The role of parents in promoting their children's interest in science through engagement with informal science learning

Parent and daughter at the 'plants under the microscope' session in July 2023.

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Abstract

This article explores an example of a family-oriented approach to science education. We consider the Saffron Science Club and the role of parental participation in enhancing the educational experience for both children and parents*. The Nottingham-based science club has been running since 2022 for families living in the locality, aiming to promote science to the community directly in an informal, out-of-school setting. Having set up the Club to support family engagement, we then evaluated and reflected on its impact. This article outlines both the establishment of the Club and our evaluation of it. By involving parents in the learning process, we wanted to see if this approach could lead to deeper-rooted connections within the community, creating a family feel in the engagement process, with the parents as active agents in promoting children's interest towards science learning. Informal dialogue with the families during the sessions informs our reflections on the process.

*Please note that the term 'parents' is interchangeable for parents/carers/ grandparents.

Keywords Informal science, parent participation, science engagement, science clubs

Introduction

Saffron Science Club began in the summer of 2022, running for one hour on a Saturday morning, once a month, in a library in the Meadows region of Nottingham. We chose the library as it serves as a vital community hub; the library is a Carnegie library, turned 100 years old in March 2025, and is well-loved by the local community. The library allows access to children attending three local primary schools and their families as an important after-school location for clubs and other library services. In Nottingham, one fifth of the population was income-deprived in 2019. Of the 316 local authorities in England, Nottingham is ranked as the 17th most income-deprived (Office for National Statistics, 2023). In terms of deprivation, approximately two thirds of residents in the Meadows region rent their homes. The Meadows residents have a lower level of formal qualifications compared to the national average, with approximately one third of residents having been born outside the UK (iLiveHere, 2021).

The Saffron Science Club's focus is to bring working scientists face-to-face with families, within an accessible, friendly local setting. Over the past few years, we have created a rolling programme. The Club runs monthly on the third Saturday at 11.00am until noon. We can cater for approximately ten children and their families.

We have found variation in engagement with the sessions during the year; for example, sometimes there are low numbers due to school holidays, celebrations of festivals, or a clash with another event running in the local area. There is some consistency in the attendance of the families, but there is also transition of the families moving to other areas of Nottingham, or to another country. Also, when the children move on to secondary school, they are reluctant to continue attending the sessions with their parents. We have high ambitions for the Club going forwards; for example, we aim to forge stronger links with the University of Nottingham's outreach programme to enable a visit to the University's campus. In addition, we also intend to reach out to the local initiative, City as Lab, to build stronger links with Nottingham City's 'Child Friendly City' initiative.

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We have considered Bronfenbrenner's Ecological Systems Theory (1979) when attempting to understand the educational impact of their surroundings on a child. The mesosystem is one of the five environmental systems in this theory, and represents the interactions between different microsystems in an individual's life, for example, the relationship between a child's home and school environments. We wanted to see to what extent these interactions can influence the family's engagement with their child's learning of science. Bronfenbrenner's Theory (1979) highlights the importance of wider systems and connections within a community for the children's learning. It explains that learning is not isolated but is linked contextually, and this is impacted by learning through the community and environment. The Saffron Science Club's focus is on informal learning within the community and whether this could impact on learning within the home and the wider community.

Parents play a powerful role in their children's education and future aspirations (Joy *et al,* 2021). Our aim was to establish a science club in the heart of a diverse community. We wanted to bring science to the families in an easily accessible format, which added meaning to their everyday lives. One of the strongest aims was to link the learning to the National Curriculum (DfE, 2013). We wanted the children to be able to make contextual links between learning at the Club and their learning in school. Our Club distinguishes itself from others by strongly emphasising the linking of new learning with existing knowledge, with learning experiences designed to connect with the prior learning from the National Curriculum (the theory of constructivism will be discussed later in the article). We aim to make learning enjoyable and engaging, but it is crucial that it remains relevant to the children's existing knowledge and goes beyond isolated enrichment sessions. Our mission is deeply rooted in extending and building upon the children's current knowledge incrementally. We ensure that learning is connected to everyday life and the local community, with the aim of supporting the children to learn more and remember more by building knowledge into their long-term memory (Sweller, 2011).

The Sutton Trust (2021) has reported interesting findings on social disadvantage and links to social mobility within the higher education sector: *'Disadvantaged young people who didn't attend higher education were also much more likely to end up in the lowest income groups'.* Higher education is a key driver of social mobility in this country. Young people from less affluent backgrounds who attend university are more likely to move into higher income brackets (The Sutton Trust, 2021). As academics in higher education, we wanted to provide opportunities for both children and their parents with the session. We interacted with the families and encouraged everyone to join in with the activities.

