Australia's National
Science Agency

Durable STEM Education Programs: Evidence from Diverse Fields

A literature review.

Jen Parsons and Christoper Banks

August 2024

Contents

Definitions

Amplification	The process of increasing the reach, effect, or intensity of a program or project's outcomes.
Durability	The measure of how long-lasting the impact of a program or project is over time and its ability to withstand counteracting forces.
Framework	A set of guidelines, processes, and procedures that define how a project should be managed.
Impact	The significant or lasting changes brought about by a program or project's outcomes, often related to strategic goals or mission.
Longevity	The time span of a program's impact, in particular how long a program can sustain its impact.
Outcome	The results or effects generated by a program or project.
Program	A set of related projects managed in a coordinated manner to obtain benefits not available from managing them individually.
Project	A temporary endeavour undertaken to create a unique product, service, or result.
Scalability	The ability of a program to grow in size (e.g., number of participants) or spread to different locations and contexts.
Sustainability	The ability of a program or project to continue delivering benefits and maintain outcomes over time.

Sustainability, durability, and longevity

These three concepts are related and are somewhat challenging to disentangle. For the purposes of this literature review, longevity is mostly concerned with the temporal aspect. A program has longevity if it has the ability to persist over a long period. Sustainability expands on this concept to include that the program continues to operate effectively over time, delivers benefits and maintains outcomes, and remains relevant and viable. Finally, durability is related to how a program delivers long-lasting impacts through its ability to withstand and adapt to changes, challenges, and counteracting forces (that is, it is resilient and can recover from setbacks). As durability encompasses aspects of both longevity and sustainability, it is the focus of this literature review.

Abstract

This literature review[1] addresses a gap in understanding of the durability of impact in STEM education programs. Despite significant investments in STEM programs in Australia, sustaining their benefits beyond initial implementation remains a challenge. This review examines interdisciplinary frameworks and strategies from diverse fields to analyse the factors contributing to the sustained success of programs and projects. It aims to identify best practices and key factors that can be applied to STEM education programs to enhance sustained impact. The review methodology included a structured search of literature across diverse fields, focusing on durability, sustainability, and longevity of programs and projects. The findings show that durability and sustainability are multifaceted concepts influenced by numerous factors, rather than a single element. The review identifies a suite of factors, categories and over-arching themes (see Figure 1) relevant to the durability of STEM education programs, including a clear vision that is strategically designed for durability and scalability. This vision is supported by long-term planning, with monitoring and evaluation processes embedded throughout the program's lifecycle to ensure continuous improvement. The importance of inclusive and collaborative structures is emphasised in the literature, fostering partnerships across various institutions, communities, and with external organisations. Aligning the program's vision and values with the host organisation and community needs is important, as is the presence of strategic and effective leadership, alongside dedicated program champions, to drive the program's success and ensure its longevity. These elements, amongst others, collectively contribute to durable programs and are relevant to the STEM education context. Insights from this review can inform the design, implementation, and delivery of future STEM education programs, contributing to their long-term success and impact.

Figure 1. Structure of findings

[1] The authors wish to acknowledge and thank the two peer reviewers (Estelle Gaillard (Industry PhD Program, CSIRO) and Mearon O'Brien (Education and Outreach, CSIRO)) whose thoughtful comments and suggestions improved this review.

Introduction

STEM education programs aim to increase Science, Technology, Engineering, and Mathematics (STEM) competencies and aspirations among students, often with a focus on increasing participation from underrepresented groups (Australian Government, 2024) or addressing a skills gap (Bentley, Sieben, & Unsworth, 2022). Despite significant investments in these programs in Australia and in many other countries, many initiatives face challenges in maintaining their impact over time, with Australia's Chief Scientist saying that "Australia is not getting the full value of its investment in STEM education" (Australia's Chief Scientist, 2024). While short-term gains in STEM student engagement and performance are often reported, the persistence of these impacts are not well documented or measured (Johnson, Margell, Goldenberg, Palomera, & Sprowles, 2023). This is compounded by a lack of comprehensive strategies or frameworks that are tailored to sustain the benefits of STEM education programs beyond their initial implementation phase. A related issue is a gap in research regarding the critical factors that contribute to impact durability in STEM education (Li et al., 2022; Santos, Anderson, & Milner-Bolotin, 2023). In Australia, the sustainability and scalability of STEM programs can be hindered by challenges in aligning with the national curriculum (Pressick-Kilborn, Silk, & Martin, 2021) and a reliance on external experts for program delivery[2] (Deehan et al., 2024).

Durability focuses specifically on the longevity and resilience of a program's impact. Concentrating on durability ensures that a program remains effective and continues to deliver benefits long (years or even decades) after its initial implementation, even as internal and external conditions may change. This can be particularly important in fields like STEM education, where the goal is to have a lasting influence on teachers and students' skills, interests and aspirations (the STEM 'pipeline' metaphor conveys the importance of early interventions having important, long-term, downstream effects (Edwards, Buckley, Chiavaroli, Rothman & McMillan, 2023)). By definition, for impact to be considered durable in a STEM education program, it should be evident in longitudinal studies and demonstrate that the benefits extend into future educational and career pursuits, pedagogical or system change. For example, Shahali, Halim, Rasul, Osman, & Arsad (2019) measured the longitudinal impact of an integrated STEM program in Malaysia on middle school students and found that while short term impacts through increased interest in STEM subjects and careers were documented, this was unable to be sustained with the cohort of students after two years, as the level of interest in STEM subjects had decreased. Additionally, Hasim, Rosli, Halim, Capraro, & Capraro (2022) conducted a literature review that provided an analysis of STEM professional development activities and how this impacted teacher knowledge and instructional practices. They found that traditional professional development failed to result in sustained improvement in teacher practice and student learning and suggested that

[2] Specifically, teachers' reliance on academics, engineers, scientists and community stakeholders to deliver integrated STEM programs may limit their sustainability as the programs cannot be delivered without these external supports.

professional learning needed more comprehensive and ongoing programs to achieve long-term impacts.

There are some studies that have shown student STEM education programs can have impact over time, for example, Burack, Melchior and Hoover (2019) showed significant impacts of an after-school robotics program on STEM engagement in college for students who participated. However, the authors acknowledged the limitations of this study, particularly in identifying the time frame at which these impacts are considered long-term.

When comparing the characteristics of successful and less successful[3] Advanced Technological Education programs in the United States, it was found that deeper institutional integration and secure and diverse funding sources were the key to sustaining success (Bailey, Matsuzuka, Jacobs, Morest, & Hughes, 2003). Similarly, a systemic literature review conducted by Hasim et al. (2022) found some evidence that successful teacher professional development programs are characterised by their integrated STEM approach and the opportunity for teachers to engage in collaborative project and problem-based learning with STEM professionals. In addition, the review found that programs that offer ongoing support for teachers, as opposed to one-time events, were more likely to result in sustained outcomes for teachers and students. Finally, an example of longer term impacts has been demonstrated though a study that found teachers who participated in an Applied Mathematics Program had more students who chose a STEM major in college than those who didn't participate (Henríquez Fernández, Barr, Antoine, Alston, & Nichol, 2021).

