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Enhancing STEM Engagement in Primary Education: Insights from a National Outreach Programme Review

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Abstract

This paper presents findings from a comprehensive review of a national STEM outreach initiative designed to foster engagement and awareness of science, technology, engineering, and mathematics in primary schools [1a,2] The study explored the programme's design, delivery, and impact on learners, teachers, and school communities, as well as its role in promoting high-quality STEM education experiences [3]. Using a mixed-methods approach, data were collected through focus groups with teachers, pupils, parents, and facilitators, alongside a nationwide teacher survey (N=36). Findings indicate that participation in the initiative significantly enhanced teacher confidence in delivering inquiry-based STEM lessons, encouraged whole-school collaboration, and increased children's awareness of STEM in everyday life and future careers. The programme's structured framework and professional development supports were identified as key enablers of integrated STEM teaching. However, challenges emerged around workload, evidencing requirements, and the need for updated resources and greater parental involvement. Recommendations include streamlining application processes, expanding professional development opportunities, and strengthening links between schools, industry, and outreach centres [4,5] This review highlights the importance of sustained, inclusive, and contextually relevant STEM outreach in building science capital and supporting national education policy goals [6,7] The findings provide actionable insights for policymakers, educators, and outreach providers seeking to embed authentic STEM learning experiences in primary education.

Keywords: *STEM education, primary schools, outreach, professional development, science capital, inquiry-based learning*

Introduction

There has been a growing commitment to developing science, technology, engineering and mathematical (STEM) competencies and skills at policy level internationally. In Ireland, a STEM Education Review Group, was established in November 2013, to review STEM education in the Irish school system, which lead to creating a vision for STEM education that will "*provide students in Ireland with a STEM education experience of the highest international quality; this provision should underpin high levels of student engagement, enjoyment, and excellent performance in STEM disciplines*" [8, p6]. As a result, 2017 saw the publication of the STEM Education Implementation Plan 2017–2019 and the STEM Education Policy Statement 2017–2026 [1a,b]. The STEM Education Policy Statement committed to delivering the highest quality STEM education experience for Irish learners through nurturing curiosity, inquiry, problem-solving, creativity, ethical behaviour, confidence, and persistence, across all levels of education [1b].

The Policy acknowledged that there are many strengths in the current STEM provision in Ireland. Nonetheless, a number of challenges existed also. A need was identified for STEM learning to improve by way of developing "*skills such as problem-solving, inquiry-based learning and team working to address demands from the world of work*" [1a, p10). In order for this to be achieved, it was acknowledged the need to adopt best practices in STEM education through developing partnerships and links between formal and non-formal education providers (SFI Strategy 2025: Shaping Our Future; Report of the STEM Review 2009). These partnerships allow educators to explore future skills needs and equip education and training providers with the skills and support to provide a quality learning experience. The policy sought to establish increased partnerships and collaborations between many stakeholders from STEM industries, business and education. By their nature STEM education

outreach initiatives are being delivered through partnerships between schools, outreach organisations, universities and industry etc. This provides a mechanism for linking curriculum content and real-world contexts [11].

The need to review of STEM outreach programmes

The STEM Education and the Irish School System report acknowledges that there is a highly active informal STEM education sector in Ireland [8]. STEM outreach involves many stakeholders with many agendas, aims and goals. Outreach is provided by a range of universities, businesses, industries, voluntary organisations, professional STEM outreach institutions, teachers and learners, employers, science centres and government bodies, delivering both formal and informal educational outreach initiatives [9]. STEM outreach programmes for schools, therefore, involve a wide variety of stakeholders, formats, goals and pedagogies [10]. As a result, there can be many challenges to the successful development and implementation of such programmes [12]. It is therefore important that outreach projects are continuously monitored and reviewed with a strong commitment to leadership and partnership engagement, clear metrics, highly developed data collection methods and strong accountability. Evaluation is a very important process for any STEM educational outreach project. It helps to identify what is working well in a project, challenges and possible adaptations and changes that can be made moving forward. SFI's Evaluation Tool Kit states that "*evaluation is a structured learning or research process that helps to identify what is working well in a project, and what can be done to improve your work even further. It can help you to see the value of what you are doing, and establish the people and participants you already work well with, or those who you are missing and would like to work with more*" [13, p1].

To date, most research regarding STEM outreach programs has been limited to investigating the implications of specific programs. Most research looks at data but does not drill down into the data, critically looking at aims, objectives and impacts, leading to a lack of comprehensive research regarding STEM outreach as a form of informal education. However, it must be noted that measuring the impact of these programs is rarely explored due to inherent difficulties in conducting long-term evaluations.

