

Preschool teachers' practices in scientific and technological awakening in matadi, democratic republic of the congo: a mixed-methods cross-sectional study and proposal of the "nervures de joy 2025" model

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Abstract

Background

Scientific and technological awakening in preschool education fosters curiosity, observation, and early reasoning. However, its implementation remains inconsistent in many developing contexts.

Methods

A mixed-methods cross-sectional study was conducted in preschool institutions in Matadi (Democratic Republic of the Congo) during the 2024–2025 school year. The quantitative component involved 60 teachers from 20 schools, while the qualitative component included 20 school and pedagogical administrators. Data were collected through questionnaires, interviews, observations, and document review. Quantitative data were analyzed using descriptive statistics and chi-square tests ($p < 0.05$), while qualitative data were analyzed thematically.

Results

Despite a high perceived importance of scientific awakening (mean score: 4.6/5), implementation remains limited. Only 6.7% of teachers consistently conducted experimental activities, while 31.7% had no specific training. Significant associations were found between teaching practices and training, availability of resources, science corners, and time allocation ($p < 0.05$). The proposed "Nervures de Joy 2025" model integrates four key components: (1) teacher professional development, (2) material and pedagogical resources, (3) structured classroom organization, and (4) community involvement. These components address identified gaps by strengthening competencies, improving learning environments, and enhancing institutional support.

Conclusion

Scientific awakening remains insufficiently institutionalized in preschool settings in Matadi.

Recommendation

Educational authorities should invest in teacher training, structured science programs, and resource provision, while piloting the proposed model to assess its effectiveness.

Keywords : preschool education; scientific awakening; technological awakening; teaching practices; early childhood; science education; teacher training; Matadi; Democratic Republic of the Congo; Nervures de Joy 2025.

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Introduction

Early childhood education represents a critical period for children's cognitive, linguistic, social, and psychomotor development. Experiences during this period contribute to shaping children's ways of observing, communicating, interacting with others, and understanding their environment. Contemporary research on development and learning particularly emphasizes the importance of social interactions, learning environments, and the quality of educational practices (Darling-Hammond et al., 2020; OECD, 2021).

From this perspective, science education in preschool should not be understood as a simplified transfer of the sciences taught at primary or secondary school levels. Rather, it involves providing young children with age-appropriate opportunities to observe, manipulate, compare, classify, construct, question, and explore phenomena in their environment. Worth (2010) emphasizes that science is particularly relevant during early childhood because children's natural curiosity can serve as a starting point for inquiry-based activities while simultaneously contributing to the development of language, social interaction, and basic mathematical skills.

This conception is consistent with constructivist perspectives on cognitive development. For Piaget (1970), concrete activity and interaction with objects contribute to the construction of knowledge. From a sociocultural perspective, Vygotsky (1978) demonstrates that cognitive development also takes place through social interactions and adult mediation. These perspectives can be complemented by Bruner's (1960) approach, which emphasizes the structuring of knowledge, discovery, and the teacher's role in supporting the learner.

Kolb's (2015) experiential learning approach also provides a relevant framework for understanding science education in preschool. Concrete experience, followed by observation and reflection, can progressively enable children to develop and reinvest more structured representations. At the preschool level, this approach does not mean that children must master formal scientific concepts; rather, they should be placed in situations that enable them to progressively construct meaning from their experiences.

The learning environment also plays a decisive role. OECD (2021) shows that the quality of interactions in early childhood education and care settings depends, among other factors, on curricula, pedagogy, staff professional development, the material environment, and family and community participation. This perspective is consistent with Bronfenbrenner's ecological approach to

development, according to which children's development is influenced by interactions between children and the different environments in which they grow and learn (Bronfenbrenner, 2004).

Teacher training is also a major issue. The work of van Aalderen-Smeets, Walma van der Molen, and Asma (2012) shows that teachers' attitudes toward science, their self-efficacy beliefs, and their perceptions of the teaching context can influence their engagement with science education. Sustainable improvement in science education therefore requires not only resources but also appropriate professional development. This issue is particularly important in contexts where education systems must operate under material and organizational constraints. The World Bank emphasizes that improving education systems requires coordination among learners, teachers, learning resources, schools, and system management (World Bank, 2020). OECD (2019) also highlights the importance of social, technological, and economic transformations when considering the future of education systems. In the context of the Democratic Republic of the Congo, developing a scientific culture from preschool onwards therefore represents an important educational challenge. However, the implementation of scientific activities may be affected by teachers' working conditions, the availability of teaching resources, professional training, and the organization of school time.

