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RESEARCH ARTICLE

Exploring Moroccan Early Childhood Teachers' Perceptions of Science Education: Importance, Confidence, and Barriers

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ABSTRACT

The underemphasis on science instruction in early childhood settings has persisted, resulting in shortages in professions reliant on robust science education. This hampers child development and equitable education progress. This study aimed to uncover Moroccan early childhood educators' perceptions regarding the significance of science experiences, their confidence in teaching science, and the obstacles they face in integrating science activities into their classrooms. Surveying 106 teachers in South Morocco, findings highlighted science's minimal priority among curriculum domains for young children. Professionals exhibited least confidence in teaching science compared to other curriculum domains. Identified barriers encompassed inadequate training, limited knowledge, negative beliefs about children's science learning aptitude, low self-confidence, time constraints, lack of content in Arabic language and limited access to resources. Addressing these issues could enhance science learning quality, equipping children for diverse fields and empowering them for future success in an in a rapidly changing world.

INTRODUCTION

Disparities in human development become evident during the early stages of life and, if left unaddressed, can endure across one's lifespan (Najman et al., 2004). Theses inequalities can mainly affect the child verbal ability, cognitive development, and educational outcomes (Najman et al., 2004). Research indicates that focused and timely intervention initiatives directed towards underprivileged children prove to be an efficacious strategy for mitigating developmental inequalities. (Doyle et al., 2009; Engle et al., 2011; Martinez et al., 2012). The formative years hold a special significance in nurturing children's social, emotional, and cognitive growth. Insights from behavioral and developmental psychology underscore that these initial phases of life play a pivotal role in establishing the groundwork for brain architecture and other biological mechanisms, which in turn sculpt the trajectory of future cognitive, social, and emotional development (Blair & Raver, 2012; Knudsen et al., 2006). Consequently, there is a widespread consensus that preschools can generate significant positive effects on a child's growth and readiness for primary education, encompassing diverse low-income and middle-income countries. In recognition of that reality, Morocco has therefore decided that preschool education should be part of the free and compulsory basic education and considered preschool programs as a potential means for overcoming educational

disabilities of children from disadvantaged backgrounds. Improving the early childhood environment can nurture cognitive development, while a range of adverse experiences can impact cognitive progress in ways that limit future learning possibilities (Shonkoff, 2010). A strong basis establishes the cornerstone for conscientious citizenship, economic well-being, thriving communities, and prosperous education for the succeeding generation (Shonkoff, 2010). Early years are the unavoidable basis for later effective learning. Hence, creating a positive environment during this phase is crucial to facilitate the learning and development of infants.

In this context, there emerges a burgeoning opportunity for play, inquiry, and a comprehensive approach to learning, all of which contribute to better preparing all children for their future endeavors. In pursuit of this goal, initiatives to initiate children into the realm of scientific inquiry should commence during their early years (Lind, 1998). It wields significant sway in shaping favorable attitudes toward science, thus constituting a pivotal juncture for enhancing the science outlook of young learners (Barmby, Kind and Jones, 2008). Likewise, pre-school children engaged in inquiry-based science activities can nurture cognitive abilities that foster analytical, evaluative, and problem-solving skills, aligning with the demands of 21st-century challenges (Furtado, 2010). Furthermore, it can nurture children's curiosity and delight in exploring the world, thus establishing the bedrock for advancing scientific learning (Association, 2002).

Educators are progressively moving beyond the conventional notion that preschoolers are too immature for engagement in scientific learning and experimentation. They are acknowledging that even young learners can actively participate in scientific exploration. This shift is grounded in contemporary research revelations that demonstrate the capacity of young children for conceptual comprehension, adept reasoning, and effective inquiry (Council, 2007). They exhibit the capability to execute diverse cognitive skills, including posing inquiries and formulating predictions, pivotal facets of scientific thought and learning that should be nurtured in children during the initial stages of their lives. Furthermore ,child who are early exposed to scientific content and processes become more proficient at navigating the scientific content and processes and developing positive attitudes toward science in higher grades (Barmby et al., 2008; Furtado, 2010).

Notwithstanding these abilities, the burgeoning skills of children often do not receive primary attention in early childhood classroom instruction. In many instances, merely a minor fraction of preschool activities is dedicated to science, and over the years, the teaching of science has been overshadowed by a stronger emphasis on reading and mathematics (Greenfield et al., 2009 ; Ramey et al., 2000). Moreover, many educators still tend to underestimate children's ability to learn science at an early age, failing to provide them with the opportunities and experiences necessary to develop their scientific skills and conceptual understanding (Council, 2007). Furthermore, the amount of time young children can focus on scientific inquiry is also underestimated. It is also noted that educators teach most, if not all school subjects and, sometime, with no content knowledge and no pedagogical training. In the Moroccan context, early childhood teachers often possess the least extensive academic and professional qualifications. This incongruity and deficiency in the educational landscape carry substantial implications when these educators are tasked with teaching science without the requisite background.

