Evaluator's role and evaluation use in STEM outreach

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ABSTRACT

STEM outreach is a key component in nurturing an affinity for subjects such as engineering in compulsory education. Impact evaluation, a way to measure the success of STEM outreach programmes, has been a well debated topic within the outreach landscape. Whilst the standard of evidence in evaluation has been criticised previously, there has been improvements in the past decade on how to do evaluation. The discussion on evaluation is hereby extended to explore the role of evaluators and evaluation use. An overview of the STEM outreach landscape is presented, highlighting the lack of research regarding evaluators. The role of evaluators is then explored in STEM outreach delivery, including beyond their stated role of conducting evaluation, as per the wider literature on evaluation in social settings. To aid evaluators in navigating their multiplicity of roles, a shift from how to do evaluation to why are we doing evaluation is required in STEM outreach. Alkin and King's (2017) framework on determining evaluation use, updated by Kelly (2019), is proposed as a solution for this shift.

Introduction

Science, Technology, Engineering and Mathematics (STEM) outreach programmes are seen as a potential solution to motivate young people to pursue the STEM pathway beyond compulsory education and ultimately as a career (M. Archer et al., 2021; Bell et al., 2016; Vennix et al., 2018). There has been a lot of attention regarding the evaluation of outreach programmes since the early 2000s (see Harrison et al., 2018; Rammell et al., 2006). There has been marked improvement related to the evaluation of outreach programmes in the last decade, such as the introduction of Theory of Change as an evaluation tool (Barkat, 2019; Davenport et al., 2021). However, there is a gap in the literature regarding the role of arguably the most important stakeholder in outreach evaluation, evaluators.

This paper seeks to address this gap by exploring the role of the evaluator within the STEM outreach landscape, including their interactions with other stakeholders and roles that they need to undertake

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beyond doing evaluation. This consideration stems from the wider literature on evaluation in social spheres, such as non-profit organisations, whereby evaluators must navigate operational conundrums, including a lack of time to fit evaluation within a programme and unavailability of resources such as electronic devices which may facilitate data collection, in implementing (evidence-based) evaluation practices (Ebrahim & Rangan, 2014; Rogers et al., 2019; Volkov, 2011). In acknowledging these operational issues and revisiting the concept of evaluation, mainly through practitioners' accounts, authors exploring non-profit organisations have made leaps in exploring evaluation concepts such as evaluation use and evaluation literacy. This culminates in a re-conceptualisation of evaluation in the sector, ensuring that it is fit for purpose (Doherty et al., 2015; Kelly, 2019, 2021; Lu et al., 2018; Rogers et al., 2019). However, such a reflective exercise has not occurred in the STEM outreach sphere, where evaluation research lags behind.

This paper aims to contribute to the growing literature on the evaluation of STEM outreach programmes, by providing a perspective centred around the individuals conducting evaluation, on tackling this area of current interest in the academic sphere. This paper reconsiders the current understanding of stakeholders involved in outreach delivery, acting as a call for further research in STEM outreach evaluation beyond suggesting methodological best practices, to addressing practical issues such as the multiplicity of an evaluator's role (Crawford et al., 2017; EngineeringUK, 2023b; TASO, 2020b).

Informing literature

In an ever-changing world, Science, Technology, Engineering and Mathematics (STEM) education plays a pivotal role in a contemporary lifestyle such as making more informed dietary choices by recognising food additives such as emulsifiers in processed food or having an appreciation of the climate crisis. A major concern for policymakers is that the United Kingdom (UK) has been facing a STEM skills shortage over the last few decades (Morgan et al., 2016; Smith, 2017). This issue has been exacerbated by the fluctuating job market following the COVID-19 Pandemic (MAC, 2020; Powell et al., 2022). For example, 33% of UK employers are experiencing engineering or technical skills shortage and there is a need to strengthen the STEM skill pipeline (IET, 2021).

STEM outreach is seen as a potential solution to motivate young people to pursue the STEM pathway beyond compulsory education and ultimately as a career (M. Archer et al., 2021; Bell et al., 2016; Vennix et al., 2018). For the purpose of this paper, we employ the definition by Tillinghast et al. (2020) to define STEM outreach:

'The act of delivering STEM content outside of the traditional [classroom] to STEM stakeholders in order to support and increase the understanding, awareness, and interest in STEM disciplines.'

Whilst STEM stakeholders can include students as well as teachers and parents, we will focus on outreach initiatives that tend specifically to under 18-year-old students.