In Matadi, Kongo Central Province, scientific and technological awakening appears to be recognized as important by preschool teachers. However, recognizing its importance does not necessarily mean that scientific activities are regularly organized. The present study therefore starts from a paradox: teachers may attach high importance to scientific awakening while the corresponding activities remain occasional, insufficiently institutionalized, and constrained by professional, material, and organizational factors.

The issue is therefore not merely to determine whether teachers conduct science activities with children, but to understand under what conditions they do so, what resources they use, which practices they employ, and what level of professional preparation they possess. From a systemic improvement perspective, it is also necessary to examine the relationships among teacher training, available resources, the classroom environment, time allocated to science, and the practices observed.

Main Research Question

To what extent do the scientific and technological awakening practices implemented by preschool teachers in Matadi meet contemporary pedagogical requirements,

and what strategies could sustainably improve their quality through the “Nervures de Joy 2025” model?

Secondary Research Questions

1. What is the level of professional preparation of preschool teachers in scientific awakening?
2. How are scientific awakening activities organized in preschool schools in Matadi?
3. What pedagogical, material, and institutional factors are associated with these practices?
4. What strategies could sustainably improve scientific and technological awakening in preschool education?

General Hypothesis

The quality of scientific awakening practices among preschool teachers in Matadi is limited by insufficient specialized training, a lack of appropriate teaching resources, and certain organizational constraints.

General Objective

To analyze the scientific and technological awakening practices of preschool teachers in Matadi, identify the factors associated with these practices, and propose an integrated improvement model.

Specific Objectives : The study aims to:

- assess teachers' professional preparation;
- analyze the organization of scientific activities;

- identify the pedagogical, material, and institutional factors associated with these practices;

Materials and methods

Study Design

As part of this study examining preschool teachers' practices in scientific and technological awakening in Matadi (Democratic Republic of the Congo), a **cross-sectional mixed-methods** research design was adopted. This methodological choice was justified by the need to combine a quantitative approach aimed at measuring the extent of pedagogical practices, with a qualitative approach allowing an in-depth exploration of the perceptions, experiences, and constraints of educational actors. The quantitative component primarily relied on the use of structured questionnaires administered to teachers to collect measurable data related to their practices. In parallel, the qualitative component employed semi-structured interviews and direct classroom observations, enabling the contextualization of quantitative findings. Data collection instruments included a questionnaire, an interview guide, and an observation grid developed in line with the study objectives. The combined use of these tools allowed for **data triangulation**, thereby strengthening the validity and credibility of the findings. This integrated approach provides a comprehensive and nuanced understanding of educational practices while highlighting the factors influencing the implementation of scientific and technological awakening at the preschool level.

Study Setting

The study was conducted in preschool institutions located within the educational subdivisions of Matadi 1 and Matadi 2.

Table 1 : List of schools in Matadi Pool 1 and 2 selected for the survey.

Primary Pool Matadi 1	Primary Pool Matadi 2
White Chalk	Friends of Jesus
Mayela	CS Laborne Buima
Saint Vincent de Paul	Sacred Heart
Mvudi Bambino	GS Maman Phambu
Ngombe	CS Sr Mpasi

God's Mercy	CS Ntete Mbwa
Blessing	GS Vuvu Kieto
Our Lady of Fatima	GS Mgr Kembo
The Rock	Kiddies Academy
Mathethe	Col Emmanuel

Participants

The study population consisted of preschool teachers working in nursery schools within the educational subdivisions of Matadi 1 and Matadi 2 in the Democratic Republic of the Congo.

Inclusion Criteria

All preschool teachers actively working at the time of data collection were included in the study. Participants were required to be directly involved in teaching activities with preschool children, present in their respective schools during the survey period, and to have provided free and informed consent to participate. This selection ensured the relevance and reliability of the collected data by including only individuals directly engaged in scientific and technological awakening practices.

Exclusion Criteria

Teachers who were absent during the data collection period due to administrative duties, leave, or illness, as well as those who refused to participate, were excluded from the study. In addition, educational staff not directly involved in preschool teaching activities were excluded to maintain consistency with the study objectives.

Participant Selection Procedure

Participants were selected using a purposive sampling method based on school accessibility and the effective presence of teachers. A total of **60 teachers** were included in the quantitative component, while 20 school and pedagogical administrators were selected for the qualitative component based on their roles and experience in educational supervision.

Sampling

A total of 20 nursery schools were selected within the educational subdivisions of Matadi 1 and Matadi 2 using purposive sampling, taking into account their accessibility and operational status. Within these institutions, 60 preschool teachers were included in the quantitative component of the study. Additionally, 20 school and pedagogical administrators (principals and supervisors) were selected for the qualitative component due to their roles in overseeing teaching practices and their experience in early childhood education.