Despite the growing excitement surrounding the introduction of science to children, there remains a dearth of information regarding the readiness, expertise, attitudes, and confidence of early childhood educators in implementing these educational practices. Considering the profound impact that teachers' convictions wield over their pedagogical choices, their perceptions towards science instruction should command considerable attention. While the connection between teachers' beliefs and actions is not flawless, it is undeniable that their beliefs do play a role in shaping their instructional approaches (Keys, 2005). Therefore, it is important to examine their perceptions of the value of science-related experiences. This examination will be crucial for enhancing scientific

education and will inform the design of effective professional development initiatives aimed at supporting and promoting science education.

To our knowledge, no prior studies have examined the perception of Moroccan teachers about the integration of science teaching in early childhood education. The purpose of this study is to explore and describe early childhood teachers' perceptions regarding integrated science instruction in their classrooms. The primary focus of this study will be on understanding kindergarten teachers' views concerning three key aspects: the importance of providing science-related experiences to young learners, their confidence in delivering integrated science instruction in comparison to other curriculum domains, and the challenges they face in implementing such integrated instruction.

This article is centered around the exploration of the following research inquiries:

1. How do early childhood educators in Morocco perceive the significance of experiences in the science curriculum domain in comparison to other curriculum domains?
2. What is the self-assessment of early childhood teachers regarding their confidence in implementing science activities as opposed to activities within other curriculum domains?
3. What are the primary obstacles to integrating science into teaching as perceived by early childhood teachers in Morocco?

LITERATURE REVIEW

The importance of science education in preschool teacher's perceptions:

Scholars and advocates for education reform have revitalized the significance of introducing young children to science and the phenomena of the natural world. However, for sustainable advancements in scientific literacy, it is imperative to challenge the conventional belief among educators that preschoolers are too young to engage in and grasp the essence of scientific learning and experimentation. The core of an effective education program's success is closely intertwined with the role of the teacher. Public sentiment overwhelmingly supports the priority of ensuring that every classroom is led by qualified educators. It is vital to cultivate and guide teachers in developing positive perceptions and attitudes towards science. Achieving world-class science education necessitates educators who possess the confidence, enthusiasm, and knowledge to deliver exceptional instruction. Furthermore, teachers, once considered a central factor contributing to student underachievement in science, are now acknowledged as a vital part of the solution. While a solid foundation in undergraduate science education is crucial for nurturing the next generation of scientists, it is equally indispensable for future science educatorse (Board (US), 1999). A fundamental component of teacher education is acquiring discipline knowledge, which plays a pivotal role in boosting the confidence of aspiring educators when it comes to teaching science. Prior research has established a robust link between the science content knowledge possessed by early childhood teachers and their actual implementation of science teaching practices (Kallery & Psillos, 2001; Pell & Jarvis, 2003) . Nonetheless, achieving science literacy is deemed a fundamental essential for educators involved in science-based instruction, despite the fact that many states do not mandate specialized pre-service training in science education as a requirement for teacher certification (Eckman, 2001). As a result, a significant number of teachers find themselves without the necessary guidance to effectively design and provide high-quality instruction. Fewer than one-third of teachers feel sufficiently equipped to teach life science, and only two out of every five feel adequately prepared to use science or math textbooks as supplementary resources rather than relying on them as the primary mode of instruction (Board (US), 1999). This reality also raises concerns among early childhood teachers. A significant majority of them have completed a relatively limited number of science and mathematics content courses (Lander, Gates Jr and Group, 2010). Furthermore, they

express a sense of unease when it comes to instructing science and mathematics (Copley & Padron, 1998; Sutton et al., 2009) .

A survey conducted by (Fulp, 2002) in the United States revealed that 42% of elementary teachers had completed four or fewer semesters of science instruction. Additionally, less than 30% of the surveyed elementary teachers expressed confidence in their preparedness to effectively teach science. This presents a significant concern, as teachers' mastery of the subject matter is a predictive factor for students' learning achievements (Enfield & Rogers, 2009; Kennedy, 1998 ; Wilson et al., 2002).

Despite its significance, science remains relatively undervalued in early childhood education, with inadequate time allocated to scientific activities. Consequently, a considerable number of children are deprived of enriching science encounters during their preschool years. These missed opportunities have the potential to profoundly impact their readiness for school and their academic achievements in the long run. Research underscores that preschool classrooms often lack the necessary planned or spontaneous math and science learning opportunities (Brenneman, Lange and Nayfeld, 2019). This scarcity of opportunities can impede children's access to crucial scientific concepts and hinder the cultivation of vital critical thinking and problem-solving abilities. A mere 7 out of 10 elementary classrooms allocate some daily time to science instruction, potentially limiting the scope for comprehensive science learning (Fulp, 2002). In the United States, preschoolers dedicate an average of merely 16 minutes per day to science-related activities, and in numerous schools, this allocation drops to zero (Keegan and Bower, 2006) .