The concepts of durability and sustainability can be understood in various ways. While some may see it as the ability to produce a lasting effect, such as teachers maintaining increased confidence and skills in STEM after a program concludes (Han, Kelley, & Knowles, 2023), or the continuation of program activities, others may define it as the continuous provision of funds and resources to continue an initiative. After the conclusion of CSIRO's Indigenous STEM Education Project[4], an evaluation revealed that there was a potential overemphasis on continued funding rather than on continued impact, with less attention paid to developing strategies for embedding programs and sustaining long-term impact until later in the project (Walker & Banks, 2021). This resulted in discussions about project sustainability focusing more on identifying alternate sources of funding rather than ensuring knowledge and capability were embedded within communities and established institutions (Walker & Banks, 2021). While funding is important, greater impact is achieved when the focus is on strategically building capacity, supporting innovation, and ensuring a program's longevity after its conclusion with or without funding (Stevens & Peikes, 2006).

Research on the critical factors that contribute to the durability of improved outcomes is also limited, particularly within the STEM education field. The analysis of these factors and their relative contributions remains a largely underexplored area (Thomas & Zahn, 2010), an

[3] Success in terms of meeting the objectives of the program.

[4] The Indigenous STEM Education project was funded by the BHP Foundation and delivered by CSIRO to aimed to increase interest and academic achievement among Aboriginal and/or Torres Strait Islander students in Science, Technology, Engineering and Mathematics (STEM) subjects and related professions. https://www.csiro.au/en/education/about-csiro-education/our-impact/indigenous-stem-education-project-outcomes

exception to this is in the field of health research (Schell et al., 2013; Wiltsey Stirman et al., 2012). Both Schell et al. (2013) and Wiltsey et al. (2012) conducted comprehensive literature reviews of sustainability in health programs and interventions and Schell et al. (2013) used this information to develop a conceptual framework for the sustainability of public health programs. Both studies found that sustainability is influenced by multiple factors and recommended that instead of focusing on a single factor, programs should create strategies that address multiple factors simultaneously. They found that health programs need time for impacts to be seen (Schell et al., 2013), and it's likely that STEM education programs also have this challenge. Both fields involve complex human behaviours and learning processes that do not change quickly. Health programs often aim to alter long-standing habits or improve public health outcomes, which necessitates sustained efforts and the accumulation of incremental changes over time. Similarly, STEM education programs are designed to build knowledge, skills, and attitudes that may take time to develop into measurable outcomes such as academic performance, career choices, or innovation in STEM fields, with early intervention and lifelong learning key aspects of STEM education (Bentley, Sieben & Unsworth, 2022; Timms, Moyle, Weldon & Mitchell, 2018). If the full benefits from investments of time and resources are to be realised, a clear understanding and focus on durability is key and the complex interactions between durability factors should be understood.

This literature review has gathered insights from a variety of fields to provide a more comprehensive understanding of the factors that drive long-term success in programs more widely. The authors have assumed that such insights will be able to be translated to the STEM education field and can be applied to this context. Incorporating insights from public health, environmental and social science, among others, can provide a richer and more nuanced understanding of the factors that could drive long-term success in STEM education projects, programs, or initiatives. The authors' intention is that this information can then be used to develop frameworks for the design, implementation and delivery of future programs. However, to ensure that these factors are transferable from diverse fields, it will be important to test and refine any tools or frameworks.

This literature review seeks to address the knowledge gap of impact durability in STEM education by examining existing research, drawing upon interdisciplinary frameworks and strategies to provide a comprehensive analysis of the factors that contribute to the sustained success of programs, projects and initiatives, more broadly. Through this review, we aim to identify best practices and key elements that could enhance sustained impact in STEM education initiatives, ultimately contributing to a more scientifically literate and technically skilled community able to meet the challenges of the future.

Methods

A literature review methodology was used to identify research and other sources focussing on durability (and sustainability) of programs and projects across a variety of fields. This

methodology included a structured search of relevant databases[5], journals, and key websites. Initial sources for potential inclusion in the review were found through Google and academic database searches, referring to existing literature reviews, and referrals from experts in the field. Initial sources then provided pathways to additional sources. Search terms used were: program and project sustainability/durability/longevity, STEM Education, impact framework, funding, scale, scaling, impact tool, sustained impact, lasting impact, amplification.

Literature that were identified during the search were included in the review if they were in English[6], judged by the authors as transferrable to the STEM education context, and described distinct programs, projects, or initiatives rather than ongoing operations in an organisation. Originally it was hoped that there would be sources focusing on STEM education or education generally, but given how few sources there were, a number of related human services fields were also included, such as health. Similarly, peer reviewed journal articles and reports were originally prioritised but several best practice and case studies were also included. Other sources included scholarly books, conference papers, and institutional grey literature.

From the literature reviewed, 25 papers and reports were found to explicitly mention factors that lead to durable (or sustainable) impact of programs and projects and were included in the analysis (see Appendix A). Specifically, 248 factors leading to durable impact were identified and each of these factors were placed into categories and themes for simplification and to reduce repetition (see Appendix B for full list of factors). Included literature encompassed the fields of environment, health, education, social science, and sustainability, with 84 per cent of the publications coming from fields outside of education. Health publications had the highest representation at 56 per cent.

Categorisation of evidence

Each relevant paper/article/report was reviewed and if any factors related to the durable impact of programs/projects/initiatives were identified, these factors were included for analysis. The strength of each factor's contribution to the durable impact of a program, project, or initiative was assessed as shown in Table 1.

[5] Such as Google Scholar, ProQuest, Scopus, and ERIC.

[6] It is acknowledged that focusing on articles in English would have led to some under-representation of some sources. However, it is estimated that 98% of the world's scientific research is published in English (Ramirez-Castaneda, 2020). The review was inclusive of a range of sources from diverse counties and cultures.

Table 1: Criteria and scores to assess the strength of factors that contribute to the durability of a program, project, or initiative.

Criteria	Description	Points
Mention of the Factor	If the factor is mentioned in the documentation or there was some discussion of the factor related to the project or program.	1
Anecdotal accounts	If there are informal accounts or stories that suggest the factor contributes to durability.	2
Documentation	If there are records or documents that explicitly state the factor's contribution to durability.	3
Measurable	If there are metrics or data that quantitatively measure the factor's contribution to durability.	4
Peer-Reviewed	If the factor's contribution to durability has been reviewed and validated by independent experts in the field.	5

Once factors were compiled, categories and over-arching themes were developed to classify factors that were similar or able to be themed to reduce duplication and for simplification. Scores were totalled for each factor category to provide a weighting and some measure of strength of contribution to durability.

