



Science for Fun: Parent–Preservice Partnerships that Build Science Capital in Primary STEM

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Abstract

Effective primary STEM education increasingly depends on approaches that connect scientific concepts to children’s lived experiences through purposeful collaboration between teachers, families and communities [1]. Creating these kinds of connections requires structured, relational approaches that make science accessible, relevant and shared across home and school contexts. The Science for Fun (SFF) programme leverages school–family–university partnerships to support primary STEM learning and broaden participation among underrepresented communities [2, 3]. Situated in three Irish primary schools, the programme positioned parents as co-facilitators alongside preservice teachers during hands-on workshops on electricity and magnetism. Drawing on science-capital theory and inclusive STEM pedagogy [4], the intervention aimed to increase children’s confidence, motivation and engagement while strengthening parents’ science capital and preservice teachers’ competencies in family–school partnerships. Using a phenomenological approach, data were gathered from reflective questionnaires (N = 23) completed by preservice teachers following each workshop. Parents were also interviewed during and after the SFF sessions (N=16). Thematic analysis revealed substantial attitudinal shifts: the pre-service teachers moved from apprehension to viewing parents as instructional partners; they reported improved communication skills, increased awareness of diverse family contexts and deeper appreciation of parents’ contributions to STEM learning [5]. Parents’ presence was perceived to boost pupils’ confidence, persistence and enjoyment of science, reinforcing research indicating the positive influence of family engagement on STEM outcomes. Similarly, parent feedback showed an increase in their confidence and learning through participation, the positive effect on the children’s engagement and enjoyment with science and the value of school–parent relationships. The study illustrates how curriculum-aligned STEM outreach can reduce barriers to participation for disadvantaged and ethnic minorities and also identifies replicable design principles. The findings support international calls to embed authentic school–family partnerships within teacher preparation and to adopt science-capital-informed approaches that make STEM relevant, familiar and accessible to all learners.

Keywords: *parent engagement; primary STEM; science capital; preservice teacher education*

1. Introduction

Strong partnerships between families, schools, and communities have consistently been shown to enhance student achievement and promote educational equity, particularly in STEM [1,6]. At primary level, these partnerships help connect abstract scientific ideas with children’s and families’ everyday life and experiences. The Science for Fun (SFF) programme responds to this imperative by structuring parent–preservice teacher co-facilitation of hands-on science workshops in Irish primary schools, with a particular focus on communities historically underrepresented in STEM. Within this model, parents are not merely visitors but instructional partners, while preservice teachers learn to design and mediate learning with, rather than just for, families [1,6,7]. Programme design and interpretation are explicitly informed by science capital [4], foregrounding the practices, resources, and identities that shape how science becomes meaningful for individuals and communities.

This paper reports on an SFF implementation across three primary schools, featuring workshops on electricity and magnetism co-facilitated by parents and preservice primary teachers. It examines preservice teachers’ reflections and parent feedback to understand how participation influenced attitudes, confidence, and engagement, and how the approach supports inclusive, curriculum-aligned STEM outreach.



2. Family–School Partnerships in Teacher Preparation

Extensive research across a range of subject areas and grade levels conducted with diverse populations confirms that student learning in specific subjects is positively influenced by family engagement activities in those subjects [6,1]. (Epstein 2018; Sheldon 2019). Epstein’s framework positions families as essential partners whose knowledge and roles should be intentionally integrated into schooling, not treated as peripheral [6]. Sheldon (2019) provides empirical evidence linking partnership practices with improved student outcomes, emphasising structured, reciprocal engagement rather than ad-hoc involvement [1].

However, building cooperation with families has been identified by beginning teachers as one of their greatest challenges [8,9,10,11]. Therefore, initial teacher education and professional development of teachers has an important role in developing teachers’ competencies in this area [12]. Recent policy for reaccreditation of all teacher education programs in the Irish context has identified “professional relationships and working with parents” [13, p14.], as a compulsory area of study, and implementation of those programs is now underway so there is an immediate need to develop research-based practice [14,15]. The SFF programme aims to help support both pre-service and in-service teachers’ competencies in building partnerships with families through hands-on engagement with science. This in turn can have an influence on an individuals’ and families’ science capital.

3. Science Capital

Archer et al. (2015) conceptualize science capital as the science-related knowledge, attitudes, experiences, and social contacts that shape a learner’s relationship to science [4]. Science capital can be affected by a variety of factors and experiences, including a learner’s science-related knowledge and attitudes, their engagement with science in everyday life, the science-linked resources and encouragement available within their family, their participation in formal and informal science learning opportunities, and the social networks and relationships that connect them to people who work in or value science (Archer et al. 2015). Seebacher et al. (2021) found that students develop a highly positive science attitude if they experience supportive social environments, intrinsic motivation, science learning in school, as well as regular engagement in arts-based learning and self-directed science learning [16].

4. Programme Context and Design

The SFF programme was delivered in three Irish primary schools. The three elementary schools involved in the Science for Fun program were selected based on their location in socio-economically disadvantaged areas. All three schools have been designated as DEIS Urban Band 1 schools, indicating that they are among the most disadvantaged schools in the scheme. Each school serves a substantial population of children from the Irish Travelling community, who were the key group we aimed to support through this programme.