Considering the significance of introducing science at an early stage and the potential advantages it brings forth, it becomes imperative to urgently bridge this gap in early childhood education. By reevaluating the prioritization of science in the curriculum and fostering a supportive learning environment, educators can better equip young learners with the foundational knowledge and enthusiasm for science that will serve them throughout their educational journey and beyond.

Barriers to Integrating Science Activities in Early Childhood Education

Despite the crucial role of science education in childhood development, many educators are still reluctant to engage in teaching it. Recent research findings indicate that children encounter fewer opportunities to learn about science in preschool classrooms compared to subjects such as literacy, mathematics, social studies, and art (Early et al., 2010; Greenfield et al., 2009). Indeed, a considerable number of educators harbor apprehensions and have never held a fondness for science (Keegan and Bower, 2006) .

Certainly, various reasons underlie the minimal attention directed towards early science instruction, and previous studies primarily examined the variables that impact the frequency of science teaching in preschool classrooms. Previous research findings suggested that one of the factors contributing to the limited amount of science instruction in the early years was a lack of topic expertise in both science and pedagogy (Appleton, 1992; Kallery & Psillos, 2001). As a result of their heightened confidence and enhanced understanding of science topics, educators who have undergone a greater number of science methods courses may exhibit a greater willingness to engage in science instruction.

Additional factors contributing to the reduction of science instruction in preschool education encompass:

- Inadequate science-related technology skills among teachers (Fulp, 2002)
- Insufficient opportunities for professional growth in the field of science (Fulp, 2002; Pell & Jarvis, 2003).

- Limited financial resources at the district or school level for acquiring science supplies or equipment (Fulp, 2002).
- The accessibility of instructional materials related to science (Early et al., 2010; Greenfield et al., 2009)
- pressures placed on teachers to give math and reading education priority (Greenfield et al., 2009; McLaughlin & Nolet, 2001; Ramey et al., 2000).
- Time demands placed on teachers and problems with classroom management related to science activities (Brownell & Thomas, 1998, Greenfield et al., 2009)
- The underestimation of children's early-age learning capacity by educators (Council, 2007).

MATERIALS AND METHODS

Overview of Methods:

The research employed a survey methodology to investigate the perceptions of in-service educators in Morocco. The survey aimed to understand their views on the significance of science experiences relative to other curriculum areas, gauge their confidence in executing these activities compared to other domains, and uncover any perceived barriers hindering successful implementation in their classrooms. This developing area of study lacks established measures for assessing early childhood educators' perceptions of science instruction. This developing area of study lacks established measures for assessing early childhood educators' perceptions of science instruction. The survey was conducted virtually, gathering data for the research between October 2022 and April 2023. Participants completed an online questionnaire that included Likert scale questions, which are commonly used to gather data in surveys.

Samples

106 early childhood teachers (100% female) from two Moroccan districts (Inzegane Ait Melloul n= 41 and Agadir Ida Outanane n=65) completed the online survey. Demographic information, including sector of practice, years of experience, grade of children with whom participants worked, initial scientific training and highest level of education completed are presented in **Table 1.**

Table 1. Early Childhood Professionals' Demographic Information

		N=106	%
District	Agadir	65	61,3
	Inzegane	41	38,7
Sector of practice	With interventions from partners	10	9,4
	Private	23	21,7
	Public	41	38,7
	Informal	32	30,2
Age (31,30 ± 6,43)	<= 25	22	20,8
	26 - 32	34	32,1
	33 - 38	33	31,1
	39+	17	16
Experience (7,82 ± 4,99)	<= 5	41	38,7
	6 - 10	39	36,8
	11 - 15	15	14,2
	16+	11	10,4
Highest level of education completed	Elementary school	8	7,5

	Middle school	15	14,2
	High school	55	51,9
	Bachelor's degree	28	26,4
	Master or Doctor degree	0	0
Scientifique Subject specialization area (Subject choice)	Literature	62	58,5
	Science	29	27,3
	Without	15	14,2
Pre-service training	Yes	27	25,5
	No	79	74,5
In-service training	Yes	97	91,5
	No	9	8,5
Specialized Science Education Training for Pre-Schoolers	Yes	5	4,7
	No	101	95,3
Age of children	Nursery classes (3 years old)	4	3,8
	Pre-K classes (4 years old)	18	17
	kindergarten classes (5 years old)	26	24,5
	4 & 5years old	37	34,9
	3 , 4 and 5	21	19,8

Respondents reported a mean age of 31 years (SD 6.4) and 7.8 years of experience as educators (SD 4.9). All the participants reported working with preschool-age children, with 3.8% working in Nursery classes (3 years old), 17.0% in pre-K classes (4 years old), 24.5% in kindergarten classes (5 years old), and 54.7% in mixed classes (34.9% pre-K and kindergarten; 19.8% Nursery, pre-K, and kindergarten).

