main focus of the teacher's work. It can be expressed through different postures. We have chosen to classify this intervention according to the categorization proposed by Dumas Carré and Weil-Barais (1998) tutelage or mediation. Both concepts are used as pragmatic concepts in accordance with the definition of Pastré *et al.* (2006). They stem from the activity and are organizers of action. They make it possible to account for the effectiveness of the teacher's intervention in the classroom from a professional point of view. The two concepts (tutelage and mediation) are sufficiently developed in the literature, but the definition of each is not unequivocal. Their definitions sometimes intersect, and the boundaries between the two concepts are sometimes confused. However, there seems to be a consensus that it is, through the role of tutor or mediator, that the teacher controls the gap between the learners and the knowledge at stake. In what follows, we detail the definition we have adopted for each of these concepts. Bruner defined tutorial interaction as a kind of scaffolding process that enables the child or novice to solve a problem, complete a task, or achieve a goal that would, without this assistance, have been beyond his or her capabilities (Bruner, 1983). For the adult, this support essentially consists of taking charge of the elements of the task that are beyond the learner's abilities and supporting him to concentrate his efforts on the elements that remain within his field of competence to meet the requirements of the task by completing the elements taken charge of (Bruner, 1983). In this case, the tutor role is an act of support exercised by an adult to create a favorable world to ensure successful learning. Bruner (1983) identifies six functions of scaffolding: enrolment, reduction of degrees of freedom, maintenance of orientation, signaling of determining characteristics, control of frustration, and demonstration or model presentation.

Winnykamen (1996) requires the presence of three conditions to enable the action of tutelage:

- Specific or general asymmetry regarding the knowledge to be acquired,
- Effective enrolment of partners,
- Different but complementary goals for interaction.

Once these three conditions have been met, the teacher-tutor can guide the learner towards new knowledge. On the other hand, given that modern teaching is based on a

constructivist paradigm which sees learning as an active and constructive process (Tardif, 1993) supervision is not enough. The teacher is called upon to allow the learner to accept responsibility for a learning situation. In this case, the teacher plays a mediating role. They position themselves between the learner and the knowledge and ensure that the learning experience is triggered for the learner as a constructive personal process. A teacher's behavior is no longer seen as the direct cause of learning but rather as a catalyst for mediating responses (Bressoux, 2002).

The concept of mediation results, in fact, from the postulate that between a learner and knowledge, there is a mediating system that enables the learner to grasp this knowledge (Weil-Barais & Resta-Schweitzer, 2008). Teachers are mediators when they stand between knowledge and the student. Their role is to encourage learners to make certain cognitive and linguistic shifts. (Numa-Bocage, 2007). In this context, mediation can be defined as the cognitive confrontation of the teacher's teaching schemas with the pupil's action schemas to create cognitive conflicts in the pupil through the new coordination of these initial schemas (Numa-Bocage, 2007). Also, in didactics, mediation refers to any intermediary action that takes place between knowledge and the learner, intending to create cognitive conflicts in learners. More specifically, Numa-Bocage (2015) defines didactic mediation as all the pedagogical and didactic means implemented by the teacher or trainer to promote the learning of concepts during interactions with learners, in teaching-learning situations.

According to Boilevin (2017), the two methods of teacher intervention - tutoring and mediation - are not mutually exclusive; they complement each other, and both appear to be necessary to ensure that pupils take ownership of knowledge and control the teaching-learning process. It is useful for teachers to be able to master them and adapt them to their didactic intentions and the needs of their pupils (Boilevin, 2013). Researchers have used these two concepts to model teachers' interventions according to the evolution of the learner-knowledge relationship (Boilevin, 2017; Saint-Georges, 2001). Saint-Georges (2001) devised a grid to distinguish between the two categories of intervention based on the following three criteria: the mode of speaking and the distribution of discourse, guiding complex tasks, and taking errors into account. We refined those criteria based on scaffolding functions defined by Bruner. We have included enrolment as another criterion, given that enrolment is essential for engaging the learner in the teaching-learning process. This criterion highlights the choice of tasks made by the teacher to anticipate student performance. Through these tasks, the teacher controls the learners' initial relationship with knowledge. In fact, for the teacher, the tasks proposed to the pupils could be seen as tools for enrolment and learning; it is they who, in the teacher's place, can reassure or worry, mobilize, or demobilize, value or devalue, and so on. In this way, he indirectly maintains his power by varying the degree of difficulty (Maurice & Murillo, 2008).