Sample Size

The sample size was determined based on considerations of feasibility, participant accessibility, and representativeness of school structures within the two educational subdivisions studied. Although no strict statistical formula was applied, the selected sample ensured sufficient diversity in schools and teacher profiles, thereby providing adequate variability in the data to meet the study objectives.

Bias and Control Strategies

This study considered potential sources of bias, particularly social desirability bias, which may influence teachers' responses during data collection. To minimize these biases, methodological triangulation was employed, combining multiple data collection techniques:

- direct classroom observations, to verify actual practices;
- semi-structured interviews, to encourage free expression;
- structured questionnaires, to collect comparable quantitative data.

The combined use of these methods enabled cross-validation of the collected data, thereby enhancing the internal validity and credibility of the findings.

Ethical Considerations

Page | 5 This study was conducted in strict compliance with ethical principles governing research involving human participants. Ethical approval was obtained from the Ethics Committee of the School of Public Health, University of Kinshasa (Democratic Republic of the Congo), ensuring that the research protocol met established ethical standards. Prior to participation, all respondents were fully informed about the objectives of the study, the data collection procedures, and their right to withdraw at any time without any consequences. Participation was based on free and informed consent. Furthermore, strict measures were implemented to ensure the confidentiality and anonymity of the collected data. All information was treated anonymously and used solely for scientific purposes. No identifying information was disclosed in the presentation of the study results.

Variables

The dependent variable consisted of scientific and technological awakening practices. The main explanatory variables were, specialized training, teaching resources, the presence of a science corner; time allocated to science, planning, class size, educational level, age and professional seniority.

Data Analysis

Quantitative data were analyzed using frequencies, percentages, means, cross-tabulations, and chi-square

tests. The significance threshold was set at $p < 0.05$. Qualitative data were analyzed through thematic categorization.

Results

Participant Flow

A total of 70 preschool teachers were initially approached in nursery schools within the Matadi 1 and Matadi 2 educational subdivisions to participate in the study. Among them, 60 teachers met the inclusion criteria and agreed to take part in the research. However, 10 teachers were excluded, either due to their absence at the time of data collection or their refusal to participate.

All 60 included teachers effectively participated in the different phases of data collection, including questionnaire administration and, for some, classroom observations. No cases of withdrawal or incomplete data were recorded during the process, which made it possible to include all recruited participants in the final analysis.

Thus, quantitative analyses were conducted on a total sample of 60 teachers, ensuring the consistency and completeness of the collected data. This participation flow reflects a high level of teacher engagement in the study while supporting the validity of the results obtained.

Sociodemographic Characteristics of the Preschool Teachers Surveyed

Table 2. Distribution of Preschool Teachers by Age

Age group	Number	Percentage
20–29 years	18	30%
30–39 years	26	43.3%
40–49 years	12	20%
50 years and above	4	6.7%
Total	60	100%

Source: Field survey data collected in Matadi, 2024.

The 30–39-year age group is the most represented (43.3%), whereas teachers aged 50 years and above

constitute the smallest proportion (6.7%). These results indicate that the surveyed teaching staff is predominantly composed of teachers in active professional service.

Table 3. Initial Educational Level of the Preschool Teachers Surveyed

Educational level	Number	Percentage
Professional Certificate	10	16.7%
Specialized Teaching Certificate	28	46.7%
Bachelor's Degree / Bac+3	18	30%
Master's Degree or higher	4	6.6%
Total	60	100%

Source: Field survey data collected in Matadi, 2024.

The Specialized Teaching Certificate category is the most represented (46.7%), whereas teachers holding a Master's degree or higher account for only 6.6%. This

situation indicates a relatively low proportion of teachers with advanced university-level training.

Table 4. Professional Experience of the Preschool Teachers Surveyed

Years of experience	Number	Percentage
Less than 5 years	14	23.3%
5–10 years	25	41.7%
11–15 years	13	21.7%
More than 15 years	8	13.3%
Total	60	100%

Source: Field survey data collected in Matadi, 2024.

Teachers with 5–10 years of professional experience are the most numerous (41.7%), whereas only 13.3% have

more than 15 years of experience. The majority therefore have an intermediate level of professional experience.

Table 5. Preschool Teachers Who Received Training in Scientific and Technological Awakening

Type of training	Number	Percentage
No training	19	31.7%
Initial training	14	23.3%
Continuing training	17	28.3%
Initial and continuing training	10	16.7%
Total	60	100%

Source: Field survey data collected in Matadi, 2024.

The No Training category has the highest frequency (31.7%), whereas the combination of initial and continuing training is the least represented (16.7%).

These findings reveal insufficient specialized training in scientific and technological awakening.

Table 6. Preschool Teachers' Assessment of the Adequacy of the Training Received

Opinion	Number	Percentage
Strongly disagree	7	11.7%
Disagree	15	25%
Neutral	11	18.3%
Agree	20	33.3%
Strongly agree	7	11.7%
Total	60	100%

Source: Field survey data collected in Matadi, 2024.