From a socio-political perspective, the need for a more diverse workforce in the STEM sector, in terms of socioeconomic background, gender or ethnicity, is prominent (DeWitt et al., 2019; Henderson et al., 2018; Schilling & Pinnell, 2018). It is within this context (often labelled as widening participation or broadening participation in the United States (US)) that STEM outreach finds itself as a supposed crucial tenet in terms of policy strategy (Banerjee, 2017; Heaslip et al., 2020; Vignoles & Murray, 2016). Indeed, various STEM outreach initiatives address an element of widening participation including the Swansea University Science for Schools Scheme (Bryan et al., 2019), Welsh Valleys

Engineering Project (Simons, 2019b) and Physics Research in School Environments (M. O. Archer & Dewitt, 2021). It is worth noting that the term widening participation is employed in this article as it is a recognised term by policy makers, practitioners, and researchers. However, the widening participation agenda as set out in the Dearing report (National Committee of Inquiry into Higher Education, 1997) has been criticised by several authors including Leathwood and O'Connell (2003), Archer (2007), Burke (2012) and Harrison and Waller (2018) for labelling students from disadvantaged backgrounds as having a deficit in terms of aspiration to attend higher education. This connotation has persisted in more recent UK Parliamentary publications, including a recent article that stated young children from lower socioeconomic background need to be taught career education to raise their aspiration (UK Parliament, 2023).

Nevertheless, the widening participation rhetoric seems to be part of the government's strategy in increasing science uptake in schools, with continued investment in informal science education partnerships (£8.9 million in 2020 alone) such as the Science Learning Partnership ran by STEM learning (GOV.UK, 2020). Another flagship investment is the creation of the Isaac Physics online learning platform, which 11–18-year-olds can use as an aid to learn physics (Kulakiewicz et al., 2021). However, with this continued injection of funding comes the need to assess whether outreach initiatives are achieving their aims through a process largely referred to as impact evaluation (Chatterji, 2008; Crawford et al., 2017; Harrison et al., 2018). It is in attempting this evaluative process that outreach programmes and the wider informal education sector have fallen short, according to policymakers and researchers alike (Banerjee, 2017; Connell-Smith & Hubble, 2018; Harrison & Waller, 2017a; Rammell et al., 2006; Robinson & Salvestrini, 2020). Criticism of evaluation stems from a lack of causal evidence to show outreach programme's impact on individuals on an extended timeframe, and the over-reporting of positive short-term outcomes, usually through post-activity survey feedback whereby participants have just had a fun experience.

However, one should acknowledge that there have been various recent developments in the evaluation of outreach in the UK (Ní Chorcora et al., 2023; Vergou, 2022). This is arguably due to constant discussions amongst individuals across outreach providers, exemplified in blog posts such as Hume (2019) and Austen (2022). A more tangible piece of evidence for the advancement of evaluation is perhaps the creation of a what works centre, renamed as Centre for Transforming Access and Student Outcomes (TASO), by higher education institutions, including King's College London and Nottingham Trent University (Robinson & Salvestrini, 2020). TASO has even received commendation from Australian counterparts, who have echoed for a similar movement in their country (Lumb et al., 2021). Whilst previous discussions (for example Barkat 2019, Crawford et al. 2017, Gorard et al. 2019, Harrison and Waller 2017b) debated various topics in outreach evaluation, such as the use of Randomised Controlled Trials (RCT) and Theory of Change (ToC), TASO have made these concepts more accessible to evaluators through their websites and webinars (TASO, 2020c, 2020a). Other professional bodies such as EngineeringUK (2023a) have followed suit, with their Tomorrow's Engineers campaign including a research and evaluation component. This led to the release of their holistic ToC that guides engineering outreach providers on what aspects they should measure in their outreach activities amongst other initiatives (EngineeringUK, 2021). Outside the UK, numerous institutional toolkits have been developed to formalise evaluation in STEM outreach, including those from Europlanet and the Earth-Life Science Institute in Tokyo (Bultitude & DeWitt, 2018; Heenatigala, 2020). Furthermore, European academics have provided guidance through evaluative case studies of eight outreach programmes as well as a conceptual framework to determine the aims of engineering outreach activities (Gumaelius et al., 2016; Rosner et al., 2023). In the United States, the National Science Foundation (NSF) has shifted from using a prescriptive toolkit to providing a

platform where outreach providers can publish their programme evaluations via Informalscience's informal STEM community repository (Clewell & Fortenberry, 2009; Informalscience, 2024).