The teacher uses other tools to maintain control over the learner-knowledge relationship. The types of questions asked, for example, as well as how knowledge is validated and incorrect or incomplete answers are dealt with, determine how knowledge is co-constructed in class. These criteria provide access to the teacher's interactional skills

and the effectiveness of his or her intervention. It is, therefore, relevant to include them in the analysis grid. The teacher uses a relevant questioning approach to help learners construct knowledge (Numa-Bocage, 2007). We also tried to refine the criterion of "taking errors into account" to highlight two important roles of the teacher: regulation and institutionalization. Errors are seen as the raw material that stimulates communication about learning. The teacher invests in errors to regulate learning and ultimately to achieve institutionally recognized knowledge (Ravestein & Sensevy, 1993).

This institutionalization phase is crucial because we need to identify what we retain from the properties of the objects we have encountered. Clearly, everything can be reduced to institutionalization. (Brousseau, 1988).. The last criterion added is the way in which learning time is managed. This criterion is an important professional indicator that depends on the teacher's profile. Research shows that novice teachers find it difficult to manage time (Masselot & Robert, 2007). Good time management is a professional skill that has a major impact on the teaching-learning process. Finally, we have proposed the following grid, which brings together the roles deemed fundamental in the teacher's classroom practices and results in a classification of the teacher's interventions according to the two modalities detailed above: tutelage and mediation.

Table 1: Analysis grid: Categorization of verbal interventions relating to tutelage and mediation (Ouerghi *et al.*, 2023)

Variables	**Tutelage**	**Mediation**	**Corresponding thematic phase**[ii]
Dialogue breakdown	- Dominated by the teacher	- Dominated by students	
Type of questioning	- Questions to redirect students or point out a contradiction. Example: "*Is the numerical value obtained of acceptable magnitude?"*	- Questions prompting students to produce (how), explain (why), justify, etc.	
Enrolment strategy	- Problem situation - Instructions	- Open question - Observation - Problem situation	
How knowledge is regulated	- Correct errors - Encourages inter-student correction	- Confronting errors with contradictions	
Knowledge validation	- Encourage students to reformulate and institutionalize results - Enhancing and optimizing efficient procedures - Generalizing the results obtained	- Suggest situations in which knowledge can be transferred.	

[ii] This column allows to follow the evolution of intervention types through the phases of the scientific approach

Time management mode	- Prescribe a precise time for carrying out the proposed tasks - Squeeze the pupils to shorten the gap between the prescribed time and the actual time	- Maintain pupils' attention to avoid wasting time while respecting their pace.	

3. Material and Methods

To answer the research questions, we conducted a qualitative study based on an in-depth analysis of the teacher's interventions during the teaching-learning sequences studied. For the analysis of verbal exchanges, we chose tutelage and mediation in a scientific teaching framework. The interventions will be classified according to two types: tutelage and/or mediation using the analysis grid presented above. The transcripts obtained from the sessions observed were analyzed using Transana software to determine the nature of each intervention, considering the criteria proposed in the grid.

Next, we conducted a descriptive statistical analysis of the experimental data collected, using empirical methods to determine the likely impact of seniority and/or initial training on the chosen intervention modality.

3.1 Selection of Participants

Sampling is based mainly on volunteers. The following criteria were used to select participants:

1) Volunteer teachers with courses on the concept of the matter.
2) Various initial training courses: bachelor's degree, fundamental license, applied license, and teacher training institute.
3) Various lengths of time: less than 5 years, between 5 and 10 years, and more than 10 years.

Table 1: Characteristics of the sample

Teacher	General seniority	Initial training
Teacher 1(Sa)	less than 5 (3)	Fundamental license
Teacher 2 (H)	less than 5 (3)	Applied License
Teacher 3 (Y)	between 5 and 10 (7)	Applied License
Teacher 4 (F)	more than 10 (25)	Teacher training institute
Teacher 5 (L)	more than 10(28)	Teacher training institute
Teacher 6 (A)	between 5 and 10 (7)	Bachelard
Teacher 7 (R)	more than 10 (15)	Bachelard
Teacher 8 (M)	between 5 and 10 (9)	Bachelard
Teacher 9 (So)	more than 10 (15)	Bachelard
Teacher 10 (I)	Less than 5 (3)	Fundamental license

The above table shows the distribution of volunteer teachers according to the different characteristics of the sample. We have tried to represent the different categories of the parent population.