Evaluation of STEM outreach

All effective models of STEM outreach emphasise the important role of ongoing cycles of evaluation that are incorporated from the initiation of a programme [9,13, 14, 15]. Evaluation plays a critical role in informing the next cycle of programme delivery, allowing for improvements and adjustments to be made [15]. Therefore, evaluation provides the foundation of planning, implementation and a continuous improvement cycle which leads to sustainable STEM Outreach.

Despite ongoing support and investment in STEM educational outreach programmes, evaluation of their outcomes and long-term impacts of STEM outreach programmes are largely absent from research literature [16]. Gomes and McCauley (2012) found that many science outreach and communication initiatives in Ireland have not established a systematic evaluation toolkit to explore the impact of their programmes with their target audiences [17]. The only means of exploring the impact beyond the initial enjoyment of the STEM outreach activities is to carry out a thorough evaluation involving all stakeholders.

The aim of this research was to review a National STEM outreach programme delivered in primary schools across Ireland. The review involved exploring the following:

- The design, delivery and implementation of the programme.
- The impact of the programme in raising STEM awareness among school communities and beyond (pupils, teachers, parents and guardians).
- The role of the programme in enhancing, embedding and realising the provision of a high-quality STEM education experience for learners.
- Recommendations for the future development of the Programme.

For the purposes of this brief paper. A summary of findings will be reported on the following: particular:

- Why schools partake in STEM outreach programmes
- Impact of the STEM Outreach programme being reviewed on children and the school community
- Impact of the STEM Outreach programme on STEM teaching and learning

Methodology

A mixed method approach was taken to data collection, gathering both quantitative and qualitative data, integrating the two, and drawing interpretations based on the combined strengths of both sets of data [18].The multiple methods of data generation from a variety of perspectives (facilitators, children, teachers and parents/guardians) ensured triangulation [19].

An exploratory sequential design to data collection was applied where an initial qualitative phase of data collection and analysis was carried out, followed by a phase of quantitative data collection and analysis, with a final phase involving the integration of the data from all sources. Qualitative data was gathered through focus groups and analysed. The qualitative results then informed the design of the questionnaire questions. Both sets of data were then converged in the final analysis and interpretation of data.

Data was gathered during the focus groups with teachers (N=15), children (N=9) and parents/guardians (N=2) partaking in the STEM Outreach programme and the porgramme facilitators (N=4) and from questionnaires to teachers nationally (N=36), to explore the participants' experiences of the programme.

Results

Why get involved in STEM Outreach programmes?

The main reasons why schools engage with the STEM outreach programme included the following: to develop a STEM culture within schools; to promote children's engagement with STEM; to develop children's knowledge and skills in STEM; to gain external recognition for the work that many are already carrying out in STEM education; as a promotional tool for individual schools and; to develop a structure around their STEM work.

Impact of the STEM Outreach programme on children and the school community

From the focus groups with the children, it was clear that they recognised the importance of the STEM opportunities and activities that the school organised as part of the programme. They mentioned the knowledge and skills they developed and practiced themselves, such as coding, construction, engineering, group work, problem solving, creativity. The children were also very aware of the importance of STEM in everyday life, future studies and future careers as a result. The teachers and parents felt that the most significant impact of the programme on their children was the fact that STEM was now a part of their everyday life in school.

Impact on STEM teaching and learning

All facilitators and teachers felt that the STEM Outreach programme enhanced the provision of a high-quality STEM education experience for learners, motivating teachers to work collaboratively in developing a cross-curricular approach to STEM education across every class level within school communities. Both teachers and facilitators acknowledged that teachers have become much more confident in the delivery of science in schools due to their involvement with the programme and their ability to plan and teach integrated STEM activities has greatly improved. All teachers and facilitators agreed that the programme "*creates a buzz about STEM*" across the school community and develops *"collegiality and working together among staff"* in developing a plan for a cross curricular approach to STEM education across every class level.

Conclusion

This review demonstrates the strong potential of national STEM outreach initiatives to positively influence teaching, learning, and whole-school STEM culture in primary education. Across diverse school contexts, participation in the programme enhanced children's understanding of STEM in everyday life and deepened their awareness of future STEM pathways. Teachers reported notable improvements in confidence, inquiry-based pedagogical skills, and their capacity to design integrated STEM learning experiences. The programme's structured framework, professional development supports, and emphasis on cross-curricular collaboration were central to these gains.

At the same time, the evaluation identified practical challenges that warrant attention. Teachers highlighted increased workload and evidencing requirements, alongside a need for updated resources and more systematic opportunities for parental engagement. Addressing these issues will be essential in sustaining long-term impact and ensuring equitable access to high-quality outreach opportunities.
Overall, the findings affirm the value of well-designed, contextually relevant STEM outreach in fostering science capital, supporting national policy goals, and strengthening partnerships between schools and external STEM providers. Streamlining programme processes, expanding professional learning, and deepening links with industry and outreach centres will help maximise the reach and effectiveness of future initiatives. This review provides actionable guidance for policymakers, educators, and STEM organisations seeking to embed authentic, engaging, and sustainable STEM experiences within primary schools.