Regarding the highest level of education completed, 28% of the teachers held a Bachelor's degree, while more than half of them (55%) had a High School degree. 9% had completed Middle School, and 8% had completed Elementary School. None of the teachers held a Master's or Doctoral degree. The percentage of teachers who underwent pre-service training specifically tailored to preschool education was low, accounting for only 22%. Additionally, approximately 89.5% of the teachers participated in in-service training in the past three years. A mere 4.7% of the teachers indicated that they had undergone specialized training in science education to support the transition from general teaching to teaching science in preschool education.

Measures

A survey was designed to assess educators' perceptions of the significance of children's experiences in different curricular domains, and educators' confidence implementing activities in different curricular domains, as well as the perceived barriers they faced in implementing scientific activities in their classrooms. As no existent individual questionnaire comprehensively addressed all the research questions comprising this study, subscales were combined from existent instruments to gather data relevant to all research questions.

The questionnaire items analyzed during the current research included (a) modified versions of the Importance of Experiences and Educators' Confidence scales from the Early Childhood Educators' Perceptions of Nature, Science, and Environmental Education (Torquati et al., 2013), and (b) a self-

designed questionnaire by the researchers based on several previous studies (Liu & Pange, 2015; McNamara et al., 1999; Saçkes, 2014; Sellami et al., 2022). These items were included to identify barriers that may affect teachers' implementation of science instruction. The survey included three scales, each consisting of questions related to: Importance of experiences, educators' confidence, and barriers to integrating science.

Importance of experiences. The importance of experiences scale encompassed five subscales: language and literacy (4 items, Cronbach's alpha = 0.82), art (6 items, alpha = 0.81), mathematics (5 items, alpha = 0.78), developmentally appropriate practices (DAP; 9 items, alpha = 0.81), and science (11 items, alpha = 0.90). Teachers were asked to rate on a scale ranging from 1 (not very important) to 5 (extremely important) how important they believe it is for children to have these experiences in early childhood education programs.

Teacher confidence. The Teacher Confidence scale comprised five subscales: science (8 items, α = 0.82), literacy (3 items, α = 0.77), social and emotional development (3 items, α = 0.76), art (3 items, α = 0.70), and mathematics (4 items, α = 0.84). Participants rated their perceived confidence in planning and executing each activity on a scale ranging from 1 (not at all confident) to 5 (highly confident)."

Barriers to Integrating Science. The School-Related Teaching Barrier scale was used to define the extent to which the educators teaching was affected due to various issues. These issues comprised of the following: Inadequate teachers' perceptions (4 items, α = 0.72), Inadequate Teacher Background (4 items, α = 0.79 0), Lack of Time for Science (3 items, α = 0.71), Lack of instructional materials and Resources for developing Scientific content (6 items, α = 0.87), Lack of Resources for developing Scientific content (7 items, alpha = 0.92) , Lack of Space and Facilities for Teaching Science (3 items, alpha = 0,69), and Lack of Administrative support (5 items, alpha = 0.88). Participants were asked to evaluate the challenges they encountered in implementing science education using a 5-point Likert scale. The scale ranged from 1 (representing "a lot" - significant hindrance) to 5 (representing "not at all" - no hindrance). Teachers' responses to these questions were categorized into two groups: those representing the lowest scores, indicating minimal hindrance, and those representing the highest scores, signifying significant obstacles.

In this study, we employed a Likert scale to assess participant's perceptions towards the subject matter. The Likert scale consisted of five scale points, each associated with a specific range of values. To interpret and present the results, we used a table that provided clear labels for each scale point interval. Responses falling within the range of 1.00 to 3.39 were categorized as "Low level," indicating a relatively lower degree of agreement or positive sentiment. On the other hand, responses in the range of 3.40 to 5.00 were classified as "High level," representing a stronger level of agreement or positive sentiment. Utilizing this table allowed us to effectively categorize and analyze the data, providing a concise overview of participants' attitudes and perceptions. By presenting the findings in this manner, we aimed to enhance the clarity and comprehensibility of the results for readers and facilitate the identification of trends and patterns in participants' responses.

Table 2: Interpretation of Early Childhood Teachers' Perceptions of Science Teaching using a Likert Scale

Likert scale	interval	rank
1	1.00-1.79	low level
2	1.80-2.59	
3	2.60-3.39	
4	3.40-4.19	high level
5	4.20-5.00	

RESULTS:

The early childhood teachers' perceptions of science teaching were evaluated using specified measures, as mentioned in the section 'Materials and Methods.' Results obtained from these measures are presented below.

Importance of Experiences across Curricular Domains Score:

Teachers were asked to rate the level of importance of providing specific experiences in early childhood education programs. The responses of early childhood teachers were coded into two groups: those who attributed a high level of importance and those who attributed a low level of importance. Results are summarized in Table 3:

Table 3. Ratings of the Importance of Experiences across Curricular Domains

Curriculum domains	**How important do you believe it is to implement the following experiences in early childhood education program? (N =106)**	
	High level of importance (%)	Low level of importance (%)
Literacy	89.50	10.50
Art	89.30	12.70
Math	88.60	20.40
DAP	25.11	74.89
Science	22.21	77.79

Based on the responses of the surveyed teachers, it was found that a significant majority (more than 88%) strongly believe in the high level of importance of literacy, art, and mathematics in an early childhood education program. However, a smaller proportion of teachers, 22 % and 25 % respectively reported science experiences and Developmentally Appropriate Practice (DAP) to be highly important in the program.