Findings

Factors and themes related to program durability

The three themes and ten categories associated with program durability/sustainability are listed here, accompanied by a description of each:

Program dynamics

- **Program Design and Implementation** – factors that include the planning and execution of a program to establish a robust foundation and adaptable framework for long-term program success and impact.
- **Monitoring, Evaluation and Learning** – any factor that refers to the processes of tracking progress, assessing results, and applying lessons learned to improve program performance and durability.
- **Adaptability and Responsiveness** – any factors that refer to a program's ability to adjust to changing conditions and respond to new challenges and opportunities in a way that maintains its relevance and effectiveness.

Community and resource dimensions

- **Financial and Resource Management** - this includes any factor that mentions the efficient and effective use of financial resources and other assets to support the program's objectives and ensure its long-term viability.
- **Stakeholder Engagement and Partnerships** - this category is for factors that involve key individuals and organisations that have an interest or stake in the program and/or mention fostering collaboration and support.
- **Community and Societal Factors** - this category includes the social and cultural context in which the program operates, including community needs, values, and behaviours that can influence its durability.

Strategic foundations

- **Leadership and Governance** – any reference to the roles and responsibilities of leaders and governing bodies in guiding the project or program towards its goals, ensuring accountability, and making strategic decisions that promote durability.
- **Organisational Capacity**– factors that refer to the internal capabilities of an organisation, including staff skills, management systems, and physical infrastructure, which support the program's durability.
- **Policy and Legislative Support** – factors that involve the alignment of the program with relevant policies and legislation that can provide a supportive framework for its ongoing activities and goals.
- **Integration and Alignment** – factors that mention the importance of integrating the program's activities and goals with other initiatives and aligned with broader strategic objectives to create synergy and enhance durability.

Strength weightings of durability categories

Based on the criteria in Table 1, of the ten durability categories, the highest weighting was Organisational capacity (144) followed by Stakeholder engagement and partnerships (128). The category with the lowest strength weighting was Policy and legislative support (37) (see Figure 2). In terms of the three durability themes, the mean weightings were: Community and resource dimensions (114), Program dynamics (80), and Strategic foundations (75).

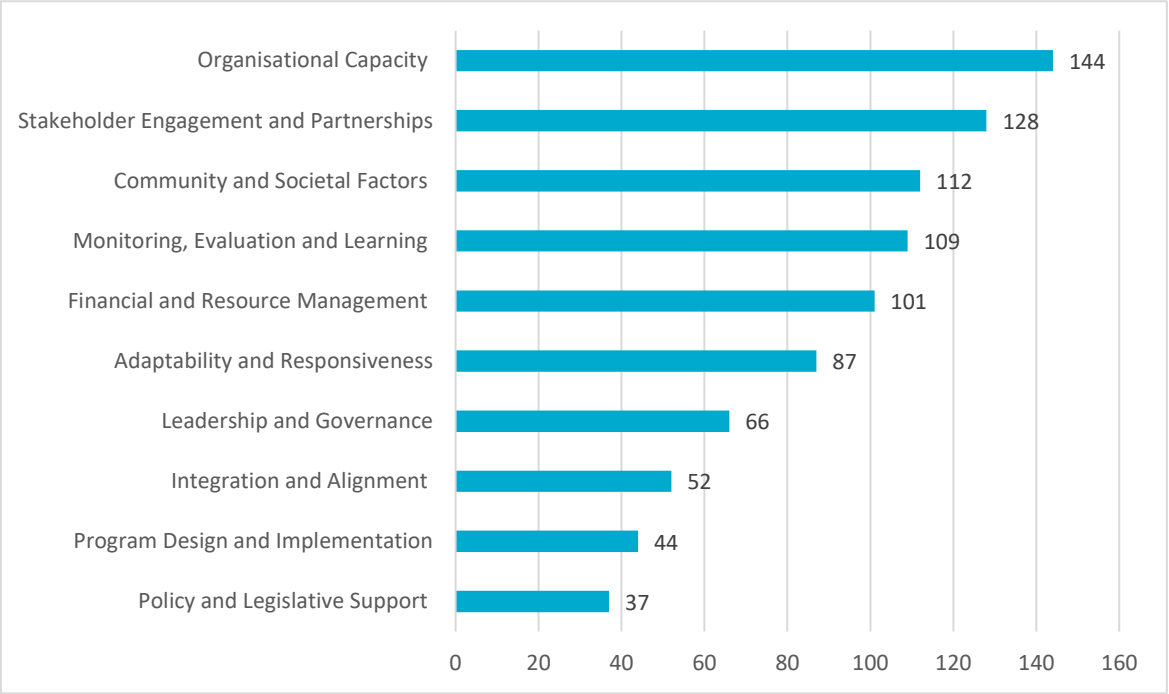

Figure 2: Program durability categories ranked by strength weighting, which is a sum of the scores given to each factor mentioned in each publication.

Discussion

This review has identified factors that contribute to program durability and provided some measure of strength for each of these. However, there is a need to be cautious when interpreting these findings. While there is evidence supporting the role of certain factors in enhancing program durability, this should not diminish the potential significance of factors with lower strength weightings. Their apparent lesser importance may be attributed to underrepresentation in the literature reviewed or challenges in measurement, rather than reflective of an actual lack of impact.

What has been consistently found across all fields included in this review, is that the durability of a program depends on multiple interrelated factors that collectively foster long-term success and impact. Organisational support, including adequate resources and management backing, is the foundation that enables a program to thrive. This, coupled with a skilled and stable workforce that harbours positive attitudes contributes to a program's consistent and effective success. Investing in the ongoing training and development of staff, enhancing their capabilities and ensuring they remain at the forefront of program delivery were also indicated as factors contributing to program durability. Staff involvement in decision-making not only increases their commitment but also aligns their personal goals with the program's success. The skill and confidence of staff in program delivery are essential, as they foster trust and credibility in the program's outcomes.

Another important factor is an environment that values and supports the program—marked by a clear organisational structure and efficient procedures— laying the groundwork for durability. This includes the host organisation's ability to adapt its procedures and systems to integrate new elements, supported by robust structures, processes, and resources. The organisation's underlying capacity, often reflected in its longevity, indicates its internal capabilities to manage and sustain a program. An organisation that supports long-term goals, a perception of impartiality, encourages diverse stakeholder collaboration, and provides program champions all contribute to a program's enduring impact. Transitioning from a time-limited project to an ongoing initiative is a strategic move that integrates the program's principles within the community, thereby becoming a fundamental part of its continuous development. This approach may be suitable for certain programs, allowing them to evolve from temporary endeavours to permanent fixtures that contribute to long-term growth and progress.

Community engagement, stakeholder involvement, and partnerships contribute to program durability, providing a network of partners and champions to advocate for a program that is both impactful and sustainable. By creating inclusive and collaborative structures, stakeholders from various sectors are united in their pursuit of common goals, ensuring that the program's vision and outcomes are shared and supported. The establishment of local and global connections not only extends the program's reach but also secures its cultural relevance and resonance with the community it serves. Financial durability is equally important, with strategies for ongoing funding and the exploration of new revenue streams providing a stable financial base for a program's longevity. The sharing of lessons learned and

best practices among stakeholders fosters a learning environment that promotes continuous improvement and adaptation, ensuring the program remains responsive to changing needs and environments. A holistic approach to program design, which integrates community and stakeholder perspectives with sound financial planning, is essential for creating programs that endure and thrive over time.