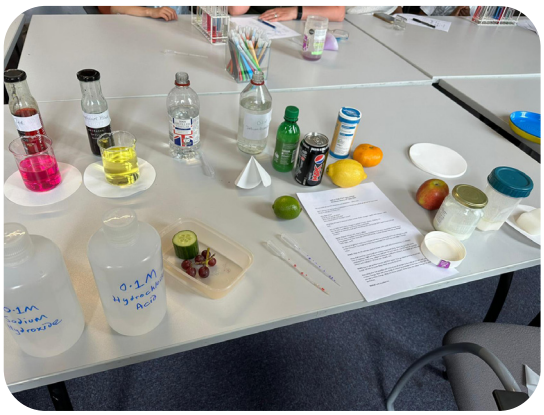
Our sessions made direct links to everyday life; e.g. the acid and alkali session linked to the colour of a rhododendron's petals, pink or blue, depending on the acidity of the soil. We looked at familiar plants and flowers under the microscope to make observational drawings and talk about the colours and textures seen at a magnified view.

Overview of last year's sessions

The Saffron Science Club 2024-2025		
20th Jan	Tim Self, Laura Kilpatrick, Robert Marcus	Food, bugs and things that glow
17th Feb	Dr Jamila Hussain	Vibrations and sound
16th Mar	Dr Mattea Finelli	How your brain works– making your own brain cells
20th Apr	Prof Reg Dennick	Potato electricity
18th May	Dr Vince Wilson	Electric circuits
15th June	Dr Vince Wilson	Electric circuits – resistors
20th July	Dr Michael Garle	Natural history/rocks
17th Aug	David McMahon, Tom Hartman	Pollinators and flowers Photographing specimens in jars. How good are my toys? The science of dinosaurs
21st Sept	Prof Reg Dennick	Chromatography
19th Oct	Tim Self	Microscopes/raspberry pi

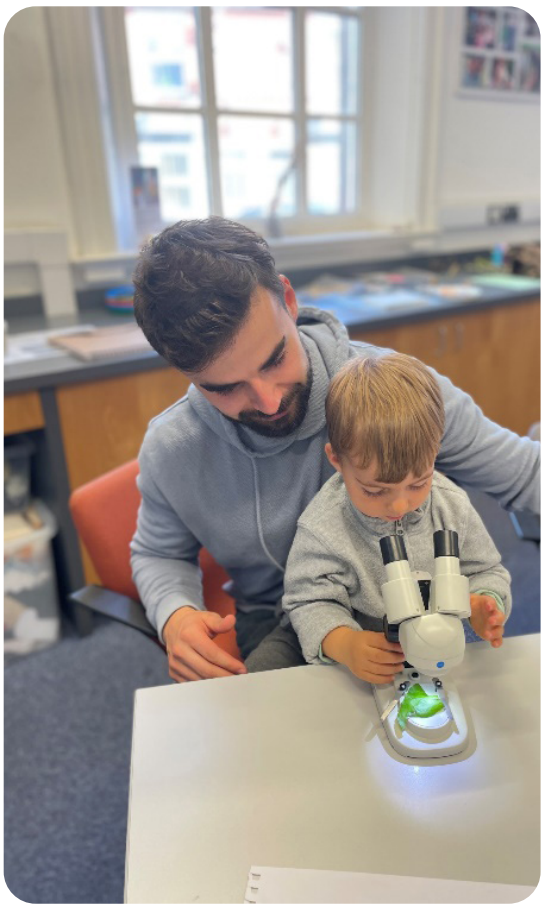
All the contributors are working scientists, either employed at, or former employees of, the University of Nottingham. Jamila Hussain is an alumnus of the University of Nottingham, currently working as a Senior Lecturer at Bishop Grosseteste University.

Professor Reg Dennick at the acid/alkali pH session, June 2023.