Early childhood teachers' feelings of confidence about teaching specific curricular domains:

Teachers were asked to rate their confidence in implementing activities in different curricular domains. The responses were categorized into two groups: either extreme or high confidence, or low or no confidence. The results are presented in table 4.

Table 4. Ratings of the teachers' feelings of confidence about teaching specific curricular domains:

Curriculum domains	**How confident are you to implement the following in your teaching? (N = 106)**	
	High confidence (%)	Low confidence (%)
Literacy	95	5
Art	77	23
Math	93	7
DAP	66	34

Science	35	65

When assessing teachers' confidence in implementing activities across various curricular domains, the findings revealed that a significant majority of early childhood educators (93%) expressed high levels of confidence in teaching language/literacy and mathematics. A substantial portion also displayed strong confidence in teaching art (over three-quarters), while a slightly lower percentage (66%) exhibited such high confidence levels in Developmentally Appropriate Practice (DAP) instruction. In contrast, a smaller proportion (35%) rated themselves as most confident in the science domain.

Main barriers to Science integration in teaching of the early childhood teacher:

Table 5: Assessing the Significance of Barriers in Integrating Science Instruction for Early Childhood Teachers

		How significant do you believe that the following barriers are in hindering the integration of science instruction in early childhood education? (N =106)	
		High level of significance (%)	Low level of significance (%)
Inadequate teachers' perceptions and knowledge	science is not a high priority in their school	37,00	63,00
	Lack of perceived self-efficacy in teaching science	89,60	10,40
	Limiting beliefs about children's ability to learn science	95,30	4,70
	Limited scientific knowledge of educators	94,00	6,00
Lack of Time for Science	Time scarcity due to prioritizing basic skills subjects	81,00	19,00
	Lack of time to prepare for teaching science	43,00	57,00
	Lack of time to teach science	82,40	17,60
Lack of instructional materials and Resources for developing Scientific content	Lack of supplies and equipment for science,	96,60	3,40
	Out of-date or inadequate school materiel	55,00	45,00
	Lack of pedagogical models on how to teach Science	11,00	89,00
	Lack of science textbooks	10,00	90,00
	Lack of content in national language	80,00	20,00
	Out-of-date or inadequate science textbooks	8,00	92,00
	Lack of space for science	57,00	43,00
	Overcrowded classrooms	56,00	44,00

Lack of Space /Facilites for science	Open area classroom is the only available option	37,00	63,00
Lack of Administrative support	Insufficient funding	31,00	69,00
	inadequate infrastructure for scientific facilities	75,80	24,20
	Lack of support for the place of science in early childhood	78,70	21,30
	Lack of pedagogical training	55,10	54,90
	Lack of Science training	98,50	1,50

Table 5 displays the statistical details of the percentages associated with the 21 barriers perceived by the participants. The findings highlight that the majority of participants strongly agreed that the most prominent perceived barriers to implementing science in their classrooms are 'Lack of Science training' (98.50%),'lack of access to resources' (96.60%), 'Limiting beliefs about children's ability to learn science' (95.30%),'Limited scientific knowledge' (94.00%), and 'Lack of perceived self-efficacy in teaching science' (89.60%). Other leading barriers referred to as "Lack of time to teach science" (82.40%),"Time scarcity due to prioritizing basic skills subjects" (81.00%), "Lack of content in the national language" (80.00%),"inadequate infrastructure for scientific facilities" (75.80%), and "Lack of support for the place of science in early childhood" (78.70%). While "Lack of space" (57.00%), "Overcrowded classrooms" (56.00%),"Lack of pedagogical training" (55.10%), and "Out-of-date or inadequate school material" (55.00%) were also reported as barriers by approximately half of the participants, they were not reported as strong barriers as frequently as the others. "Lack of pedagogical models on how to teach Science" (11.00%), "Lack of science textbooks" (10.00%), and "Out-of-date or inadequate science textbooks" (8.00%) were the least prominent barriers.

DISCUSSION:

The objective of this study was to investigate the perceptions of early childhood educators regarding science education and gain a deeper understanding of their training, knowledge levels, and attitudes towards prioritizing science education. Additionally, the study aimed to explore the barriers to science integration in teaching, focusing on Moroccan early childhood teachers.