A program designed with a clear vision that encompasses durability and scalability has an increased probability to endure and adapt over time. By aligning design with the organisation's broader goals and strategies, the program contributes to achieving key objectives while also leveraging resources effectively. Consequently, the organisation's overall impact and cohesive progression towards shared targets is enhanced. The critical role of long-term planning, monitoring, and evaluation cannot be overstated, as these elements are crucial for tracking progress and facilitating necessary adjustments. A solid theoretical and research foundation supports the program's methodologies and outcomes, providing a credible evidence base for its activities. The ability to adapt to the evolving educational landscape, especially in STEM education, is essential for maintaining relevance and effectiveness. Continuous improvement and the flexibility to modify strategies and approaches as needed are hallmarks of programs that not only aim to make an immediate impact but also strive for lasting impact.

This literature review has confirmed there is a significant gap in our understanding of the factors that ensure STEM education programs in particular have enduring impact. While evidence from other sectors has informed valuable framework for shaping our understanding, a concentrated effort to deepen this understanding for STEM education programs is essential. Each of the categories and themes identified across the diverse fields in this review can be directly applicable to STEM education programs. There are specific contexts relevant to STEM education that are likely to have been insufficiently addressed in this review such as the education system and Australian curriculum. Although the relevant category in this review scored lowest for evidence, this may diminish the role that this factor plays in STEM education, or education more broadly. Similarly, the earlier identified over-reliance of external experts in some STEM education programs could be considered when boosting the capabilities and resources of all project participants. A focus on teacher professional development is another way of sustaining impact. Professional development equips teachers with the skills to continuously improve their STEM knowledge and practice, which is particularly important in the everchanging STEM education landscape. This leads to sustained improvements, rather than temporary boosts that might come from short-term student-focused initiatives. Table 2 outlines some specific ways to apply these findings for STEM education programs.

While all programs are different, a common starting point for enhancing durability should be: "What does durable impact look like for this program?" This question prompts a deep dive into the program's long-term goals, the desired outcomes, and the strategies in place to achieve and maintain them. It encourages a reflective approach to program design and implementation, ensuring that the initiatives are not just effective in the short term but also structured to withstand challenges and adapt to changes over time. The factors presented here can be used to develop a durability framework that can be tested across programs, with

program teams, stakeholders and funding partners to provide real-world validation, identification of any gaps and to allow for context specific customisation.

Table 2. Suggestions for increasing the durability of STEM education programs

Program dynamics	Community and resource dimensions	Strategic foundations
Durable STEM education programs:		
Are designed with a clear vision and long-term goals, and with durability and scalability in mind (specifically an explicit strategy for achieving sustained impact) Are designed with diverse voices and perspectives, which ensures that the program is tailored to the specific needs and challenges of the community it serves, ultimately leading to a more durable program. Have long-term planning, monitoring and evaluation processes in place, including incorporating regular assessment and feedback mechanisms to track progress and make data-driven decisions, and having contingencies for post-program monitoring and evaluation. Are based on robust education, social, and personal theory and research that underpins the design and implementation of the program. Have, built in the from the beginning, adaptability to changing conditions and needs, specifically flexibility to respond to the evolving demands of the STEM industry and the changing interests of students. Have the ability to grow, either in terms of scaling to more locations, different participant groups, or having deeper impact.	Have partnerships within and across institutions, communities, and with external organisations. Building strong relationships with industry professionals, educational institutions, and community organisations can provide valuable resources and support for STEM programs. These partnerships can enhance the real-world relevance of the curriculum and offer students and teachers opportunities for mentorship and hands-on learning experiences. Have stakeholders and partners that are supportive of the program's vision and outcomes. Engaging stakeholders such as educators and community members in the program's development and execution can lead to a more invested and supportive community, which fosters a sense of ownership and shared responsibility. It also ensures that the program is tailored to the specific needs and challenges of the community it serves, ultimately leading to a more durable program. Maintain a stable financial environment with strategies for ongoing funding from diverse sources and exploration of avenues for new revenue streams	Have a vision, values and objectives that align with host organisation, community and industry workforce needs, curriculum, broader educational needs, and relevant policies and regulations Have strategic and effective leadership and program champions, including potentially distributed leadership within community networks and schools Ensure that the program has the necessary support from the hosting organisation that is backed by a committed team can have a positive impact on its durability. Boost the capabilities and resources of all project participants to ensure they continue to apply program impacts into the future Identify and mitigate potential risks early in the project lifecycle

This literature review provides an analysis of the factors that contribute to the durability of programs and projects, with a focus on the strength of these factors. However, it does not address how these factors maintain impact over time. Future research should focus on the impact of these factors, considering their long-term effects and assigning additional weight to them. This will enhance our understanding of durability in the context of program and project management, ensuring that impact is not only achieved but preserved and consolidated over time. Such an approach will provide a more holistic view of durability, encompassing both

immediate success and enduring influence. It is also important to consider the interaction of factors across various levels (e.g., individual, group, program, organisation, system), as well as the challenges related to maintaining consistency and adapting to change.

Conclusion

The literature review emphasises the critical importance of durability in STEM education programs, highlighting its multifaceted nature. It reveals that long-term success hinges on a complex interplay of factors, including organisational capacity, stakeholder engagement, and adaptability. The review advocates for programs to have a clear vision designed with durability and scalability in mind, supported by long-term planning, monitoring, and evaluation. It also emphasises the significance of inclusive and collaborative structures that foster partnerships at various levels, and strategic foundations, which align vision and values with organisational and community needs, led by effective leadership and program champions. Programs which are adaptable, responsive to the evolving demands of the STEM industry, and inclusive of stakeholder engagement are more likely to be durable and produce sustained outcomes. The review calls for a broader understanding of durability, urging a comprehensive approach that integrates insights from various fields to inform the design and implementation of enduring STEM education programs.

Future endeavours should focus on empirical validation of these factors in various educational contexts, longitudinal studies to track the long-term impact of STEM programs, and exploration of diverse educational settings to understand how these factors operate in different cultural and institutional settings. Additionally, an investigation into the role of policy changes, curriculum development, technology integration, teacher professional development, community and societal impact, and sustainable funding models in enhancing the durability of STEM programs would be beneficial.

By addressing these areas, future research can build upon the foundation laid by this review, contributing to the development of STEM education programs that are not only effective in the short term but also have a lasting impact on students, educators, and the broader community. The goal is to ensure that STEM education is a driving force for innovation and progress, equipping future generations with the skills and knowledge necessary to meet the challenges of a rapidly changing world.