Whilst guidance is crucial for upskill evaluators, it is important to acknowledge that the recent formalisation of evaluation practices also places the onus on evaluators to improve their practice. Professional bodies such as the Office for Students (2019a) and TASO (2020b) have emphasised the importance of standardising evaluation to ensure replicability and foster collaboration across the sector. However, there is an underlying push towards evidence-based, positivist evaluation approaches. This shift aligns with what Kelly (2021) refers to as orthodox evaluation, which prioritises certain quantitative methods over qualitative ones. For instance, RCT treatments being at the top of the evaluation pyramid (TASO's (2020b) evaluation framework depicts this) prompting critics such as Harrison and Waller (2017a) to question if this approach is at the detriment of students and teachers, and if longer-term outcomes can realistically be attributed to outreach programmes given the significant influence of teachers, peers and family members on a child's development.

In this article, we argue that whilst an orthodoxy evaluation movement has overtaken the STEM outreach landscape, certain aspects of the operational realities that exist within outreach have been overlooked. We begin by examining the STEM outreach ecosystem drawing on works like Compeau's (2021) thesis on STEM learning ecosystems, which overlooks the role of the evaluator. We then discuss the daily interactions evaluators face, interweaving anecdotal evidence such as Squire's (2023) reflections of being an evaluator in the outreach sector. Finally, we propose that scholars should shift the focus away from evaluation methods and theories to recognising the operational challenges evaluators encounter and how the wider evaluation literature might apply to this context.

STEM outreach landscape

It is essential to identify the stakeholders involved in STEM outreach and understand their interactions to better grasp how outreach programmes and research efforts influence the overall goal of improving participants' STEM understanding. By doing so, it becomes easier to identify both the barriers and enablers that affect the expansion and long-term impact of these programmes. This section presents an overview of the STEM outreach landscape, with a focus on key stakeholders. The following databases were used for this literature review: Google Scholar and Litmaps. The initial search terms used were 'STEM outreach model' and 'STEM outreach stakeholders'. Additional resources were drawn from the reference lists of previous reviews related to STEM outreach (Abramowitz et al., 2024; Compeau, 2021; Tillinghast et al., 2020). Given the rapid evolution of STEM outreach evaluation in the past decade, only studies from the last 10 years were included.

One of the most elementary models of outreach delivery is provided by Ryan et al. (2017, p995), as outlined in Figure 1. It states that outreach is funded by a body (e.g., government, university), often managed by another entity that acts as a provider (this can either be a department within funding organisation or external entity), delivered by an outreach officer (which we have labelled practitioner) and the recipients being either students, teachers, or the wider community (e.g., parents/guardians) through events such as science week.
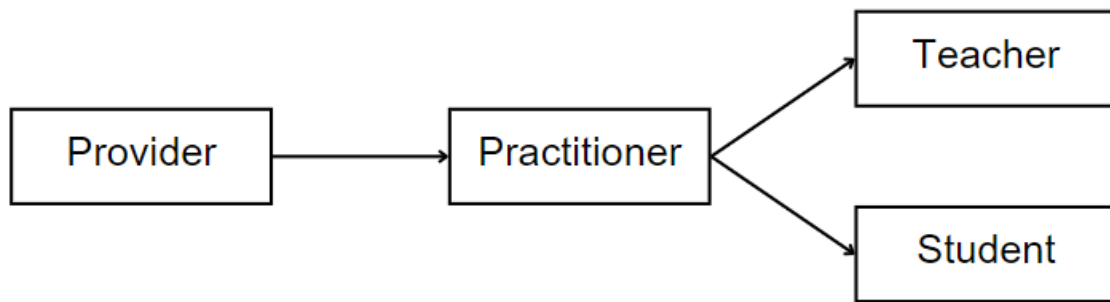
Figure 1: Simplified model of STEM outreach delivery showcasing the flow of knowledge (from left to right) (Adapted from Ryan et al. 2017).