Parents were invited to actively co-facilitate hands-on workshops, working alongside preservice teachers, that were focused on electricity and magnetism. The topics were chosen for their accessibility and alignment with the Irish primary science curriculum, and their potential to strengthen family-level science capital.

The programme’s low-cost materials and station-based format supported inclusive participation and adaptability across settings. The design aimed simultaneously to: (a) increase pupils’ confidence, motivation, and enjoyment in science; (b) strengthen parents’ science capital; and (c) develop preservice teachers’ competencies and skills for engaging and working with families.

The program was designed and delivered by academics in Sociology and Educational Disadvantage (N = 1) and STEM education and outreach (N = 2). It also involved preservice elementary teachers (N=23), in their third year of a four-year undergraduate degree, taking an elective course devoted to developing understanding and competencies in building family, school and community partnerships.

5. Methodology

A phenomenological qualitative approach was used to capture participants lived experiences of partnership in the SFF context.



Data collections involved:

- Preservice teachers (N=23): After each workshop, preservice teachers attended focus groups and completed reflective questionnaires capturing perceptions of parent participation, child engagement, and their own learning about family–school partnerships.
- Parents (N=16): Supplementary parent feedback was gathered during the SFF workshops. The semi-structured interviews with the parents explored their prior classroom experience, confidence with science, and experience of participating in the SFF programme.

6. Findings

6.1 Preservice Teachers: From Apprehension to Partnership

The reflective questionnaires reveal a marked attitudinal shift where preservice teachers reported moving from uncertainty about involving parents to seeing them as instructional partners who enrich children's learning. They described improved communication, greater sensitivity to diverse family contexts, and a deeper appreciation of parents' unique contributions to STEM learning. Collectively, they perceived that the presence of parents boosted pupils' confidence, persistence, and enjoyment of science.

These findings resonate with partnership frameworks [6,1] and suggest that learning to teach with parents is itself a critical teacher-education outcome [5].

The programme highlighted the value of preservice teachers learning with parents, as the design required them to mentor, collaborate with, and co-facilitate science activities alongside parents — a process that helped preservice teachers recognise parents as knowledgeable partners in children's learning

6.2 Parents' Experiences and Perspectives

Parent feedback showed an increase in their confidence and learning through participation. They also highlighted the positive effects on the children's engagement and enjoyment with science and the value of school-parent relationships.

Many parents entered apprehensively, often citing limited prior experience: *"I never did science before and I'm not very good at it"*.

The parents' engagement at the workshops reduced their anxiety and the facilitator role supported their learning: *"I am learning a lot. I didn't know all this science."*

Parents emphasised the children's engagement and enjoyment: *"The children are really engaged."* and *"the kids are thinking"*. Parents that had initially identified feeling low in confidence about doing science activities with the children, still reported positive engagement.

All the parents stated that they valued the school relationship and that they *"Love coming in to the school"* and *"like being involved at school."*

Together, these perspectives show that SFF simultaneously deepens children's engagement in science, strengthens parents' confidence and science capital, and enhances preservice teachers' partnership competencies — creating a mutually reinforcing triad that sits at the heart of inclusive STEM practice [1,3,4,5]. Several programme features appear especially pivotal in driving this impact, including:

- Hands-on, station-based activities that encourage guided co-exploration: children, parents, and preservice teachers engaged together in practical investigations of electricity and magnetism, allowing all participants to learn through shared discovery
- Visible and purposeful roles for parents as co-facilitators in the learning process: Parents were not passive participants — they were actively prepared in dedicated information sessions and then invited to co-lead stations, positioning them as co-educators and affirming their expertise
- Preparation for preservice teachers that emphasised learning with parents: Preservice teachers were participating in a module on working with parents, increasing their comfort and competence in engaging parents in science learning
- Parent–Preservice teacher information sharing sessions that built confidence and shared understanding: short pre-workshop sessions allowed parents and preservice teachers to explore scientific content and pedagogy together, strengthening relational trust and shared ownership of the learning experience
- Clear alignment with curriculum goals, ensuring relevance and continuity between home and school



- Home-extension opportunities that continued to build science capital: STEM kits were sent home to encourage continued family engagement with science, reinforcing the idea that science learning can happen beyond school and within everyday family contexts

7. Discussion and Conclusion

The findings from this study demonstrate that Science for Fun (SFF) offers an effective model for integrating family–school partnerships into initial teacher education while simultaneously supporting children’s science learning and family engagement. For preservice teachers, participating in co-facilitation with parents shifted initial apprehension toward an appreciation of parents as instructional partners. Through structured opportunities to collaborate with families in classroom contexts, preservice teachers developed greater confidence, communication strategies, and sensitivity to diverse family experiences.

Parents, many of whom began the programme with limited confidence in science, reported increased ease, curiosity, and enjoyment in engaging in hands-on science activities alongside their children, even among those with initially low confidence or limited science experience at home. Their involvement not only strengthened their own confidence and added to their science capital, it also reinforced positive relationships with the school. Parents consistently noted the heightened engagement and perseverance of their children during the workshops, highlighting the importance of supportive intergenerational learning environments.

Overall, the SFF programme highlights how embedding structured family engagement within teacher preparation can address recognised gaps in teachers’ readiness to work with families, while simultaneously contributing to more equitable STEM learning opportunities. The programme offers a scalable model for schools seeking to strengthen partnerships and broaden participation in science.

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