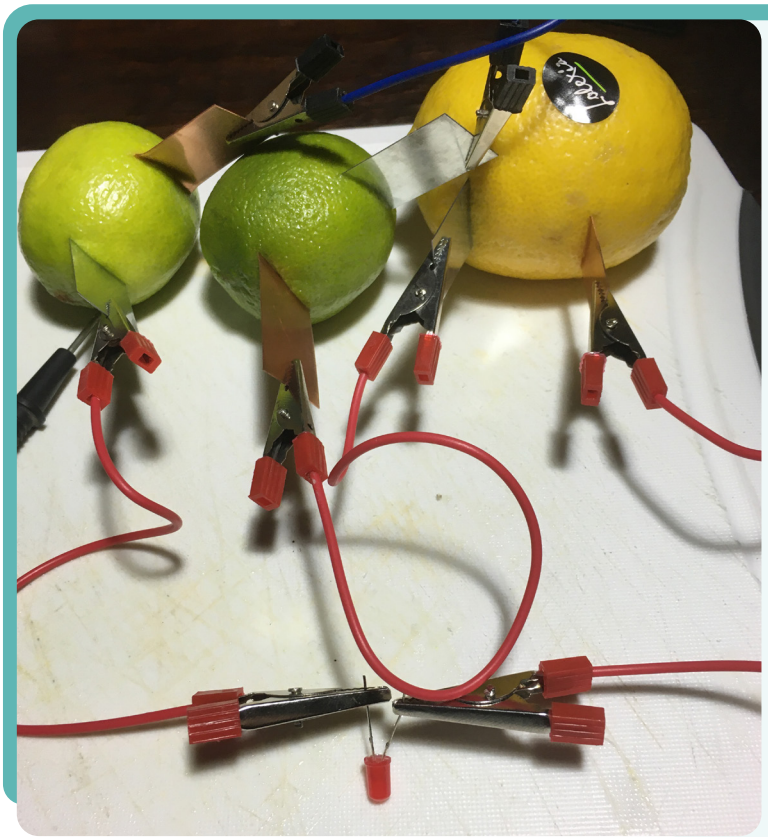


The library's room capacity was sufficient for up to ten children and their parents/carers. Children attended with parents, grandparents and other extended family members. We had children as young as two years attending, right up to age eleven years.

Looking at plants using confocal light microscopes loaned by The Royal Microscopic Society, October 2024.



Electricity from fruit, April 2024.



We encouraged all attendees to join in with the hands-on learning (Montessori, 1964): for example, designing electrical circuits using fruit and making a model of a neural pathway with play dough.

Our pedagogical approach was to use children's prior knowledge to make connections to new learning (Vygotsky, 1972; Piaget, 1978; Bruner, 1960). We wanted the children to understand how they could link their existing understanding of the world with new learning, through step-by-step instructions and the introduction of new knowledge in accessible chunks, adding to their existing schemas (Piaget, 1952). By involving parents in the learning process, we wanted to see if this approach could lead to much deeper-rooted connections within the community, creating a family feel in the engagement process. We engaged with the parents and attempted to draw them into conversations and discussions about the science. We explored how the parents could act as active agents in promoting children's interest in science learning (Bruner, 1960; Halim *et al,* 2017). We wanted the parents to see themselves as *'the more knowledgeable other'* alongside the scientists who delivered the sessions (Vygotsky, 1978).

Methods

We now move to discussion of our research that emerged from the set-up of the Club.

The primary aim of our work was to explore the effectiveness of engaging parents alongside their children with science learning. Having set up the Club, we then wanted to determine whether this approach could make learning family-oriented, to see if parents could become co-creators in their children's journey of acquiring science knowledge.

Our research questions included:

1. Can a family-oriented approach to science education develop deeper connections within the community?
2. What role does parental participation play in enhancing the educational experience for both children and parents?

We obtained ethics approval through Bishop Grosseteste University to collect views and voices from the children and the families. We carried out the sessions with the intent of focusing on the parents as much as the children. This was an exploratory, investigative project, which gathered data through in-person, face-to-face interactions and observations with the parents and their children who engaged with the Saffron Science Club**.**

During the actual sessions, the scientist delivering the learning focused on the teaching and learning aspects of the science being introduced. The supporting academics observed, informally, the engagement with the activities and the interactions within the families and between the families and the scientists. Additional data were collated through questions posed directly to both children and the families about their views and perspectives of science education, after the sessions had finished.

Informal interviews were also conducted as conversations and informal dialogue throughout the sessions. Children were asked about their engagement with the sessions and aspects of the science activities that they found to be most interesting, and their future aspirations with respect to careers in science or STEM. The observations carried out in the sessions also involved taking photographs and note-taking, and incidental conversations about parents' own lived experiences of science learning.

There were insufficient data generated for thematic analysis or pattern identification from the very small numbers agreeing to participate in this study (n=7 for the children, n= 5 parents), so we have presented emerging themes and issues as findings. The sessions consisted of different families attending; on occasion, we had the same children and families attending different sessions.

"This was an exploratory, investigative project, which gathered data through in-person, face-to-face interactions and observations with the parents and their children who engaged with the Saffron Science Club."