Traphagen and Traill (2014) expands on the notion of providers as a network of collaborators which includes schools, businesses, libraries, museums that work together to deliver STEM education. By adopting this holistic overview of STEM education, integrating formal and informal education (e.g., outreach), there is a recognition that each stakeholder contributes to a learner's experience, and as a collective they have a bigger overall impact. Likewise, several authors including Austen (2022) and Moores et al. (2023) have heralded collaboration as key for advancing the sector. However, Ward (2015) points out that, in practice, collaboration is often absent due to operational challenges such as departmental silos and conflicting agendas across sectors. Squire (2023) echoes this in the context of a UK university, noting that whilst collaboration occurs within their small team, it is largely absent between institutions. Although these accounts stem from individual experiences, the reality may be more nuanced. For instance, successful collaborations exist in certain outreach programmes like the Welsh Valley Engineering Education Programme which attributes its success to its partnership with the Panasonic Trust (Simons 2019b). Conversely, Abramowitz et al. (2024) alludes to a lack of partnership with host schools as a potential barrier to classroom outreach activities.

Nevertheless, exploration of the STEM outreach landscape has yielded significant insights, as shown in Table 1. Of note, Compeau's (2021) examination of the brokering capabilities within university STEM outreach units reveals a clear pathway for practitioners to extend their influence across the sector. This model encourages a more strategic engagement with stakeholders to ensure outreach programmes reach a wider student base. They also build upon Ward's (2015) earlier outreach model, by re-centring informal STEM education provision around providers and perhaps giving more onus to practitioners on what can be achieved. Similarly, Appel et al.'s (2020) stakeholder analysis uncovers some of the hidden aspects of STEM outreach, particularly the crucial role of school administrators and management in facilitating or hindering outreach activities. This underscores the importance of collaboration between schools and outreach providers, given that over two-thirds of STEM outreach occurs in UK schools (Morgan et al., 2016).

One key observation from the reviewed outreach models is the omission of evaluators as distinct stakeholders in STEM outreach, as shown in Table 1. Certain models such as Ward's (2015) focus on the broader STEM education ecosystem, which might explain the exclusion of evaluators. However, several outreach-specific models, such as those by Bagiya (2016), Compeau (2021) Kaggwa et al. (2023) and Ryan et al. (2017), also fail to explicitly recognise evaluators, despite acknowledging the importance of evaluation. In these models, the role of the evaluator is often subsumed under that of the practitioner, exemplified by Bagiya (2016) interviewing practitioners regarding the evaluation of STEM outreach. While this approach may apply to certain initiatives, there is a growing number of

outreach programmes that employ evaluators specifically (see Bryan et al. 2019, Burgess et al. 2021, Simons 2019b, Weaver and Staiano 2021). Moores et al. (2023) explore this growing dichotomy of outreach evaluators in their recent publication; internal evaluators are classed as in-house practitioners and external evaluators classed as those from an external entity, independent from the outreach provider. Their article has sparked further discussion on evaluators in outreach, to date the only academic article we are aware of this kind. This article aims to extend this discussion on evaluators.

Table 1: Illustrative list of studies exploring STEM outreach landscape

Authors	Aim/Focus	Stakeholders/Elements	Origin	Conclusion
(Appel et al., 2020)	To analyse the roles of different stakeholders involved in STEM outreach.	1. Organisation and individuals providing STEM outreach, 2. Policymakers who affect STEM learning provisions and indirectly impact outreach, 3. Researchers who participate, evaluate or conduct research on STEM outreach, 4. Mentors and role models that volunteer to run outreach activities, 5. Administrators within school that support teachers and liaise with outreach providers, 6. Parents/guardians as outreach receivers and influencing students' perception of STEM, 7. Teachers as both outreach receivers and providers who influence students' achievement in STEM subjects, 8. Students as outreach receivers, 9. Student peers who influence each other's' perception of STEM.	Modelled based on a literature review conducted.	Each stakeholder influences the STEM outreach landscape and an understanding of the relationships between stakeholders will lead to an improved provision.