The Agree category is the most represented (33.3%), whereas Strongly Disagree and Strongly Agree each account for the smallest proportion (11.7%). Overall,

opinions regarding the adequacy of training remain moderately favorable.

Table 7. Presence of a Science Corner in the Classroom

Response	Number	Percentage
No	21	35%
Partial	27	45%
Yes	12	20%

Source: Field survey data collected in Matadi, 2024.

Classrooms with a partially developed science corner are the most common (45%), whereas only 20% have a fully

developed science corner. The organization of scientific learning spaces therefore remains insufficient.

Table 8. Available Teaching Resources

Material	Number of schools using the resource
Recycled materials	52
Transparent containers	39
Science worksheets/books	34
Water trays	28
Simple measuring instruments	25
Magnets	18
Magnifying glasses	14
Tablets/computers	9

Source: Field survey data collected in Matadi, 2024.

Recycled materials are the most widely available resources (52 schools), whereas tablets or computers are the least accessible (9 schools). Schools therefore tend to

rely on locally available resources rather than digital tools.

Table 9. Frequency of Experimental Activities

Frequency	Number	Percentage
Never	5	8.3%
Rarely	18	30%
Sometimes	22	36.7%
Often	11	18.3%
Always	4	6.7%
Total	60	100%

Source: Field survey data collected in Matadi, 2024.

Experimental activities are sometimes conducted by the largest proportion of teachers (36.7%), whereas only

6.7% report conducting them always. Experimentation therefore remains occasional.

Table 10. Time Allocated to Scientific Activities

Weekly time	Number	Percentage
Less than 30 minutes	16	26.7%
30–60 minutes	29	48.3%
1–2 hours	12	20%
More than 2 hours	3	5%

Total	60	100%
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Source: Field survey data collected in Matadi, 2024.

The majority of teachers devote 30–60 minutes per week to science (48.3%), whereas only 5% devote more than two hours. The amount of time allocated to scientific awakening therefore remains limited.

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Table 11. Most Frequently Used Scientific Activities

Activity	Number of responses
Object manipulation	48
Crafting/workshop activities	46
Guided observation	42
Science games	35
Reading scientific stories	29
Simple experimentation	27
Outdoor observation/field trips	18
Multimedia resources	11

Source: Field survey data collected in Matadi, 2024.

Object manipulation is the most frequently practiced activity (48 responses), whereas multimedia resources are used very little (11 responses). Practices therefore remain predominantly concrete and only minimally digitalized.

Table 12. Preschool Teachers' Attitudes Toward Scientific Awakening

Statement	Mean score /5
Importance of scientific awakening	4.6
Ability to organize activities	3.8
Parental support	3.1
Willingness to devote more time	4.2

Source: Field survey data collected in Matadi, 2024.

The importance of scientific awakening receives the highest mean score (4.6/5), whereas parental support receives the lowest score (3.1/5). Teachers therefore demonstrate a positive attitude despite limited parental involvement.

Table 13. Main Constraints Identified

Constraint	Number of responses
Lack of materials	49
Lack of training	43
Large class sizes	31
Lack of time	26
Limited support from school management	15
Low parental interest	12

Source: Field survey data collected in Matadi, 2024.

Lack of materials is the main constraint (49 responses), whereas low parental interest is the least frequently reported constraint (12 responses). The difficulties encountered are therefore primarily material in nature.

Bivariate analyses

Relationship Between Training in Scientific Awakening and the Frequency of Experimental Activities

Table 14. Training in Scientific Awakening and Frequency of Experimental Activities

Training in scientific awakening	Never/Rarely (%)	n	Sometimes (%)	n	Often/Always (%)	n	Total	χ^2	df	p-value
No training	15 (78.9)		3 (15.8)		1 (5.3)		19			
Initial training	6 (42.9)		5 (35.7)		3 (21.4)		14			
Continuing training	5 (29.4)		7 (41.2)		5 (29.4)		17			
Initial + continuing training	2 (20.0)		3 (30.0)		5 (50.0)		10	16.82	6	0.010
Total	28		18		14		60			

Source: Field survey data collected in Matadi, 2024.

The chi-square test shows a statistically significant association between training in scientific awakening and the frequency of experimental activities ($\chi^2 = 16.82$; $p = 0.010$). Teachers who received both initial and continuing

training conduct regular scientific activities more frequently (50%) than those who received no training (5.3%). Training therefore appears to be an important factor in the integration of scientific practices at the preschool level.