References

Abson, D. J., Fischer, J., Leventon, J., Newig, J., Schomerus, T., Vilsmaier, U., … Lang, D. J. (2017). Leverage points for sustainability transformation. *Ambio*, *46*(1). doi:10.1007/s13280-016-0800-y

Altpeter, M., Schneider, E. C., & Whitelaw, N. (2014). Examining Strategies to Build and Sustain Healthy Aging Programming Collaboratives. *Health Education & Behavior*, *41*(1_suppl). doi:10.1177/1090198114537065

Arbelaez-Ruiz, D., Franks, D. M., Sturman, K., & Ezeigbo, C. (2021). *Durable Change-sustaining impact in natural resource governance*. Brisbane, QLD Australia: The University of Queensland. Retrieved from https://assets.contentstack.io/v3/assets/bltdab1ff5a32c89a3e/blt42ccc1e703399c72/63d3583b48166810e8b60237/NRG_Insight_SustainabilityCaseStudy_DurableChange.pdf

Australian Government. (2024). *Pathway to Diversity in STEM Review. Final recommendations*. Retrieved from https://www.industry.gov.au/sites/default/files/2024-02/pathway-to-diversity-in-stem-review-final-report.pdf

Australia's Chief Scientist. (2024). *Dr Foley welcomes release of STEM Career Pathways report*. Retrieved from https://www.chiefscientist.gov.au/news-and-media/dr-foley-welcomes-release-stem-career-pathways-report-0

Bailey, T., Matsuzuka, Y., Jacobs, J., Morest, V., & Hughes, K. (2003). *Institutionalization and Sustainability of the National Science Foundation's Advanced Technological Education Program*. Retrieved from https://ccrc.tc.columbia.edu/media/k2/attachments/institutionalization-sustainability-nsf-ate.pdf

Baum, F., Jolley, G., Hicks, R., Saint, K., & Parker, S. (2006). What makes for sustainable healthy cities initiatives? - A review of the evidence from Noarlunga, Australia after 18 years. *Health Promotion International*. doi:10.1093/heapro/dal023

Bennett, A., Naylor, R., Mellor, K., Brett, M., Gore, J., Harvey, A., … Whitty, G. (2015). *Equity initiatives in Australian Higher Education: A review of evidence of impact*. Retrieved from https://opal.latrobe.edu.au/ndownloader/files/28850364

Bentley, B., Sieben, R., & Unsworth, P. (2022). STEM Education in Australia: Impediments and Solutions in Achieving a STEM-Ready Workforce. *Education Sciences,, 12*(10). doi:10.3390/educsci12100730

Bodkin, A., & Hakimi, S. (2020). Sustainable by design: A systematic review of factors for health promotion program sustainability. *BMC Public Health*, *20*(1). doi:10.1186/s12889-020-09091-9

Burack, C., Melchior, A., & Hoover, M. (2019). Do after-school robotics programs expand the pipeline into STEM majors in college? *Journal of Pre-College Engineering Education Research*, *9*(2). doi:10.7771/2157-9288.1244

Ceptureanu, S. I., Ceptureanu, E. G., Luchian, C. E., & Luchian, I. (2018). Community based programs sustainability. a multidimensional analysis of sustainability factors. *Sustainability (Switzerland)*, *10*(3). doi:10.3390/su10030870

Chalmers, D., & Gardiner, D. (2015). The measurement and impact of university teacher development programs. *Educar, 51*(1). doi:10.5565/rev/educar.655

Cobian, K. P., & Ramos, H. V. (2021). A cross-case analysis of developing program sustainability and institutionalization in early stages of a multisite biomedical student diversity initiative. *BMC Medical Education*, *21*(1). doi:10.1186/s12909-021-02663-2

Deehan, J., Danaia, L., Redshaw, S., Dealtry, L., Gersbach, K., & Bi, R. (2024). STEM in the classroom: a scoping review of emerging research on the integration of STEM education within Australian schools. *Australian Educational Researcher*. doi:10.1007/s13384-024-00691-7

Edwards, D., Buckley, S., Chiavaroli, N., Rothman, S., & McMillan, J. (2023). The STEM pipeline: pathways and influences on participation and achievement of equity groups. *Journal of Higher Education Policy and Management, 45*(2), 206–222. https://doi.org/10.1080/1360080X.2023.2180169

Han, J., Kelley, T., & Knowles, J. G. (2023). Building a sustainable model of integrated stem education: investigating secondary school STEM classes after an integrated STEM project. *International Journal of Technology and Design Education*, *33*(4). doi:10.1007/s10798-022-09777-8

Hasim, S. M., Rosli, R., Halim, L., Capraro, M. M., & Capraro, R. M. (2022). STEM Professional Development Activities and Their Impact on Teacher Knowledge and Instructional Practices. *Mathematics*, *10*(7). doi:10.3390/math10071109

Henríquez Fernández, C., Barr, C., Antoine, A., Alston, C., & Nichol, C. (2021). Long-Term Impact of Teacher Professional Development on Black Female Students' Engagement in STEM. *The Journal of STEM Outreach*, *6*(1). doi:10.15695/jstem/v6i1.01

Hodge, L. M., & Turner, K. M. T. (2016). Sustained Implementation of Evidence-based Programs in Disadvantaged Communities: A Conceptual Framework of Supporting Factors. *American Journal of Community Psychology*. doi:10.1002/ajcp.12082

Johnson, M. D., Margell, S. T., Goldenberg, K., Palomera, R., & Sprowles, A. E. (2023). Impact of a First-Year Place-Based Learning Community on STEM Students' Academic Achievement in their Second, Third, and Fourth Years. *Innovative Higher Education*, *48*(1). doi:10.1007/s10755-022-09616-7

Lam, D. P. M., Martín-López, B., Wiek, A., Bennett, E. M., Frantzeskaki, N., Horcea-Milcu, A. I., & Lang, D. J. (2020). Scaling the impact of sustainability initiatives: a typology of amplification processes. *Urban Transformations*, *2*(1). doi:10.1186/s42854-020-00007-9

Li, Y., Xiao, Y., Wang, K., Zhang, N., Pang, Y., Wang, R., … Star, J. R. (2022). A systematic review of high impact empirical studies in STEM education. *International Journal of STEM Education*. doi:10.1186/s40594-022-00389-1

Loh, L. C., Friedman, S. R., & Burdick, W. P. (2013). Factors promoting sustainability of education innovations: A comparison of faculty perceptions and existing frameworks. *Education for Health: Change in Learning and Practice*, *26*(1). doi:10.4103/1357-6283.112798

Luke, D. A., Calhoun, A., Robichaux, C. B., Moreland-Russell, S., & Elliott, M. B. (2014). The program sustainability assessment tool: A new instrument for public health programs. *Preventing Chronic Disease*, *11*(2014). doi:10.5888/pcd11.130184

Mancini, J. A., & Marek, L. I. (2004). Sustaining community-based programs for families: Conceptualization and measurement. *Family Relations*, *53*(4). doi:10.1111/j.0197-6664.2004.00040.x

McCreight, M. S., Rabin, B. A., Glasgow, R. E., Ayele, R. A., Leonard, C. A., Gilmartin, H. M., … Battaglia, C. T. (2019). Using the Practical, Robust Implementation and Sustainability Model (PRISM) to qualitatively assess multilevel contextual factors to help plan, implement,

evaluate, and disseminate health services programs. *Translational Behavioral Medicine*, *9*(6). doi:10.1093/tbm/ibz085