3.2 Choice of Variables

The choice of variables aims to highlight the tutor or mediator aspect of the didactic interventions to understand the mechanism of accompanying learners in the construction of knowledge. The indicators of the tutor or mediator aspect in this context are the type of questioning, the way errors are dealt with, the validation of correct answers, etc. These indicators are included in the analysis grid and were used to analyze verbal interventions.

3.3 Data Collection

We carried out an observation with each of the teachers. Each observation was preceded by a pre-interview aimed at investigating the teacher's profile. The questions asked during the interview concerned:

- The teacher's profile: seniority, initial training, and experience in relation to the classes assigned.
- The teacher's attitude to teaching.
- The teacher's attitude to science and science teaching.

We attended classes of 1ère basic year (6-7 years old), 2ème year (7-8 years old), and 4ème year (8-9 years old). The sessions focus on the macroscopic characteristics of matter. Each session lasts between 40 and 60 minutes. The sessions observed are recorded and then transcribed.

The figure shows examples of keywords, questions, or instructions identified during the analysis of a given episode and which are indicative of tutelage or mediation. We proceed in the same way for all the episodes to classify the interventions according to the two modalities of tutelage or mediation and to determine their frequency at the level of each episode.

4. Results and Discussion

4.1 Variation in Intervention According to the Advancement of Scientific Approach Phases

Analysis of the transcripts using Transana software makes it possible to track verbal exchanges and to superimpose these exchanges on a time scale. The figure below shows the distribution of interventions during a given episode.

Figure 1: Transcription of a phase from an observed session

T: Does water have mass? T
S: Yes
E: No
T: Yes or no, you must explain. M

S: …

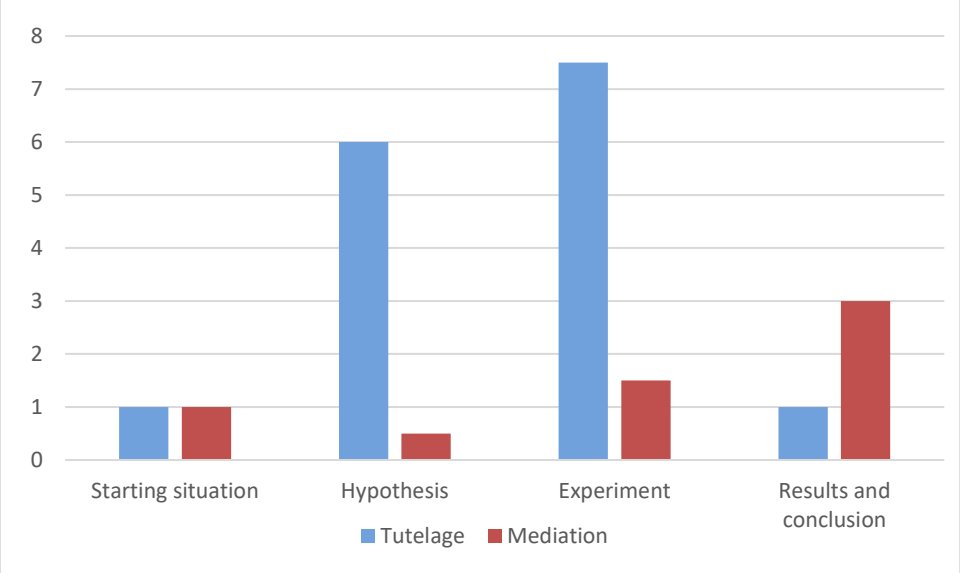
T: Who said yes? Why? M
S: Because it has mass
T: Yes, T we're going to check. We're going to measure the mass of the empty glass. T

T: What is its mass? T
S: 2g
T: Now add some water. How much does it weigh? T
E: 109 g
M: Good then water has mass T

Note: T: Teacher **S**: student **T**: Tutelage M: mediation

We analysed the entire corpus of transcripts, identifying all the tutorial or mediation-type interventions and quantifying the teachers' didactic choices, which enabled us to draw up the intervention monitoring tables (see appendix). The tables obtained show a difference in relation to the number of episodes, which differs from one session to another. We, therefore, chose to group the episodes according to the stages of the scientific approach followed. According to the official curricula, teachers are required to implement a scientific approach of the hypothetico-deductive method, which starts with a problem, followed by the formulation of hypotheses, experimentation, verification and, finally, the formulation of a conclusion. The results obtained show that tutelage-type intervention predominates. Teachers tend to control the learning process and limit the freedom given to learners. The following graph, plotted from the medians, shows the intervention pattern during the different phases of the scientific process.