(Bagiya, 2016)	To conceptualise a STEM outreach model through the lens of outreach practitioners, teachers and students.	1. STEM outreach practitioners delivering activities, 2. Mediator promoting STEM (supporting practitioners), 3. Teachers acting as coordinator with outreach practitioners, 4. Students receiving outreach.	Conceptualised by author based on literature review for a doctoral thesis and enhanced based on primary data from outreach practitioners, STEM teachers and students.	Communication between various outreach stakeholders needs to be improved to ensure successful continuous delivery of outreach activities. An evaluation tool developed between various outreach providers may improve impact evaluation of outreach.
(Compeau, 2021)	To demonstrate the characteristics of a university STEM outreach department.	1. STEM outreach funders (e.g., government) 2. University STEM outreach department as outreach provider, 3. STEM outreach practitioners delivering activities, 4. Students, teachers and parents as STEM outreach receivers	The conceptual framework is developed on experience and then enhanced based on empirical quantitative data from university outreach units.	University STEM outreach departments are knowledge brokers between outreach stakeholders and are key to STEM knowledge capacity building amongst outreach receivers. However, to increase efficiency within this knowledge brokering role, programme impact evaluation needs to be implemented.
(Eilam et al., 2016)	To explain the different types of STEM outreach provision by universities, including in terms of relationships between stakeholders, using the 'top-down' versus 'bottom up' approaches.	1. University as outreach provider constituting of: - Administrators, - Volunteer scientists, - Coordinators, - Presenters 2. Students, teachers and parents as STEM outreach receivers	Conceptual framework based on Theory of Legitimacy and tested on document analysis from 9 Australian and 3 Israeli universities.	'Top-down' initiatives which operate under high institutional legitimacy are more successful than grass root 'bottom up' ones.
(Kaggwa et al., 2023)	To propose an inclusive model of STEM outreach between under resourced schools and volunteer scientists.	1. STEM Outreach provider organisation ensuring delivery of outreach is successful, 2. Volunteer scientists from various backgrounds acting as outreach practitioner, 3. Teachers acting as coordinators,	Conceptualised based on outreach model delivered in four schools over course of two years.	STEM outreach is beneficial to students (increase in interest in STEM), teachers (increase in knowledge of STEM) as well as volunteer scientists who improve their communication skills as exposed to a

		4. Students receiving outreach.		different teaching environment to their day-to-day role.
(Ryan et al., 2017)	To demonstrate the level of stakeholders involved in outreach.	Their framework includes: 1. Funding bodies (e.g., government), 2. Outreach providers (e.g., university department), 3. Outreach officers 4. Participants including students, teachers and parents.	Modelled based on experience.	There is a variety of outreach providers, with differing goals and widening participation is only relevant to some.
(Traphagen & Traill, 2014)	To demonstrate the elements of a STEM learning ecosystem.	1. Libraries, Science centres & museums, businesses, higher education providers as outreach provider, 2. Schools as a medium for outreach to occur, 3. Students, family, and community as outreach receivers.	Modelled based on experience.	Various strategies to improve STEM learning ecosystem including collaboration between STEM providers and capacity building for educators within these organisations. Informal and formal education need to also synergise to offer students and the community a better provision.
(Ward, 2015)	To simplify the complex system of interacting elements that make up STEM outreach.	Three groups that directly affect pre-university students' provision of STEM including via outreach: 1. General community compromising of government, non-profit organisations, businesses and parents, 2. Teachers, 3. Higher education compromising of academic, technical and non-STEM providers.	Modelled based on discussion with faculty outreach providers within a university.	The model provides a useful way to further discussion regarding how an individual project may influence the STEM pipeline and has been used by outreach providers as well as academic researchers.

Do evaluators really make a difference?

Volkov (2011) posits that an evaluator's role extends beyond applying rigorous methodology and data analysis in programme contexts. There is an expectation that evaluators also act as change agents who act upon and/or influence decision-makers to enact changes based on evaluation findings. However, implementing such changes can be challenging, especially when it demands additional resources from programme providers (Taylor-Schiro - Biidabinikwe & Cram, 2021). Therefore, evaluators' responsibilities begin at the programme planning stage , where they advocate for the importance of evaluation use to other stakeholders. Rogers et al. (2019) illustrate this multifaceted role in a small

non-profit organisation, where evaluators had to persuade programme participants of the importance of evaluation through informal conversations and nudge programme managers to adopt changes to programmes based on evaluation findings.