REFERENCES

[1a] Department of Education and Skills (2017). STEM Education Policy Statement 2017–2026.
[1b] Department of Education and Skills (2017b) STEM Education Implementation Plan 2017–2019, Dublin: Department of Education and Skills. Available: https://assets.gov.ie/43631/194126acae544b93895436013dadbefb.pdf
[2] Science Foundation Ireland. (2021). *Strategy 2025: Shaping Our Future*. Dublin: SFI. Available at: https://www.sfi.ie/strategy/SFI-Strategy-2025-Shaping-Our-Future.pdf
[3] Department of Education and Skills. (2017b). *STEM Education Implementation Plan 2017–2019*. Dublin: DES. Available at: https://assets.gov.ie/43631/194126acae544b93895436013dadbefb.pdf
[4] Laursen, S., Liston, C., Thiry, H., & Graf, J. (2007). What Good Is a Scientist in the Classroom? Participant Outcomes and Program Design Features for a Short-Duration Science Outreach Intervention in K-12 Classrooms. *Cell Biology Education*, 6(1), 49–64.
[5] Vennix, J., Den Brok, P., & Taconis, R. (2017). Perceptions of STEM-based outreach learning activities in secondary education. *Learning Environments Research*, 20(1), 21–46. https://doi.org/10.1007/s10984-016-9217-6
[6] Archer, L., DeWitt, J., Osborne, J. et al. (2015). Science capital: A conceptual, methodological, and empirical argument. *Journal of Research in Science Teaching*, 52(7), 922–948.
[7] Bybee, R. W. (2013). *The Case for STEM Education: Challenges and Opportunities*. NSTA Press.
[8] Department of Education and Skills (2016) *STEM Education in the Irish School System Report, A Report on Science, Technology, Engineering and Mathematics (STEM) Education,* Dublin: The Stationery Office, available: https://www.education.ie/en/Publications/Education-Reports/STEM Education-in-the-Irish-School-System.pdf.
[9] Davison, K., McCauley, V., Domegan, C. and McClune,W. (2008). A Report for the Standing Conference on Teacher Education North and South, Dublin: Discover Primary Science.
[10] Veenstra, C.P., Padró, F.F. & Furst-Bowe, J.A. eds. (2012) *Advancing the STEM Agenda: Quality Improvement Supports STEM: Selected Papers from the 2011 Advancing the STEM Agenda in Education, the Workplace and Society Conference at the University of Wisconsin-Stout,* ASQ Quality Press.
[11] Vennix, J., Den Brok, P., & Taconis, R. (2017). Perceptions of STEM-based outreach learning activities in secondary education, Learning Environments Research, 20(1), 21–46. https://doi.org/10.1007/s10984-016-9217-6
[12] Laursen, S., Liston, C., Thiry, H., & Graf, J. (2007). What Good Is a Scientist in the Classroom? Participant Outcomes and Program Design Features for a Short-Duration Science Outreach Intervention in K-12 Classrooms, *Cell Biology Education,* 6 (1), 49-64.
[13] Science Foundation Ireland (2015) *Evaluation Toolkit- A Guide to Evaluating your Project*, Dublin:

SFI.
[14] Ward, A.R. (2015). Promoting Strategic STEM Education Outreach Programming Using a Systems
Based STEM-EO Model, *Research Management Review*, 20 (2).
[15] Wilkerson, S. & Haden, C.M. (2014). Effective Practices for Evaluating STEM Out-of-School Time Programs, *Afterschool Matters*,10-19, available: https://files.eric.ed.gov/fulltext/EJ1021960.pdf.
[16] Sadler, K., Eilam, E., Bigger, S. W., & Barry, F. (2018). University-led STEM outreach programs: Purposes, impacts, stakeholder needs and institutional support at nine Australian universities. Studies in Higher Education, 43(3), 586–599. https://doi.org/1 0.1080/03075079.2016.1185775
[17] Gomes, D., & McCauley, V. (2012) Science Outreach and Science Education at Primary Level in Ireland: a Mixed Methods Study. *New Perspectives In Science Education*, 2nd Edition.
[18] Creswell, J.W. (2014). Research Design. Qualitative, Quantitative and Mixed Methods Approaches.
Fourth Edition. John W. Creswell (ed.). Sage Publications.
[19] Cohen, L., L. Manion, & K. Morrison (2011). *Research Methods in Education*. 7th ed., 117. Hoboken:
Taylor and Francis.