Quantitative analyses conducted revealed that professionals assigned lower priority to the curricular domain encompassing science when considering experiences for young children. On the other hand, literacy, art, and math experiences consistently received the highest ratings of importance. Professionals also expressed higher confidence in implementing language and literacy activities, while demonstrating lower confidence in implementing science activities. This finding aligns with the historical emphasis placed on art and mathematics development in early childhood education, as well as the recent emphasis on language and literacy. To address these priorities, several effective professional development programs and curricular supports have been developed. (e.g., (Björklund et al., 2020; Brown, 2014; Çetin, 2021;Council, 2009); Hui et al., 2015; Ricciardi et al., 2021; Welsh et al., 2020; Yuhasriati & Yuriansa, 2018). These findings corroborate previous studies that have also highlighted the limited opportunities for children to engage in science learning within preschool classrooms, in contrast to the emphasis placed on subjects like literacy, mathematics and art (Early et al., 2010; Greenfield et al., 2009).

The identified trend of professionals exhibiting the lowest confidence in the field of science corresponds with earlier research that has documented teachers' apprehensions and uncertainties surrounding the teaching of science. It has been observed that a significant number of educators exhibit a fear or aversion towards science, fostering a general dislike for the subject (Keegan & Bower, 2006; Sutton et al., 2009). This further supports the notion that in typical early childhood

classrooms, instructional practices often do not prioritize the cultivation of children's emerging skills (Tu, 2006; Saçkes, 2014). This imbalance in the availability of learning opportunities suggests that science receives comparatively less attention during the early years of education compared to other subjects.

However, integrating science with other subjects enables children to learn science and other disciplines more profoundly (Kellough, 1995). Furthermore, integrating science with other disciplines provides avenues to enhance both the quantity and quantity of science instruction, as well as student learning (Jarrett, 1999). Fusing science also furnishes a more expansive framework for pupils to employ recently acquired scientific concepts. This approach allows for a more holistic and interdisciplinary approach to education, providing a richer and more meaningful learning experience for young learners. By integrating science with other subjects, we can enhance the overall effectiveness of science education and promote a deeper understanding of scientific concepts among students.

The outcomes of the current study also correspond with the worries voiced by half of the surveyed teachers in the UK, who highlighted a notable lack of confidence and proficiency in teaching science as a significant concern within primary education (Murphy, Neil and Beggs, 2007). This study revealed that primary teachers ranked their confidence to teach science as the third out of six subjects, trailing behind English and mathematics. This starkly contrasts with Harlen, (1995) study, where science was ranked eighth, surpassing music, ICT, and technology. The persistent lack of teacher confidence in teaching science necessitates focused interventions and support systems to address this vital concern. By addressing these challenges and enhancing teacher confidence, we can empower them to foster a strong foundation of scientific knowledge and curiosity in young learners. This will contribute to a more engaging and robust early childhood science education. Targeted interventions and professional development programs are essential to support primary teachers in improving their science pedagogy skills. It is important to acknowledge that these results are based on self-reports rather than direct observations of the actual time allocated to activities in different curricular domains.

The leading barriers perceived by the participating early childhood teachers on science integration in teaching included lack of science training, limited scientific knowledge, limiting beliefs about children's ability to learn science, Lack of perceived self-efficacy in teaching science , Time scarcity , lack of content in Arabic language and access to resources. On the contrary, Lack of pedagogical models, lack of science textbooks, and Out-of-date or inadequate science textbooks were the least prominent barriers.

A prevailing trend in research underscores that a considerable number of early childhood educators frequently encounter inadequate and insufficient professional training in the domains of mathematics and science. This shortfall results in a dearth of comprehensive content knowledge and a noticeable lack of self-assurance when it comes to providing enriching Science, Technology, Engineering, and Mathematics learning opportunities for young learners (Brenneman et al., 2019;Greenfield et al., 2009). Moreover, prior studies have also emphasized the significance of insufficient science and pedagogical content knowledge as a contributing factor to the limited emphasis on science education during the early years (Appleton, 1992;Kallery & Psillos, 2001; Saçkes, 2014) . The findings of this present study align harmoniously with this prior research, providing compelling evidence that both in-service and pre-service teachers can significantly enhance the frequency of science instruction in kindergarten classrooms through active participation in science methods courses. These courses, thoughtfully designed to address both science content knowledge and effective pedagogical techniques, emerge as potent contributors to bolstering science education during these critical early years. The results underscore the vital role that specialized

training can play in empowering educators to incorporate science concepts seamlessly into their teaching, thereby fostering a deeper and more engaging learning experience for young students.

In the absence of science-related instructional materials, teachers have demonstrated a commendable commitment to incorporating specific science content more frequently in kindergarten classrooms. This finding emphasizes the critical role that the availability of manipulatives and teaching aids plays in facilitating the teaching of science concepts at this early stage of education. A well-stocked supply of science teaching materials can significantly enhance teachers' motivation to introduce fundamental scientific ideas to young learners (Brenneman et al., 2019; Saçkes, 2014; Sheu & Ijaiya, 2017; Yıldırım, 2021). However, studies have highlighted a concerning trend where early childhood teachers tend to underutilize the available science teaching materials effectively when teaching science (Nayfeld, Brenneman and Gelman, 2011) (Saçkes et al., 2011; Tu, 2006). Facilitating successful science instruction during the early years entails purposefully crafting occasions for inquiry, where children engage with age-appropriate materials to observe, predict, and explore solutions to questions (Saçkes, 2014). Hence, science methods courses designed for educators of young children should prioritize imparting knowledge and skills pertinent to the adept utilization of science teaching materials within early education environments. By equipping teachers with these valuable insights, such courses hold the potential to markedly elevate the caliber and influence of science education throughout these pivotal formative years.