We propose an updated model of outreach delivery in Figure 2. It's aim is to spark conversations amongst STEM outreach stakeholders regarding the social impact of integrating an evaluator within an outreach programme.
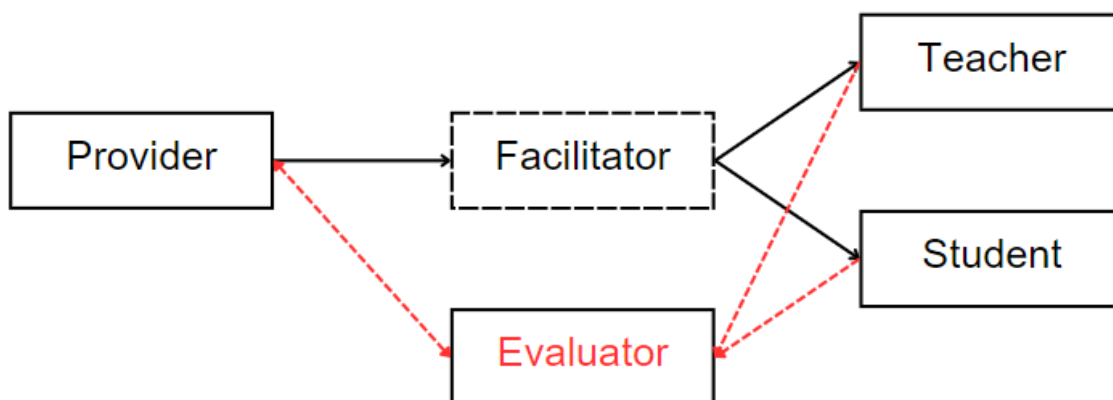

Figure 2: Simplified model of outreach delivery with the inclusion of evaluators

Note that we previously referred to the facilitator as a practitioner (see Figure 1). As outlined previously, the term practitioner is an umbrella term (see above section) that implies involvement in delivery of outreach activities, without specifying a particular role. Whilst we don't infer any internal or external dichotomy of evaluators in this article, our proposed model posits that the practitioner role can be split into two: facilitator and evaluator. We believe that the term facilitator more accurately reflects the new role of someone focussed solely on the delivery of activities. However, it is essential to acknowledge that facilitators may, in practice, also contribute to other elements of outreach programmes beyond the scope of this model, such as activity design.

The role most impacted by the inclusion of an evaluator is often that of the facilitator. Conventional evaluation typically implies upward accountability, including that of the facilitator's role (Hayton, 2016). This accountability can lead to tension between facilitators and evaluators. Additionally, introducing an evaluator somewhat decentralises the flow of information between participants and outreach providers, reducing the facilitator's role as an intermediary. Finally, as is often the case in social change efforts, differing groups of individuals share different epistemological and socio-political values (Johnson & Stefurak, 2013). As time is usually limited for delivery of an outreach activity, one can foresee a tension between extending an activity or conducting evaluation. It is in this regard that Volkov (2011) argues that an evaluator conducts a multiplicity of role in informal settings, including that of a collaborator, advocate for change and ultimately conducting evaluation.

Teachers are often the reason that a school participates in an outreach programme (Aslam et al., 2018). In effect, they act as gatekeepers on selection of outreach activities as well as its participants. However, the evaluation of activities may not align with teacher's values as they want to maximise the time their

students are spending outside the classroom productively. Several teachers were frustrated that their students had to fill evaluation surveys after outreach activities according to Aslam et al.'s (2018) study. Outside the realm of STEM, *Tutoring with Alphie,* a literacy outreach programme, faced attrition amongst participating schools, whereby an arguably intrusive evaluation instrument was used (Biggart, 2015). It should also be noted that students themselves are not always responsive to evaluation. This is illustrated by a poignant account from Matt Lumb, an outreach evaluator, who was asked 'Why are you here?' by a 12-year-old participant, during an introductory evaluation session, to which they could not reply (Lumb et al., 2021).

However, there are also positive examples of evaluators successfully onboarding teachers in outreach evaluation (Anders et al., 2017; Kutnick et al., 2022; Simons, 2019a). A common theme amongst such examples is the involvement of teachers, including in programme evaluation, from the onset. Teachers also provide useful triangulation data which is then used in conjunction with participants' feedback to measure a programme's impact. This is best exemplified in the Welsh Valley Engineering Programme, whereby teachers highlighted which aspects of the programme were most beneficial to their students. The programme achieved continuous evaluation over a five-year period, including during the challenges of the COVID-19 pandemic, and successfully raised the profile of engineering within schools, even though the subject was not formally taught (RAEng, 2022).

There are numerous limiting factors during the evaluation of outreach programmes, such as the availability of resources at an organisational level and the type of activities being assessed (Bourgeois & Cousins, 2013; Ruhf et al., 2022). However, one cannot deny the influence of evaluators beyond their role as an evaluator (described by Scriven (1996, p159) as 'someone who can do technically challenging evaluation' – in other words a theoretical and methodological expert in evaluation) in ensuring the aims of evaluation are met within an outreach programme.

Supporting evaluators beyond guidance on how to do evaluation.