Pressick-Kilborn, K., Silk, M., & Martin, J. (2021). STEM and STEAM Education in Australian K–12 Schooling. In *Oxford Research Encyclopedia of Education*. doi:10.1093/acrefore/9780190264093.013.1684

Ramirez-Castaneda, V. (2020). Disadvantages in preparing and publishing scientific papers caused by the dominance of the English language in science: The case of Colombian researchers in biological sciences. *PLoS ONE 15*(9): e0238372. https://doi.org/10.1371/journal.pone.0238372

Rhoades, B. L., Bumbarger, B. K., & Moore, J. E. (2012). The Role of a State-Level Prevention Support System in Promoting High-Quality Implementation and Sustainability of Evidence-Based Programs. *American Journal of Community Psychology*, *50*(3–4). doi:10.1007/s10464-012-9502-1

Rubio, M. A., Guevara-Aladino, P., Urbano, M., Cabas, S., Mejia-Arbelaez, C., Rodriguez Espinosa, P., … Sarmiento, O. L. (2022). Innovative participatory evaluation methodologies to assess and sustain multilevel impacts of two community-based physical activity programs for women in Colombia. *BMC Public Health*, *22*(1). doi:10.1186/s12889-022-13180-2

Santos, R., Anderson, D., & Milner-Bolotin, M. (2023). Research trends in international science, technology, engineering, and mathematics education conference series: An analysis of a decade of proceedings. *Frontiers in Education*, *7*. doi:10.3389/feduc.2022.1099658

Sarriot, E., Yurkavitch, J., Ryan, L., The Sustained Health, & Outcomes (SHOUT) Group. (2008). Taking the Long View : A Practical Guide to Sustainability Planning and Measurement in Community- Oriented Health Programming. *Manual*.

Scheirer, M. A. (2005). Is sustainability possible? A review and commentary on empirical studies of program sustainability. *American Journal of Evaluation*, *26*(3). doi:10.1177/1098214005278752

Scheirer, M. A., & Dearing, J. W. (2011). An agenda for research on the sustainability of Public Health Programs. *American Journal of Public Health*, *101*(11). doi:10.2105/AJPH.2011.300193

Schell, S. F., Luke, D. A., Schooley, M. W., Elliott, M. B., Herbers, S. H., Mueller, N. B., & Bunger, A. C. (2013). Public health program capacity for sustainability: A new framework. *Implementation Science*, *8*(1). doi:10.1186/1748-5908-8-15

Shahali, E. H. M., Halim, L., Rasul, M. S., Osman, K., & Arsad, N. M. (2019). Students' interest towards STEM: a longitudinal study. *Research in Science and Technological Education*, *37*(1). doi:10.1080/02635143.2018.1489789

Shediac-Rizkallah, M. C., & Bone, L. R. (1998). Planning far the sustainability of community-based health programs: Conceptual frameworks and future directions for research, practice and policy. *Health Education Research*, *13*(1). doi:10.1093/her/13.1.87

Stevens, B., & Peikes, D. (2006). When the funding stops: Do grantees of the Local Initiative Funding Partners Program sustain themselves? *Evaluation and Program Planning*, *29*(2). doi:10.1016/j.evalprogplan.2006.01.009

Thomas, S., & Zahn, D. (2010). *Sustaining improved outcomes: A toolkit*. Retrieved from https://nyhealthfoundation.org/wp-content/uploads/2017/11/sustaining-improved-outcomes-toolkit.pdf

Timms, M., Moyle, K., Weldon, P.R. & Mitchell, P. (2018). Challenges in STEM learning in Australian schools: Literature and policy review. Australian Council for Education Research.

Retrieved from https://research.acer.edu.au/cgi/viewcontent.cgi?article=1028&context=policy_analysis_misc

Walker, L., & Banks, C. (2021). *Indigenous STEM Education Project - Final Evaluation Report*. Canberra, Australia.

Wiltsey Stirman, S., Kimberly, J., Cook, N., Calloway, A., Castro, F., & Charns, M. (2012). The sustainability of new programs and innovations: A review of the empirical literature and recommendations for future research. *Implementation Science*. doi:10.1186/1748-5908-7-17

Appendix A: Literature used to identify program durability factors

Literature included in the analysis and the fields of study related to the publication.

Author/s	Year	Field
Abson et al.	2017	Environment
Altpeter et al.	2014	Health
Arbelaez-Ruiz et al.	2021	Environment
Baum et al.	2006	Health
Bennett et al.	2015	Higher Education
Bodkin & Hakimi	2020	Health
Calhoun et al.	2014	Health
Ceptureanu et al.	2018	Social Science
Chalmers & Gardiner	2015	Higher Education
Cobian & Ramos	2021	STEM Education
Hodge & Turner	2016	Health
Lam et al.	2020	Sustainability
Loh et al.	2013	Education
Mancini & Marek	2004	Social Science
McCreight et al.	2019	Health
Rhoades et al.	2012	Health
Rubio et al.	2022	Health
Sarriot et al.	2008	Health
Scheirer & Dearing	2011	Health
Scheirer	2005	Health
Schell et al.	2013	Health
Shediac-Rizkallah & Bone	1998	Health
Stevens & Peikes	2006	Social Science
Thomas & Zahn	2010	Sustainability
Wiltsey Stirman et al.	2012	Health

Appendix B. Factors, categories, and themes

PROGRAM DYNAMICS: Program design and implementation

Factor	Description	Reference
Strong vision	A clear and comprehensive vision	Baum *et al.* (2006)
Strategic Planning	Long-term planning to guide program direction and sustainability efforts.	Schell *et al.* (2013)
Strategic Planning	This involves defining program direction, goals, and strategies, with an emphasis on integration into existing organizational structures.	Bodkin and Hakimi (2020)
Spread	The dissemination and adoption of improved outcomes beyond the initial implementation.	Thomas and Zahn (2010)
Specific sustainability actions and processes	Organisational actions and processes designed to enhance sustainability.	Ceptureanu *et al.* (2018)
Recognition of the Project as a Solution	Being recognised as a viable solution to social problems enhances project credibility and support.	Stevens and Peikes (2006)
Program Implementation	This refers to the process of carrying out program activities, with a focus on involvement of external partners.	Bodkin and Hakimi (2020)
Program Design	Programs should be designed from the planning stage to build an evidence base that allows for complex questions about impact	Chalmers and Gardiner (2015)
Nature of Project's Design and Selected Strategy	The design should have clear long-term goals and objectives, be transferable to other departments, and allow for further research/initiatives.	Loh, Friedman and Burdick (2013)
Multilevel Impacts	Programs that address various levels of the socioecological model (individual, social, and community) are more likely to be sustainable by fostering a holistic approach to change.	Rubio *et al.* (2022)
Long-term Planning Capacity	The ability to develop and implement long-term plans for securing funds and sustaining operations.	Stevens and Peikes (2006)
Early sustainability planning	Developing strategies for program continuation from the early stages of implementation.	Cobian and Ramos (2021)
Continuing Program Activities or Components	Sustaining specific activities or components of the original intervention rather than viewing sustainability as a binary outcome.	Scheirer and Dearing (2011)
Communications	Effective communication strategies to promote the program and its benefits.	Schell *et al.* (2013)
Communication	Effective communication strategies to promote the program's goals and achievements.	Calhoun *et al.* (2014)