Early childhood teachers frequently express a lack of confidence in teaching math and science (Greenfield et al., 2009; Sutton et al., 2009). Certain educators hold the perspective that science holds lesser importance than literacy in preschool education, often feeling compelled to prioritize literacy and social-emotional learning over science instruction (Greenfield et al., 2009; Torquati et al., 2013). Addressing these challenges and providing adequate support for teachers in these areas are crucial to fostering a well-rounded and inclusive early childhood education environment. In comparison with the current study, earlier research findings show a similar pattern regarding early childhood teachers' priorities, favoring literacy and social-emotional learning over science instruction. Consistent with previous studies the current study also reveals that teachers tend to allocate more time to teaching literacy and social-emotional learning compared to science education (Greenfield et al., 2009; Torquati et al., 2013; Tu, 2006). Furthermore, akin to the concerns raised in earlier research, the current study highlights that teachers express a lack of confidence when it comes to effectively teaching science concepts. These shared observations emphasize the importance of addressing the existing challenges in science education during the early childhood years. By implementing measures to achieve a balance between literacy and science instruction and providing adequate professional development opportunities to enhance teachers' confidence in teaching science, we can foster a more comprehensive and supportive early childhood education environment.

Educators who possess confidence in their students' capacity to grasp taught concepts tend to be more inclined to integrate science into their teaching practices. The constrained science instruction observed in kindergarten classrooms could stem from teachers' perceptions that young children may not be adept at learning science effectively. Nonetheless, prior research has extensively established that young children do exhibit the capability to comprehend fundamental science concepts and skills (Carey & Spelke, 1994; Kuhn & Pearsall, 2000; Ledrapier, 2010; Larimore, 2020). To address this issue, science methods courses should focus on emphasizing young children's innate capacities for learning science. By doing so, these courses can increase the likelihood of early childhood teachers including science concepts in their instruction, fostering a more robust and engaging science education experience during the formative years.

In Moroccan preschools, delivering scientific instruction in the national language (Arabic) offers numerous benefits. Teaching science in Arabic enhances children's language comprehension, promotes cultural relevance through local examples, ensures inclusivity for all learners, facilitates

effective teacher-student interaction, and prepares children for a smoother transition to formal education. This approach lays a robust foundation for young learners, fostering their interest and understanding of science from the early stages of education. However, a leading barrier to implementing this approach is the lack of content in the national language. Access to resources with content in Arabic can significantly amplify the benefits of delivering scientific instruction. These resources further enhance children's language comprehension and engagement with scientific concepts, as the content becomes more accessible and relatable. Moreover, having resources in the national language allows educators to seamlessly integrate culturally relevant examples, fostering a stronger connection between science and the children's everyday experiences. Additionally, such resources enable teachers to cater effectively to the diverse linguistic backgrounds of their students, promoting inclusivity and equitable learning opportunities for all

Limitation:

We need to acknowledge several limitations in this study. Firstly, the findings are derived from self-reported data provided by participants. This includes their beliefs about the significance of experiences in various curricular domains, their confidence in conducting activities across different areas, and their perceptions of barriers when implementing science. However, these conclusions do not stem from direct observations of actual classroom practices. To advance our understanding, future research should incorporate observational assessments to measure the frequency, depth, and duration of science activities in early childhood settings. Second, the survey used in this study was purpose-built and should be further refined and validated. Some subscales had limited items due to low reliability. Enhancing the survey's reliability and comprehensiveness will strengthen the validity of future investigations.

The sample's characteristics bring about certain limitations. The self-selection of teacher respondents into the study based on their interest in the subject can impact the general applicability of the findings. However, it's worth acknowledging that if there exists any selection bias favoring participants with a more positive inclination toward science, the outcomes could potentially overstate the significance and confidence in implementing science activities. Notably, despite this plausible bias, the science domain emerged as the least significant in terms of experiences, and participants displayed diminished confidence in this realm. This implies that even in a sample devoid of such selection bias, the ratings for importance and confidence are likely to remain comparatively low.

Acknowledging the recognized constraints, this research offers a distinctive and invaluable addition to researchers' comprehension of the preparedness of early childhood educators for science education involvement. Remarkably, this study stands out as the inaugural endeavor to methodically scrutinize early childhood teachers' perspectives on the significance of experiences, their confidence in executing science education, and the perceived hindrances obstructing the integration of science activities. In accomplishing this, the creation of research tools became an essential undertaking.