In the previous section, we discussed the multifaceted roles of evaluators in outreach programmes. However, current guidance in the outreach sector has centred around what works and integrating concepts such as Theory of Change to enhance evaluation practices. Using Bourgeois and Cousins' (2013) framework on evaluation capacity, the sector has mainly focussed on capacity to do evaluation and neglected capacity to use evaluation. Despite concerns of the standard of evaluation in the sector, limited attention is given to what happens post-evaluation.

Outreach evaluator Ruth Squire (2023) offer a glimpse into arising issues as a result of this negligence. For instance, a) there is a lack of evaluation literacy amongst stakeholders which acts as a barrier to onboarding evaluation within their institution and b) it is subsequently difficult to raise evaluation literacy. While evaluation literacy is an established concept in the wider evaluation literature, it has not been discussed in the outreach literature (Squire (2023) simply refers to it). Evaluation literacy is succinctly referred to as 'the ability to understand and use evaluation, not necessarily the capacity to do evaluation' (Doherty et al. 2015, p36). In other words, evaluation literacy does not require individuals to conduct evaluation themselves but have the competence to apply evaluation findings effectively.
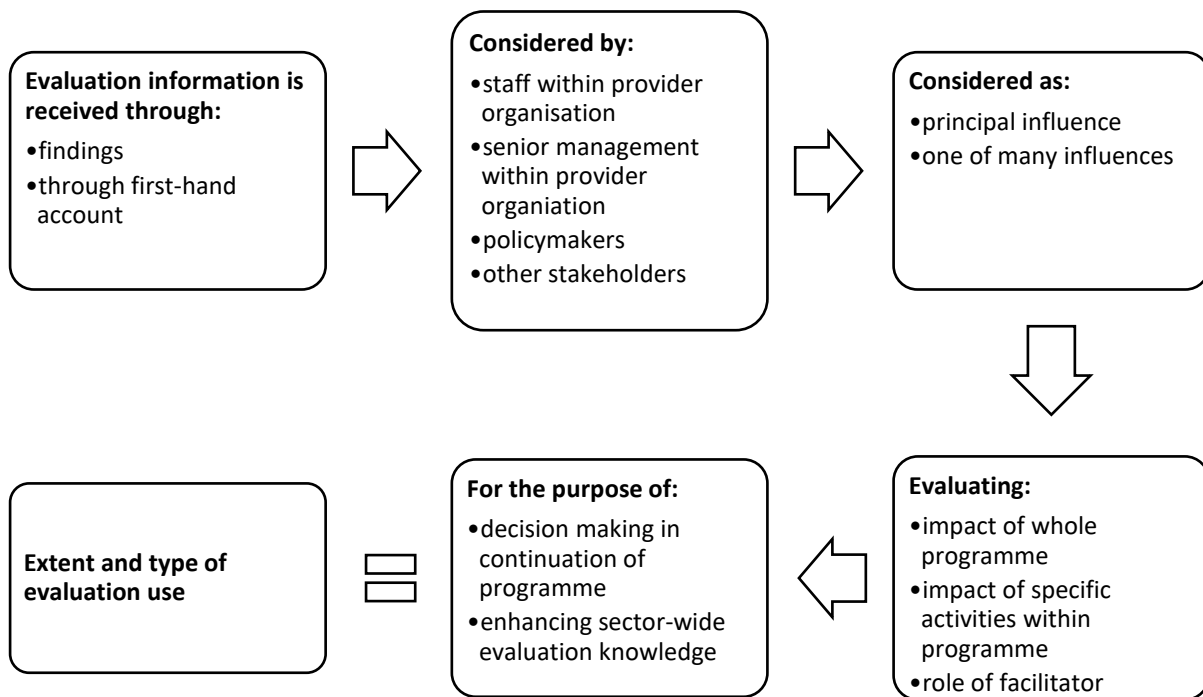
Figure 3: Framework to determine evaluation use in STEM outreach programmes (Concept adapted from Alkin and King (2017) and Kelly (2019)).

Alkin and King (2017) introduced a visual representation of evaluation use, as an engaging way to introduce the concept to stakeholders, as shown in Figure 3. By clearly outlining how evaluation data has been gathered, who the intended users of evaluation are and the goals of evaluation, transparency in the evaluation process is enhanced, especially when this information is shared with all relevant stakeholders. Furthermore, an evaluator can use this framework as a planning tool, actively considering the five components to foster evaluation use (Alkin and King, 2017). In Table 2, two scenarios illustrate how evaluation use differs across evaluation contexts. In scenario 1, the evaluator would likely target ongoing evaluation whilst navigating limited resources. An experienced evaluator may also encourage the outreach programme manager to attend the workshop for first-hand experience prior to making their decision. In scenario 2, the evaluation is geared towards a formal report that provides a snapshot of the programme, and will be scrutinised with academic rigour (i.e., validity and reliability of data collected). The evaluator may have further resources available in this scenario but may need to liaise with several stakeholders to ensure successful data collection and employ their technical evaluation skills in writing their report.