Relationship Between Academic Educational Level and Scientific Activities

Table 15. Educational Level and Frequency of Scientific Activities

Educational level	Never/Rarely	Sometimes	Often/Always	Total	χ^2	df	p-value
Professional Certificate	7	2	1	10			
Specialized Teaching Certificate	16	8	4	28			
Bachelor's Degree / Bac+3	4	6	8	18			
Master's Degree or higher	1	1	2	4	14.57	6	0.024
Total	28	17	15	60			

Source: Field survey data collected in Matadi, 2024.

The analysis reveals a significant relationship between academic educational level and the frequency of scientific activities. As educational level increases, the frequency of scientific activities also tends to increase. Teachers

holding a Bachelor's or Master's degree appear to be better able to plan and organize scientific inquiry activities.

Relationship Between Professional Seniority and Scientific Activities

Table 16. Professional Seniority and Scientific Activities

Professional seniority	Never/Rarely	Sometimes	Often/Always	Total	χ^2	df	p-value
Less than 5 years	5	5	4	14			
5–10 years	11	8	6	25			
11–15 years	7	4	2	13			
More than 15 years	5	1	2	8	4.36	6	0.628
Total	28	18	14	60			

Source: Field survey data collected in Matadi, 2024.

The chi-square test indicates no statistically significant association between professional seniority and scientific practices ($p > 0.05$). Professional experience does not

appear to directly influence scientific awakening practices. Other factors, particularly specialized training and teaching resources, appear to be more influential.

Relationship Between the Presence of a Science Corner and the Frequency of Scientific Activities

Table 17. Science Corner and Scientific Activities

Science corner	Never/Rarely	Sometimes	Often/Always	Total	χ^2	df	p-value
No	16	4	1	21	18.96	4	0.001
Partial	10	11	6	27			
Yes	2	3	7	12			
Total	28	18	14	60			

Source: Field survey data collected in Matadi, 2024.

A highly significant association is observed between the presence of a science corner and the frequency of scientific awakening activities. Teachers with a science

corner conduct regular activities more frequently (58.3%) than those without one (4.8%). The pedagogical environment therefore appears to be an essential factor.

Relationship Between Teaching Resources and Scientific Activities

Table 18. Availability of Resources and Scientific Activities

Teaching resources	Never/Rarely	Sometimes	Often/Always	Total	χ^2	df	p-value
Insufficient	17	5	2	24	21.43	4	0.000
Moderate	9	8	5	22			
Sufficient	2	5	7	14			
Total	28	18	14	60			

Source: Field survey data collected in Matadi, 2024.

The chi-square test reveals a highly significant association between the availability of resources and scientific activities. Better-equipped schools report a higher frequency of scientific activities. Lack of materials therefore constitutes a major barrier to the development of children's scientific competencies.

Relationship Between Time Allocated to Science and the Frequency of Experimental Activities

Table 19. Time Allocated to Science and Frequency of Experimentation

Weekly time	Never/Rarely	Sometimes	Often/Always	Total	χ^2	df	p-value
Less than 30 min	13	2	1	16	17.21	6	0.009
30–60 min	12	11	6	29			
1–2 hours	3	4	5	12			
More than 2 hours	0	1	2	3			
Total	28	18	14	60			

Source: Field survey data collected in Matadi, 2024.

Relationship Between Teachers' Age and Scientific Activities

The amount of time devoted to scientific activities is significantly associated with the frequency of experimentation. Teachers who allocate more time to scientific activities conduct inquiry and experimentation activities more frequently.

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Table 20. Age and Frequency of Scientific Activities

Age	Never/Rarely	Sometimes	Often/Always	Total	χ^2	df	p-value
20–29 years	6	5	7	18	13.75	6	0.032
30–39 years	10	9	7	26			
40–49 years	8	3	1	12			
50 years and above	4	1	0	4			
Total	28	18	15	60			

Source: Field survey data collected in Matadi, 2024.

The statistical test shows a significant association between age and scientific practices. Younger teachers appear to be more engaged in scientific activities than older teachers.

This situation may be explained by their more recent exposure to innovative pedagogical approaches.

Table 21. Summary of the Bivariate Analyses

Variables associated with scientific practices	χ^2	df	p-value	Decision
Specialized training	16.82	6	0.010	Significant
Educational level	14.57	6	0.024	Significant
Professional seniority	4.36	6	0.628	Not significant
Science corner	18.96	4	0.001	Highly significant
Teaching resources	21.43	4	0.000	Highly significant
Time allocated to science	17.21	6	0.009	Significant
Age	13.75	6	0.032	Significant

Source: Field survey data collected in Matadi, 2024.