CONCLUSION:

This study primarily focuses on exploring teachers' perceptions regarding the importance of learning experiences in science and their confidence in implementing science, especially in comparison with other curriculum domains. Additionally, the research aims to understand the obstacles they encounter while incorporating science instruction in early childhood settings. The findings indicate that teachers have an average level of perceptions regarding the importance of science learning experiences, encounter high levels of challenges, and recognize the significance of effective science teaching practices in early childhood education. The findings revealed that professionals assigned a lower priority to the curricular domain encompassing science when considering experiences for young children. Additionally, professionals expressed lower confidence in implementing science

activities. The leading barriers perceived by the participating early childhood teachers on science integration in teaching included lack of science training, limited scientific knowledge, limiting beliefs about children's ability to learn science, lack of perceived self-efficacy in teaching science, time scarcity, lack of content in Arabic language, and limited access to resources.

To enhance science experiences in preschool settings, empowering educators through investments in resources and professional development is crucial. By providing necessary support, teachers can address negative attitudes, enhance their knowledge, and improve their teaching practices, thus fostering early engagement and proficiency in science among children. This lays a strong foundation for their future success in this vital field.

Nevertheless, it is important to acknowledge the limitations of the current study, particularly its reliance on self-reported variables and the non-specificity of teachers' perceptions to science content. The study's focus on secondary data analysis also neglects the assessment of instruction quality. To advance knowledge in this area, future research should adopt a small-scale interpretive approach, providing comprehensive descriptions of science teaching practices by early childhood teachers. Utilizing mixed methods and diverse data sources, such as classroom observations and teacher perceptions, can offer deeper insights into the state of science teaching in early childhood. These findings will contribute to informed decisions about the quality of science instruction and guide science education training for early childhood teachers, effectively addressing their needs. Overall, such efforts will play a crucial role in promoting high-quality science education in the early years and nurturing children's curiosity and interest in scientific exploration. It is vital to prioritize science in early education to ensure that all students have the opportunity to develop their scientific knowledge and skills, empowering them for future success in a rapidly changing world and across various career paths.

The findings of this study provide valuable insights for designing professional development programs that equip early educators to integrate science effectively into the curriculum.

- Implement Thorough Preservice Training: Mandate robust science courses for preservice elementary education teachers, encompassing effective science teaching methodologies and substantial teaching experience through consistent field engagement.
- Prioritize Science in Professional Development: Infuse current scientific knowledge into staff development programs, with a special focus on early childhood education teachers who often express a demand for professional advancement, especially in the realm of science.
- Allocate Resources for Science Equipment and Materials: Reassess budget allocations and explore funding options to modernize science equipment and ensure ample supplies for engaging science activities.
- Adopt Comprehensive Science Curricula: Embrace comprehensive published science curricula that provide structured lesson plans and classroom materials to facilitate effective teaching.
- Foster Collaboration and Expertise Exchange: Collaborate with district personnel possessing science expertise or partner with cooperating teachers, such as special educators, to promote interdisciplinary teamwork.
- Integrate Science Across Disciplines: Weave science concepts into other subjects to highlight interconnections and deepen students' grasp of science within real-world contexts.
- Emphasize Core Concepts: Enhance the efficiency of science instruction by spotlighting fundamental concepts that address multiple standards concurrently, fostering deeper learning.

- Develop a Sustainable Implementation Strategy: Formulate a long-range blueprint for science curriculum implementation, ensuring consistent and coherent science instruction rather than sporadic activities.
- Address Classroom Management: Implement effective classroom management techniques, including positive reinforcement, adherence to laboratory rules, visual and verbal reminders for regulations, and thoughtful transition management.
- Cultivate a Mindset Shift: Encourage a shift in mindset among teachers, administrators, and policymakers, acknowledging and prioritizing the value of early science education.
- Reevaluate and Innovate Science Teaching: Motivate educators to revisit established effective methods while exploring novel strategies, approaches, and resources for enhancing science instruction.
- Enhance Early Childhood Education with Arabic Scientific Content: Invest in developing Arabic-language scientific content and educational resources tailored for early childhood education, fostering inclusive and accessible science learning experiences for Arabic-speaking young learners.
- Engage in Reflective Practice: Promote critical self-reflection among teachers to contribute to an ongoing dialogue on refining elementary science instruction.

Authors Contributions

Phd OUABICH Raja: Conceptualization, design, data acquisition, data analysis and interpretation, drafting manuscript

Pr. TIFROUTE Lahcen: Conceptualization, critical revision of manuscript

Pr. RAFOUK Leila: Conceptualization, critical revision of manuscript

Disclosure Statement

There are no conflicts of interest to declare in this study.

Ethical Approval

All procedures involving human subjects in this study adhered to the ethical standards set by institutional and/or national research committees, in accordance with the 1964 Helsinki Declaration and its subsequent amendments or other relevant ethical guidelines. Furthermore, informed consent was secured from all adult participants.

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