Graphics 1: Distribution of verbal interventions by teachers according to the phases of the scientific method



The "Starting situation" phase involves the presentation of a problem situation, an observation, or an open question. This phase shows a balance between the two types of intervention. The teachers allowed students to think freely about the problem posed in the initial situation. However, when formulating hypotheses, the teachers proceed in such a way as to guide the learners and limit their choices to possible paths toward the target knowledge. During the experimentation phase, tutoring is also abundant. The teachers, through their questions and instructions, guide the learners and constantly monitor the learner-knowledge relationship. During the interpretation of the results and the reformulation of the conclusion, the teachers play more of a mediating role. The questions asked by the teachers encourage the development of ideas and reflection since the aim is to take up the results achieved to reformulate the conclusion. Some tutorial-type interventions are also present, given that the teachers direct the learners towards institutional knowledge and lead them to reformulate the conclusion using the same terminology from the official documents. The dominance of tutelage throughout the process shows that teachers tend to limit the learners' freedom and control the scientific approach used. As a result, the teachers proceed in such a way as to curtail the spontaneous process of constructing knowledge. There are several possible explanations for this behavior. Some are linked to the teacher's profile. This led us to investigate the influence of seniority and initial training on the intervention methods chosen.

4.2 Qualitative analysis of the impact of seniority and initial training on the type of intervention

Initial training was associated with each type of intervention, followed by the teacher's professional experience. The underlying hypothesis is that as teachers draw on their training or gain experience, they display different practices. To verify this hypothesis, a Shapiro normality test (s) with SAS (9.4) was first performed on the data. It indicated that the data relating to the Mediation (Med) and Tutelage (TUT) approaches respectively

among teachers were abnormally distributed (s = 0.904; p=0.243 and s = 0.918; p=0.342). This led to the use of non-parametric statistical tests of independent samples, such as the Kruskal-Wallis H test. The results of the test concerning initial training led to a value of Pr > Chi-2, for the two variables tutelage and mediation. We can conclude that initial training has no impact on the choice of didactic intervention in the classroom. However, the test shows a value of Pr = 0.05 concerning the influence of seniority on tutorial intervention. A table illustrating the variation in tutorial intervention as a function of seniority was therefore drawn up.

Age	**Teacher**	**Number of tutelage interventions**
Less than 5 years	1	14
	2	15
	10	12
Between 5 and 10 years	3	28
	6	25
	8	31
10 years to go	4	10
	5	17
	7	19
	9	10

The category of teachers with between 5 and 10 years' experience showed an abundance of tutorial-type interventions. Teachers in this category abuse tutoring and impose themselves enormously on the teaching-learning process. Novice teachers are generally accompanied by the pedagogical framework and set up co-developed pedagogical scenarios. This explains the freedom they allow their learners. Teachers with between 5 and 10 years' experience are beginning to adopt their professional habits and are therefore attached to their previous scenarios and seek to guide learners to get around learning difficulties on the one hand and to manage learning time on the other. Experienced teachers have a better grasp of these two factors. They are, therefore, more confident and more flexible regarding their preparation, which explains, according to our hypothesis, the restoration of tutoring-type interventions.