The bivariate analyses show that teaching resources, the presence of a science corner, specialized training, and the time allocated to scientific activities are the factors most strongly associated with scientific and technological awakening practices in preschool schools in Matadi. In contrast, professional seniority does not have a statistically significant association with the frequency of scientific activities. These findings confirm that improving pedagogical practices requires, as a priority, strengthening teachers' professional capacities and adequately equipping preschool institutions.

Other Associated Factors

Age was statistically associated with teaching practices ($\chi^2 = 13.75$; $p = 0.032$). Educational level also showed a statistically significant association ($\chi^2 = 14.57$; $p = 0.024$). In contrast, professional seniority was not significantly associated with scientific practices ($\chi^2 = 4.36$; $p = 0.628$). This finding suggests that the accumulation of years of professional experience does not automatically guarantee the updating of competencies in science education.

Qualitative Results

Table 22: Thematic Analysis and Quantification of Qualitative Data (n = 20)

Main Theme	Sub-theme	Frequency (n)	Percentage (%)	Illustrations (ID)
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Pedagogical resources	Lack of materials	20	100%	A1, A2, A9, A10
	Absence of a science corner	12	60%	A3, A4
	Use of recycled materials	18	90%	A10
Teacher training	Insufficient training	17	85%	A5, A7
	Lack of continuous training	14	70%	A3, A8
Pedagogical practices	Activity planning	41/60	68.3%	A2, A15
	Predominance of closed-ended questions	16	80%	A7
School organization	Lack of time	14	70%	A12, A16
	Absence of a science timetable	20 schools	100%	A12
	Overcrowded classrooms	17	85%	A17
Effects on children	Increased curiosity	20	100%	A11
	Improvement in oral expression	16	80%	A19
	Increased autonomy	14	70%	A20
Expressed needs	Demand for continuous training	20	100%	A8
	Demand for science kits	20	100%	A1

Table 23: Correspondence Matrix Between Verbatims and Themes

ID	Actor	Resources	Training	Organization	Effects
A1	Headteacher	✓	✓		
A5	Inspector		✓		
A10	Pedagogical supervisor	✓			
A12	Inspector			✓	
A17	Teacher			✓	
A19	Teacher				✓

Table 24: Summary of Constraints and Opportunities

Category	Identified problems (%)	Consequences	Needs
Resources	100%	Theoretical learning	Science kits
Training	85%	Low pedagogical quality	Continuous training
Organization	70%	Weak integration	Curriculum revision
Classroom	85%	Difficulty in supervision	Reduction of class size
Effects	100%	High curiosity	Strengthening of practices

Table 25: Quantification of Qualitative Data by Issues (n = 20)

Issue (category)	Identified sub-elements	n (participants)	%	Verbatims (ID)
1. Material constraints	Lack of teaching materials	20	100%	A1, A2, A9
	Absence of a science corner	12	60%	A3, A4
	Use of recycled materials	18	90%	A10
2. Training constraints	Insufficient training	17	85%	A5, A7
	Lack of continuous training	14	70%	A3, A8
3. Organizational and pedagogical constraints	Lack of time	14	70%	A12, A16
	Overcrowded classrooms	17	85%	A17

	Absence of a science timetable	20	100%	A12
	Less interactive practices (closed questions)	16	80%	A7
4. Effects and perceptions	Children's curiosity	20	100%	A11
	Improvement in oral expression	16	80%	A19
	Development of autonomy	14	70%	A20
	Expressed need for training	20	100%	A8
	Demand for science kits	20	100%	A1

Table 26 : Issue 1: Material Constraints (n = 20; 100%)

No.	ID	Verbatim
1	A1 (Principal)	<i>"In our institution, the lack of scientific materials is a widespread reality. No appropriate equipment is available, which reflects what we observe in almost all schools. Teachers are forced to teach science in a theoretical manner, which significantly limits children's understanding."</i>
2	A2 (Principal)	<i>"The absence of teaching equipment makes it difficult to implement concrete scientific activities. Even when teachers plan activities, they lack the means to carry them out effectively."</i>
3	A3 (Supervisor)	<i>"We also observe that several classrooms do not have a space dedicated to scientific activities. This reduces opportunities for children's experimentation."</i>
4	A4 (Principal)	<i>"In more than half of the classrooms, there is no science corner. Children therefore do not have access to a stimulating environment for exploration and manipulation."</i>
5	A9 (Principal)	<i>"Pedagogical resources are insufficient in all the schools visited. This limits pedagogical innovation and hinders active learning."</i>
6	A10 (Supervisor)	<i>"Faced with this lack, teachers use recycled materials. This practice is widespread, but it does not replace appropriate didactic materials."</i>

27 : Issue 2: Training Constraints (n = 17; 85%)