PROGRAM DYNAMICS: Monitoring, evaluation, and learning

Factor	Description	Reference
Systematic and Extended Evaluation	This calls for a consistent and long-term approach to assessing the effectiveness of teacher development programs.	Chalmers and Gardiner (2015)
Sound conceptual frameworks to guide research	Theoretical models that provide a clear understanding of sustainability factors.	Wiltsey Stirman *et al.* (2012)
Shared Measurement Systems	Developing and utilising common metrics to measure progress and impact collectively.	Altpeter, Schneider and Whitelaw (2014)
Robust Theory and Research Base	Effective programs are grounded in strong theoretical frameworks and research, ensuring they are well-designed and evidence-based.	Bennett *et al.* (2015)
Project Outcomes	The project should address specific and recurring needs, be equitably distributed among stakeholders, and result in increased awareness of the issue addressed.	Loh, Friedman and Burdick (2013)
Program theory	The existence of a clear framework outlining the program's goals, target population, and expected outcomes.	Ceptureanu *et al.* (2018)
Program Evaluation	Ongoing assessment and improvement of program activities.	Calhoun *et al.* (2014)

Factor	Description	Reference
Program Evaluation	Ongoing assessment and evaluation to measure program impact and inform improvements.	Schell *et al.* (2013)
Program evaluation	The program's ability to align its characteristics with the needs of its stakeholders.	Ceptureanu *et al.* (2018)
Program Evaluation	This involves monitoring and evaluating program activities and outcomes, including data collection and analysis.	Bodkin and Hakimi (2020)
Program effectiveness	The program's ability to document its successes and disseminate them among stakeholders.	Ceptureanu *et al.*, (2018)
Perceived Benefits	Readily perceived benefits to staff members and/or clients.	Scheirer (2005)
Monitoring, Evaluation, and Learning	Effective sustainability relies on evidence-based practices. Regular evaluations, including ex-post evaluations, help to understand the long-term impacts and improve program design and implementation.	Arbelaez-Ruiz *et al.* (2021)
Monitoring and Feedback	Systems in place to track progress and provide feedback on the sustainability of outcomes.	Thomas and Zahn (2010)
Monitoring and Evaluation Strategies	The project should have established monitoring and evaluation strategies, including future assessments and checkpoints at appropriate intervals.	Loh, Friedman and Burdick (2013)
Monitoring and Evaluation	Implementing robust monitoring and evaluation systems to track progress and inform continuous improvement.	Sarriot *et al.* (2008)
Monitoring and Evaluation	Continuous monitoring and evaluation to track progress, make necessary adjustments, and demonstrate the impact of the project.	Abson *et al.* (2017)
Monitoring and Evaluation	Regular assessment and evaluation of program processes and outcomes to inform continuous improvement.	McCreight *et al.*, (2019)
Fidelity monitoring and evaluation	Regular assessments to ensure the program is being implemented as intended and achieving its desired outcomes.	Wiltsey Stirman *et al.* (2012)
Fidelity Monitoring	Regular monitoring and evaluation of program implementation to ensure adherence to the original program design, which is critical for achieving desired outcomes.	Rhoades, Bumbarger and Moore (2012)
Evaluation and Feedback Mechanisms	Implementing evaluation and feedback mechanisms helps in continuous improvement and demonstrates the program's effectiveness to stakeholders.	Rhoades, Bumbarger and Moore (2012)
Evaluation	Documented effectiveness through evaluation.	Scheirer (2005)
Effective Evaluation	Ongoing, rigorous evaluation helps refine programs and demonstrate their value, securing continued support and funding.	Bennett *et al.* (2015)
Early and Ongoing Planning	Sustainability must be integrated from the design stage through implementation and beyond. Continuous planning involves adaptive strategies that can respond to changing circumstances and stakeholder needs.	Arbelaez-Ruiz *et al.* (2021)
Demonstrating Program Results	Regular evaluation and reporting of program outcomes build credibility and trust among stakeholders. Demonstrating tangible results helps in justifying the continuation and expansion of the program.	Mancini and Marek (2004)
Demonstrated effectiveness of the program or intervention	Evidence showing that the program achieves its intended outcomes.	Wiltsey Stirman *et al.* (2012)
Comprehensive measurement strategies to assess sustainability at multiple levels	Robust methods to evaluate sustainability across different dimensions and contexts, ensuring a holistic understanding of the program's impact and longevity.	Wiltsey Stirman *et al.* 2012)
Communications	This refers to strategic communication of program outcomes, results, and activities with stakeholders, decision-makers, and the public.	Bodkin and Hakimi (2020)
Communication and Feedback Mechanisms	Effective communication channels and feedback loops to facilitate information flow and stakeholder input.	McCreight *et al.* (2019)