5. Discussion

According to Brousseau (1988), the teacher's activity has two main objectives: devolution and institutionalization. He defines devolution as the activity by which the teacher leads the learner to take ownership of the learning project and institutionalization as the process by which the teacher brings the knowledge produced in class (events, results, etc.) closer to the targeted knowledge. During institutionalization, the aim is to bring the results achieved through the scientific approach closer to the institutional knowledge validated by the scientific community. The teacher must, therefore, guide the learners towards this validated knowledge. The pragmatic concept of organizing the activity in this case, is tutelage. Observations show that the teacher intervenes through certain

questions or instructions to guide the learners. He also plays a mediating role, the second pragmatic concept, during institutionalization, to get learners to reorganize the knowledge evoked, to explain, and to decontextualize and generalize the conclusions. However, tutelage seems to be overused in devolution. The devolution activity corresponds to the first phase of the scientific approach. The teacher must get the learners to appropriate the need to learn and adopt the scientific problem. Theoretically, we would expect a greater number of mediation-type interventions in this phase, given that, unlike institutionalization, devolution aims to get the learner to accept responsibility for learning and to agree to become involved in the learning project. The learner must have a certain amount of freedom and sufficient distance from knowledge to allow cognitive conflict, hypotheses, and negotiations around knowledge to take place. In devolution, the teacher allows learners to freely formulate hypotheses and experiment with the paths they choose. Teachers seem to abuse tutelage, which could be justified by institutional requirements such as the absence of an experimental set-up: generally, it is the teacher who carries out the experiment. The learners observe and comment. The teacher is, therefore obliged to encourage student participation by asking leading questions. Tutoring is also a methodical choice for managing learning time. Teachers choose to "drive forward" the learning process and control the scientific approach used. The dominance of tutoring could also be due to obstacles linked to knowledge itself. The role of the tutor is to reduce the gap between the learners and the target knowledge. Teachers sometimes anticipate and limit learners' choices, perhaps to get around obstacles linked to knowledge or perhaps because they do not have sufficient mastery of mediation strategies and are unable to control the learner-knowledge relationship properly, depending on the objective of each phase of the scientific approach. The initial training criterion we have chosen has no impact on the effectiveness of classroom intervention. On the other hand, seniority has an influence on tutelage. Experienced teachers with more than 10 years of experience impose the scientific approach less and give learners more freedom to propose and follow paths of their own choosing.

6. Conclusion

This research was conducted to get a better understanding of teachers' didactic choices in class and their impact on the development of the scientific method process. The results obtained showed that there is a domination of tutelage intervention type, which can inhibit a learning process based on knowledge construction. Trying to define the reasons behind this domination, we could demonstrate that the initial training is irrelevant for our sample. However, seniority influences the type of intervention adopted. We think our research contributes to a better understanding of teachers' choices and their influence, but our simple remains restrained.

Conflict of Interest Statement
The authors declare no conflicts of interest.

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Appendix

Breakdown of interventions for the various sessions observed:

Teacher 1

Phase	Checking prerequisites	Starting situation	Hypothesis	Experiment	Conclusion	Total
Tutelage	5	0	1	6	2	14
Mediation	1	1		1	1	4

Teacher 2

Phase	Checking prerequisites	Starting situation	Experiment	Institutionalization	Conclusion	Total
Tutelage	2	4	4	1	2	15
Mediation	0	2	0	1	2	5

Teacher 3

Phase	Starting situation	Experiment	Institutionalization	Conclusion	Total
Tutelage	4	7	12	5	28
Mediation	1	1	2	4	8

Teacher 4

Phase	Starting situation	Hypothesis	Experiment	Institutionalization	Total
Tutelage	2	2	2	4	10
Mediation	2	0	2	1	5

Teacher 5

Phase	Starting situation	Experiment	Institutionalization	Conclusion	Total
Tutelage	1	5	6	3	15
Mediation	1	0	2	2	5

Teacher 6

Phase	Checking prerequisites	Starting situation	Hypothesis	Experiment	Institutionalization	Total
Tutelage	4	1	4	9	8	26
Mediation	0	2	2	4	4	12

Teacher 7

Phase	Starting situation	Hypothesis	Experiment	Verification of hypothesis	Conclusion	Total
Tutelage	3	0	2	4	10	19
Mediation	1	2	1	2	2	8

Teacher 8

Phase	Presentation of the equipment (the scales)	Starting situation	Hypothesis	Verification of hypothesis	Institutionalization	Application	Total
Tutelage	9	1	5	5	8	3	31
Mediation	0	1	0	4	5	2	12

Teacher 9

Phase	Starting situation	Hypothesis	Experiment	Application	Total
Tutelage	1	3	4	3	11
Mediation	1	3	2	3	9

Teacher 10

Phase	Starting situation	Hypothesis	Experiment	Institutionalization	Conclusion	Total
Tutelage	1	0	2	7	2	12
Mediation	1	1	1	9	0	12