Data from practice

Finding 1

Session feedback highlighted that parents who received their education outside the UK found that a holistic approach to understanding science formed the basis of their science education in school. One parent who has spent two years in the UK stated: '*In primary school, when studying plant growth, we also looked at the long-term benefits on the environment…as well as health benefits of eating plants. At secondary school, we learnt about a pollution-free environment…using electric cars…and looking at alternative fuel sources…rather than fossil fuels…*' (the quotes have been translated and/or paraphrased).

Finding 2

When parents who received their science education outside the UK reflected on their experiences of science whilst growing up, they reported that an immersive home experience, where science was embedded in daily life at home, provided context to formal learning. For example, two parents, born outside the UK, stated: *'Growing up, we kept animals such as goats, chickens, rabbits and dogs. We grew green chillies, mangoes, aubergines and pumpkins. We pickled cucumbers and carrots. We made our own yoghurts and jam'*. We discovered a sense of a wealth of incidental science knowledge linking home experiences to school education from the parents who were born outside the UK.

"Growing up, we kept animals such as goats, chickens, rabbits and dogs. We grew green chillies, mangoes, aubergines and pumpkins. We pickled cucumbers and carrots. We made our own yoghurts and jam."

Finding 3

UK-born parents discussed their views on science education as children and as adults. These parents reflected on their early life struggles with learning science as children at school. They went on to discuss how this early experience impacted on their confidence and views of science later in life as adults. For example, two parents stated that early life experiences had impacted negatively on their views of science today; they also stated that, because of their schooling experiences, they found relating to science hard as adults.

Finding 4

Discussions with the children highlighted their ambitions to have a career in science (teacher, doctor, dentist). There was no talk about other routes within science, such as a research scientist. Children are exposed to the roles of dentists and doctors from a young age, at home and in school, meaning that children are more easily able to identify with these roles as potential careers for themselves. One Year 6 (age 11) child stated: *'I would like to become a secondary school science teacher…because I have always wanted to do science stuff with children…big children in secondary school understand more…I would like to learn about the hard bits of science, e.g. how some animals became extinct, how long does it take for an astronaut to get to the moon…why do leaves come off trees?'* Another Year 6 child said: *'I would like to become a haematologist, talking to a doctor…would help me decide'*. Another Year 6 child: '*I would like to become a dentist…visiting people in their place of work would help me decide'*.

Finding 5

The children expressed various requests for what they would like to see more of in their science sessions. From the seven children, we had a range of answers: e.g. *'cooking/healthy food/food-tasting/making ice cream, melting chocolate, having visitors, making something fun, planting, building a bug hotel/building circuits, more outdoor learning, learn about germs, practical experiments of everything'*. These results reinforce Ofsted's (2021) findings of relevant practical experiments to reinforce children's learning. Johnston and Tunnicliffe (2014) also reported the importance of *'hands-on science-based activities providing "practical experience" of scientific phenomena'*. The fun element of a club setting was also highlighted by Burke *et al* (2021).

Finding 6

Reflecting on the Saffron Science Club sessions since the summer of 2022, we have observed parental interactions with the activities and with their children. Sometimes the parents have been hesitant to join in, then, towards the end of the session, they have found themselves in competition with their children, for example, making observational drawings from a microscope, or making a picture from fruit that lights up under UV light. It has been interesting to see the parents in the role of learners themselves; as reported by Watts (2000), *'both children and adults grew in enthusiasm, excitement and enjoyment…'.*

Finding 7

We also noted the powerful role that language plays in science communication, not only when introducing activities to the families, but also when asking them to follow clearly defined step-by-step instructions. We need to dedicate more time to the language aspect of science learning in the future; suffice to say, a large bank of scientific vocabulary would be clearly beneficial and supportive in producing more in-depth dialogue and discussion about our sessions. We know that language plays a definitive role in enabling children's acquisition of knowledge of the world at any stage of early development (Nelson, 1998).

Dr. Michael Garle and a 'Rocks' session, June 2024.

Discussion of findings

It is important to acknowledge that the families participating in our science club have made an active choice to attend, indicating a pre-existing interest in science. Consequently, our findings are representative of these engaged families and cannot be generalised to all families within the Meadows community. The data reflect a selective, purposeful sample of those who chose to participate, rather than the entire population of the area.