No.	ID	Verbatim
7	A5 (Inspector)	<i>"The majority of teachers have not received specific training in scientific awakening. This explains their difficulties in organizing activities adapted to the preschool level."</i>
8	A6 (Supervisor)	<i>"Teachers often improvise their activities due to a lack of adequate training, which affects the quality of learning."</i>
9	A7 (Principal)	<i>"Teachers themselves acknowledge their limitations in science. Without training, they tend to favor simple methods, often not very interactive."</i>
10	A8 (Inspector)	<i>"There is no structured continuing training program, even though all stakeholders express an urgent need for capacity building."</i>
11	A14 (Supervisor)	<i>"The lack of regular pedagogical support contributes to maintaining traditional practices that are not well adapted."</i>

Table 28 : Issue 3: Organizational and Pedagogical Constraints (n = 14–20; 70%–100%)

No.	ID	Verbatim
12	A12 (Inspector)	<i>"The time allocated to science is insufficient in most schools. Moreover, no specific timetable is planned for these activities."</i>
13	A13 (Principal)	<i>"Scientific awakening is not considered a priority in the school curriculum, which explains its limited presence."</i>
14	A15 (Teacher)	<i>"Even when I plan activities, time constraints and an overloaded program limit their implementation."</i>

15	A16 (Teacher)	<i>"Science activities often come after core subjects, which reduces their importance in our practices."</i>
16	A17 (Teacher)	<i>"Classrooms are overcrowded, making it difficult to organize practical activities with all children."</i>
17	A18 (Teacher)	<i>"There is no specific pedagogical monitoring for science, which does not support its development."</i>

Table 29 : Issue 4: Effects and Perceptions of Stakeholders (n = 14–20; 70%–100%)

No.	ID	Verbatim
18	A11 (Principal)	<i>"Despite the difficulties, scientific activities always stimulate children's curiosity. They show genuine interest when they participate."</i>
19	A19 (Teacher)	<i>"We observe an improvement in children's oral expression when they participate in scientific activities."</i>
20	A20 (Teacher)	<i>"Scientific activities also help develop children's autonomy, even if they are not always well organized."</i>

Comments

The qualitative analysis, supported by a quantification of verbatims (Tables 1 to 3), highlights a **strong convergence in the perceptions of educational stakeholders** around four major categories of constraints, while also revealing positive effects on children.

Predominance of material constraints

The results show that **all participants (100%)** reported a **lack of teaching materials**, making it the most unanimously shared constraint. This situation reflects a **structural insufficiency of pedagogical resources**, also confirmed by the frequent use of **recycled materials (90%)** and the **absence of science corners (60%)** in classrooms. These elements indicate that scientific awakening relies mainly on improvised practices, thereby limiting experiential learning, which is essential at the preschool level. Verbatims from school heads and supervisors (A1, A2, A9, A10) emphasize that this deficiency leads to a **dominance of theoretical approaches**, which are not well adapted to young children's cognitive abilities.

Insufficiencies in training and pedagogical support

A large proportion of participants highlighted gaps in training: **85% reported insufficient training**, and **70%**

reported the absence of continuous professional development. These findings reflect a **systemic deficit in capacity building**, directly affecting the quality of pedagogical practices. Inspectors and supervisors (A5, A7, A8) stressed that, due to the lack of specific training, teachers adopt limited pedagogical strategies, often centered on **closed-ended questions (80%)**, thus reducing interactivity and children's participation. This situation compromises the development of basic scientific skills.

Major organizational and pedagogical constraints

The data also reveal constraints related to school organization. The **lack of time (70%)**, combined with the **absence of a dedicated science timetable in 100% of schools**, indicates a **weak institutionalization of scientific awakening** in preschool programs. Furthermore, **overcrowded classrooms (85%)** complicate the implementation of practical activities, as highlighted by several teachers (A17). This overcrowding limits individualized support and reduces the effectiveness of experimental activities. Overall, these organizational constraints reflect an **insufficient prioritization of science**, which is often relegated behind so-called core subjects.

Positive effects despite constraints

Despite these challenges, the findings reveal **significant positive effects on children.** All participants (100%)

observed **increased curiosity**, while **80% reported improvements in oral expression**, and **70% noted increased autonomy**. These results confirm the **high pedagogical potential of scientific awakening**, even under unfavorable conditions. Verbatims (A11, A19, A20) show that when such activities are implemented, they promote children's active engagement and stimulate their cognitive and language development.

Unanimous expression of needs

Finally, all stakeholders expressed priority needs:

- **100% requested continuous professional development,**
- **100% called for appropriate scientific kits.**

This unanimity reflects a **collective awareness of the shortcomings of the current system** and highlights the urgency of structured intervention.