Table 2: Scenarios showcasing different types of evaluation use

	Scenario 1: Outreach programme manager wants to change one element (series of workshops offered to schools) of a multi-intervention STEM outreach programme	Scenario 2: Policymaker wants to understand the behaviour changes of student participants within several nationwide STEM outreach programmes prior to determining future policies and imparting the next cycle of funding to providers
Evaluation information is received through	Findings (e.g., data collected by evaluator) and through first-hand account (e.g., attending workshop once)	Findings (e.g., reports from each programme)
Considered by	Staff within provider organisation	Staff within provider organisation, senior management within provider organisation and policymakers
Considered as	Principal influence	One of many influences
Evaluating	Impact of specific activities within programme	Impact of whole programme
For the purpose of	Decision making in continuation of programme	Decision making in continuation of programme and enhancing sector-wide evaluation knowledge

However, this framework overlooks social factors that influence evaluation use, such as the relevant stakeholders' attitudes towards evaluation findings or the evaluator's ability to engage other stakeholders in evaluation. As such, further research is needed to establish if this framework suits STEM outreach programmes. However, this template has been successfully employed in non-profit organisations focussing on community development, where the focus is on social change, similar to STEM outreach (Kelly, 2019). STEM outreach has previously adopted an evaluative concept from community development, notably Theory of Change, originally introduced by Weiss (1995). Community development evaluators have also explored evaluation topics beyond that discussed within outreach. This includes a) accountability myopia (i.e., focus on short-term outcomes over long-term social change) due to the shift towards evidence-based evaluation, and b) the importance of everyday feedback, labelled as informal evaluation, in contributing to overall evaluation (Ebrahim, 2005; Ebrahim & Rangan, 2014; Kelly, 2019). While it may be unpractical to fully translate all these concepts/debates into STEM outreach, it is clear that outreach evaluators should be given more onus to reflect on their roles beyond technical and methodological expertise.

Future Work

Whilst this paper extends the exploration of STEM outreach evaluation beyond current studies, it is limited to a conceptual proposition, with limited empirical evidence. Further research is required to develop a better understanding of the roles of evaluators in STEM outreach and how they interact with other stakeholders such as teachers and outreach facilitators. Collecting in-depth, qualitative data through direct engagement with evaluators and other stakeholders, would enhance this understanding.

Conclusion

Whilst evaluators play a pivotal role in enabling the evaluation of STEM outreach programmes, their role is overlooked in the literature. It is hoped this exploration into the role of evaluators in an outreach setting will enact policymakers and practitioners to reflect on the current trajectory of evaluation in the sector. Guidance on how to conduct evaluation is valued and a collaborative ethos in sharing what works as well as what doesn't work should continue. However, there should also be a recognition of the operational realities that evaluators face, and guidance should include why should we conduct evaluation (i.e., raise awareness around concepts such as evaluation use and evaluation literacy to empower evaluators). This also raises further questions such as if current evaluation practices are actually being used to benefit participants or simply a mean towards reinforcing upward accountability.

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Declaration of Interest

The authors declare there is no conflict of interest in this paper.

Notes on Contributors

Youn Affejee is a PhD student at WMG, University of Warwick. His PhD research explores impact evaluation of STEM outreach programmes.

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Dr Michael Mortenson is the incoming Course Director for the MSc in Business Analytics at Warwick Business School and a lead academic at the Gillmore Centre for Financial Technology. He holds a PhD in Analytics and an MSc in eBusiness. His specialisms include natural language processing, computer vision, Bayesian methods and data engineering. Alongside his academic work he has significant practical experience working on data science, AI and digital transformation projects for companies such as Amazon Web Services, Vodafone and Newcastle Airport.

Professor Robin Clark is Dean and Managing Director of WMG and was appointed to this position in October 2020 having been at WMG since 2017. Robin is a National Teaching Fellow and founded the UK and Ireland Engineering Education Research Network. Robin publishes regularly on the subject of engineering education and is regarded as a leading researcher in the field.

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