After running the science club sessions for over two years, we realised that, to engage the children and their parents in the learning process, we needed to maintain the informal learning atmosphere (DeVille, 2024). We engaged the families with purposeful science learning (Bevan *et al,* 2019; Ofsted, 2021). They related everyday objects to science, e.g. looking at broccoli and lettuce leaves at a magnified level, seeing the colours in felt tip pens, and using investigations to find out whether predictions were true or not. In the floating and sinking session, the children became researchers and developed their scientific literacy. Holbrook and Rannikmae (2009) highlighted important aspects that reflect Saffron Science Club's core values with family engagement, namely, enabling a positive attitude to science, recognising science's societal impact, e.g. development of the COVID vaccine, and the interdisciplinary nature of science within STEM and the creative arts (Aguilera & Ortiz-Revilla, 2021; Vincent-Lancrin *et al,* 2019).

Plants and Light session, July 2024.

We realised the importance of dialogue between the children and their parents (Alexander, 2008), and the value of continuing these conversations at home, with *'dyadic conversational turn-taking at home'* in addition to the importance of *'decontextualised language* ***leading****... to conversations that are longer and more sustained'* (Leech *et al,* 2021). Furthermore, these authors conclude that, when parents engage with their children in extended conversations during everyday opportunities, this leads to building strong language skills in early childhood. Language proficiency is particularly important in the early years for children's attainment; e.g. only 43% of those pupils who were recorded as being new to English achieved a good level of development at the end of Reception compared to 88% of those who were recorded

as fluent in English (DfE, 2020). Parents who engage in more conversations with their children encourage the children's language skills development and related vocabulary and academic language abilities, moving from the social to more formal learning (Cummins, 1979, 2001). This is particularly crucial for children who are disadvantaged, or have been disadvantaged by the impact of the pandemic (Pascal *et al,* 2021).

Although we agree that hands-on practical activities that relate to the daily lives of the families support new science learning (Hainsworth, 2017), we also focused on the use of decontextualised scientific vocabulary in future sessions, for example, 'specimen' when referring to a petal on a microscope slide, 'light microscopy, magnification' and words such as 'chromatography' and 'infra-red/ultra-violet radiation'.

The findings regarding differences in children's responses based on their parents' views were ambiguous. Some children showed greater interest and engagement in the sessions when their parents were more interested, and *vice versa.* However, the alignment between children's and parents' views on science was inconsistent and not explicitly measured. This could be an area for future investigation, to determine if and how parental interest influences children's engagement.

In conclusion, our preliminary findings support the importance of working with parents to promote their children's interest in science activities. This may lead to enhanced interest in pursuing careers in STEM-related fields. Indeed, a study by Tiza *et al* (2021) concluded that that evoking participant interest and engagement is best practice to increase interest in STEM fields. The study also illustrated the importance of providing participants with freedom of choice, and making an activity playful also made the topic more accessible. This is the basis of Saffron Science Club's sessions. We hope that the holistic approach of family engagement instigates science conversations that are continued in the home and when the family visit places in their localities. We will pursue the use of scientific language in both contextual and decontextual pedagogies to promote the development of accurate scientific language. We will promote the importance of language for science (Hussain, 2021). We will spend the upcoming sessions exploring how children are influenced by extrinsic motivators (factors such as parental advocacy and educator praise), and wholly or partly intrinsic motivators, where they take the lead/initiative to direct an interest in a chosen area themselves for the motivation for and pride in what they have accomplished (Ryan & Deci, 2000).

Conclusion: Addressing research questions

Can a family-oriented approach to science education develop deeper connections within the community? Our findings suggest that engaging both children and parents in science education can promote stronger community ties. The family-oriented approach can encourage shared learning experiences and sustained conversations at home.

What role does parental participation play in enhancing the educational experience for both children and parents? Parental participation plays a crucial role in enhancing the educational experience by promoting active engagement and interest in science. When parents are involved, they can support and extend their children's learning, leading to improved language skills, scientific literacy and a positive attitude towards science. This collaborative approach also helps parents to become co-creators in their children's educational journey, making the learning process more meaningful and impactful.

Next steps

In the upcoming year, we will focus on children's science identity. We recognise that children from under-represented groups often lack visible role models within scientific fields; this is partly due to the current curriculum (DfE, 2013). We also acknowledge that there is a diminished identification with STEM disciplines as viable career pathways, other than medical routes (doctor/dentist). We will try to address this in forthcoming sessions. A focus on language is also an important consideration for us – we want *'to increase adult comfort and confidence with family science'*. We will aim to further promote parental conversations to increase children's scientific dialogue.

To support family science and serve the community, we need to tap into the rich resource of science capital that families have to offer by giving parents a platform for 'family science' fun. We will attempt to promote parents' confidence in their own ability to support emergent scientific thinking with their children, by giving them a sense of empowerment and recognition of themselves as contributors.

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