Interpretative synthesis

Overall, the qualitative results reveal a **multidimensional problem**, in which material, pedagogical, and organizational constraints interact to limit the effective integration of scientific awakening in preschool education. However, the positive effects observed in children demonstrate that these activities represent a **powerful pedagogical lever**, fully justifying the implementation of an improvement framework. These findings therefore support the relevance of proposing a structured model such as the "**Nervures de Joy 2025**" model, aimed at simultaneously addressing needs related to **equipment, training, and pedagogical organization**.

Comments

The qualitative analysis, supported by a quantification of verbatims (Tables 1 to 3), highlights a strong convergence in the perceptions of educational actors around four major categories of constraints, while also revealing positive effects among children.

Predominance of material constraints

The results show that all participants (100%) report a lack of teaching materials, making it the most unanimously shared constraint. This situation reflects a structural insufficiency of pedagogical resources, also confirmed by the frequent use of recycled materials (90%) and the absence of science corners (60%) in classrooms. These elements indicate that scientific awakening largely relies

on improvised practices, thereby limiting experiential learning, which is essential at the preschool level. The verbatims of school heads and pedagogical supervisors (A1, A2, A9, A10) emphasize that this shortage leads to a dominance of theoretical approaches, which are poorly suited to young children's cognitive abilities.

Insufficiencies in training and pedagogical support

A significant proportion of participants highlight gaps in training: 85% report insufficient training, and 70% indicate the absence of continuous professional development. These results point to a systemic deficit in capacity building, directly affecting the quality of pedagogical practices. Inspectors and supervisors (A5, A7, A8) stress that, due to the lack of specialized training, teachers adopt limited teaching strategies, often centered on closed-ended questions (80%), thus reducing interactivity and children's participation. This situation undermines the development of basic scientific skills.

Major organizational and pedagogical constraints

The data also reveal barriers related to school organization. The lack of time (70%), combined with the absence of a dedicated science schedule in 100% of schools, indicates a low level of institutionalization of scientific awakening within preschool programs. Furthermore, overcrowded classrooms (85%) make it difficult to implement practical activities, as noted by several teachers (A17). This overcrowding limits individualized support and reduces the effectiveness of experimental activities. These organizational constraints therefore reflect an insufficient prioritization of science, which is often relegated behind so-called core subjects.

Positive effects despite constraints

Despite these challenges, the results reveal significant positive effects on children. All participants (100%) observe increased curiosity, while 80% report improved oral expression and 70% greater autonomy. These findings confirm the high pedagogical potential of scientific awakening, even under unfavorable conditions. The verbatims (A11, A19, A20) show that when such activities are implemented, they promote children's active engagement and stimulate their cognitive and language development.

Unanimous expression of needs

Finally, all stakeholders express priority needs:

- 100% request continuous training,
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This unanimity reflects a collective awareness of the shortcomings of the current system and highlights the urgency of structured intervention.

Interpretative synthesis

Overall, the qualitative results reveal a multidimensional problem, in which material, pedagogical, and organizational constraints interact to limit the effective integration of scientific awakening in preschool education. However, the positive effects observed in children demonstrate that these activities represent a powerful

pedagogical lever, fully justifying the implementation of an improvement framework. Thus, these findings support the relevance of proposing a structured model such as the “Nervures de Joy 2025” model, aimed at simultaneously addressing needs in equipment, training, and pedagogical organization.

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List of abbreviations

Abbreviation	Meaning
A1 – A20	Identification codes of respondents (participants in the qualitative study)
N	Sample size (number of participants concerned)
%	Percentage
DRC	Democratic Republic of the Congo
OECD	Organisation for Economic Co-operation and Development
P	Statistical significance value
Matadi 1 / Matadi 2	Educational subdivisions studied
SC	School Complex
“Nervures de Joy 2025” Model	Proposed intervention model for scientific awakening
IT / CT	Initial Training / Continuous Training

Data availability

The data used in this study were collected as part of research conducted among preschool teachers and school administrators in the Matadi 1 and Matadi 2 educational subdivisions. Any sharing of individual-level data must comply with applicable ethical and institutional requirements.

Declaration of conflict of interest

The authors declare that they have no known conflicts of interest that could have influenced the design, conduct, or interpretation of this study.

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Author contributions

Tunamau Kiese Joy contributed to the writing of the introduction, as well as to the analysis of the results and the discussion of the study.

Senker Ndimba Bob was responsible for the methodology, field data collection, the development of the “Nervures de Joy 2025” model, and the final formatting of the manuscript.

Otto Michel participated in the fieldwork and contributed to the writing of the introduction.

Kinyoka Kabalumuna God’El and Mata Tombo José Emmanuel provided scientific supervision, critical revision, and validation of the final version of the manuscript.

Hamuli Mastaki Benjamin provided scientific supervision, critical revision, and validation of the final version of the manuscript.

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