PROGRAM DYNAMICS: Adaptability and responsiveness

Factor	Description	Reference
Transferring	This involves taking an initiative and implementing a similar but independent one in a different place, adapted to a new but similar context.	Lam *et al.* (2020)
Timing	The project should have a defined time schedule with flexibility to adjust activities based on participant readiness.	Loh, Friedman and Burdick (2013)
Spreading	This involves disseminating core principles and approaches to other places with a dissimilar context, often through online platforms, publications, and personal exchange.	Lam *et al.* (2020)
Speeding Up	This involves increasing the pace at which initiatives create change, often through efficiency improvements.	Lam *et al.* (2020)
Scaling and adapting to expand programmatic impact	Expanding the reach of successful program elements to serve more students or adapting interventions to fit institutional needs.	Cobian and Ramos (2021)
Responsivity	The ability of the program to adapt to changing community needs.	Ceptureanu *et al.* (2018)
Responsive and Accessible Initiatives	Programs that are easily accessible and responsive to student needs are more likely to be used and valued, contributing to their sustainability.	Bennett *et al.* (2015)
Replicating	This refers to copying an initiative into a dissimilar context, adapting it to local conditions.	Lam *et al.* (2020)
Quality improvement processes	Continuous efforts to enhance the program based on feedback and evaluation results.	Wiltsey Stirman *et al.* (2012)
Program Responsivity	Programs that can adapt to changing conditions and evolving community needs are more likely to endure. Responsivity ensures that the program remains relevant and effective, even as circumstances change.	Mancini and Marek (2004)
Program flexibility	The program's ability to adapt to changing circumstances.	Ceptureanu *et al.* (2018)
Program Adaptation	The ability to adapt to changing conditions and needs.	Calhoun *et al.* (2014)
Program Adaptation	Allowing programs to adapt to local contexts while maintaining core components ensures relevance and sustainability.	Rhoades, Bumbarger and Moore (2012)
Program Adaptation	The ability of the program to adapt to changing conditions and needs.	Schell *et al.* (2013)
Program Adaptation	This refers to the program's ability to adjust to changing needs, research knowledge, and environmental conditions.	Bodkin and Hakimi (2020)
Program Adaptability	The ability of the program to be tailored to meet the specific needs of the target population.	Hodge and Turner (2016)
Organisational Flexibility	The ability of the project to adjust staffing structures and program activities without altering basic operations.	Stevens and Peikes (2006)
Modifiability	Programs that can be adapted to meet local needs and conditions are more likely to be sustained.	Scheirer (2005)
Growing	This involves expanding the impact range of an initiative without changing its core approach (e.g., expanding geographically or increasing service offerings).	Lam *et al.* (2020)
Adaptive Management	Regularly assessing program effectiveness and adapting based on feedback and changing needs is vital for sustainability.	Rubio *et al.* (2022)
Adaptation Skills	Ability to perceive changes in the environment and respond flexibly with creative solutions to emerging challenges.	Altpeter, Schneider and Whitelaw (2014)
Adaptability and flexibility of the program	The program's ability to be adjusted in response to changing needs and circumstances.	Wiltsey Stirman *et al.* (2012)
Adaptability and Flexibility	Programs should be adaptable to changing conditions and flexible enough to incorporate new information and feedback.	Sarriot *et al.* (2008)
Adaptability and Flexibility	Ability of the program to adapt to changing conditions and feedback, ensuring it remains relevant and effective.	Abson *et al.* (2017)
Adaptability and Flexibility	The ability of the program to adapt to changing conditions and needs.	McCreight *et al.* (2019)
Ability to Juggle Competing Demands	The capacity to navigate and balance competing priorities and stakeholders, fostering collaboration and consensus-building among different interests.	Baum *et al.* (2006)

COMMUNITY AND RESOURCE DIMENSIONS: Financial and resource management

Factor	Description	Reference
Technical Assistance on Fundraising	Receiving expert advice on fundraising strategies enhances the ability to secure new funds.	Stevens and Peikes (2006)
Sustained Effort and Investment	Continuous effort and investment are crucial for maintaining the impact of equity initiatives over the long term.	Bennett *et al.* (2015)
Strategic Funding	A well-planned funding strategy ensures that the program has the necessary financial resources to operate both now and in the future.	Mancini and Marek (2004)
Revenue-Generating Activities	Developing new revenue streams, such as user fees, helps projects become financially independent.	Stevens and Peikes (2006)
Resource Availability	Availability of funding and other resources.	Scheirer (2005)
Project Financing	Secure and reliable financial resources are crucial for program sustainability.	Shediac-Rizkallah and Bone (1998)
Project Duration	Short-term funding cycles often undermine long-term sustainability efforts.	Shediac-Rizkallah and Bone (1998)
Program funding	The availability of financial resources to support the program.	Ceptureanu *et al.* (2018)
Ongoing support and reinforcement	Continuous encouragement and resources provided to maintain the program	Wiltsey Stirman *et al.* (2012)
Market Mechanisms	Creating business models that benefit the cause and promote sustainability by making markets work in favor of the program.	Altpeter, Schneider and Whitelaw (2014)
Low-cost Delivery	Use of volunteers or other low-cost delivery methods	Scheirer (2005)
Involvement of Local Funders	Engagement of local funders ensures diversified funding sources.	Stevens and Peikes, 2006)
Involvement of Local Funders	Engagement of local funders who can provide financial support and guidance.	Stevens and Peikes (2006)
Individual Donor Pools	Building a pool of individual donors ensures a steady stream of funding.	Stevens and Peikes (2006)
Identifying additional funding and cost-cutting measures	Securing new funding sources or implementing cost-saving strategies to sustain programs beyond the grant period.	Cobian and Ramos (2021)
Funding Stability	The ability to secure consistent and reliable funding.	Calhoun *et al.* (2014)
Funding Stability	Long-term financial support ensures the continuous operation of programs and allows for planning and implementation without frequent interruptions.	Rhoades, Bumbarger and Moore (2012)
Funding Stability	Ongoing and consistent financial support for the program.	Schell *et al.* (2013)
Funding Stability	This refers to securing stable and diverse funding sources to ensure the long-term viability of the program.	Bodkin and Hakimi (2020)
Funding Sources	Nature of the original sources of financing. Availability of various funding sources or transfer of support to local government sources.	Scheirer (2005)
Funding partner factors	The project should align with donor standards, have flexible donors, provide donors with their desired level of control, and have long-term support from committed donors.	Loh, Friedman and Burdick (2013)
Funding	The financial resources available to support the ongoing sustainability of outcomes.	Thomas and Zahn (2010)
Financial Sustainability	Ensuring financial sustainability at the local level is critical. This involves building financial management skills and creating mechanisms to secure long-term funding and resource allocation.	Arbelaez-Ruiz *et al.* (2021)
Financial Sustainability	Ensuring program has stable financial base/strategies for continued funding.	Sarriot *et al.* (2008)
Financial Sustainability	Developing strategies to ensure ongoing financial resources, including local funding mechanisms and cost-recovery strategies.	Abson *et al.* (2017)
Financial Stability	Secure and adequate funding to support program activities over the long term.	McCreight *et al.* (2019)
Capacity for Securing Adequate Resources	The project should have a strategy to secure adequate resources and be self-sustaining.	Loh, Friedman and Burdick (2013)

Availability of funding and resources	Sufficient financial and material resources to support the program over the long term.	Wiltsey Stirman *et al.* (2012)
Aggressive Funding Pursuit	Proactive efforts by the project to secure new funding sources.	Stevens and Peikes (2006)

COMMUNITY AND RESOURCE DIMENSIONS: Stakeholder engagement and partnerships

Factor	**Description**	**Reference**
University Links and Research Focus	A strong partnership with a university to provide academic expertise, research support, and capacity building for the initiative, contributing to its evidence-based approach and ongoing learning.	Baum *et al.* (2006)
Transparency	Informing stakeholders about the program's processes and outcomes using recognised methods.	Ceptureanu *et al.* (2018)
Support and participation of key stakeholders	Engagement and backing from individuals and groups who have a vested interest in the program's success.	Wiltsey Stirman *et al.* (2012)
Strong Collaboration	Collaboration between institutions and communities, and within universities, enhances resource sharing, support networks, and overall program impact.	Bennett *et al.* (2015)
Stakeholder Involvement	Involving local stakeholders during the start-up and design process.	Scheirer (2005)
Stakeholder Engagement	Active involvement of all relevant stakeholders, including local communities, government bodies, and other organizations, in the planning and implementation of the project.	Abson *et al.* (2017)
Stakeholder Engagement	The involvement and commitment of all stakeholders, including staff, participants, and external partners.	McCreight *et al.* (2019)
Shared Models	Common frameworks or approaches shared among stakeholders that support sustained outcomes.	Thomas and Zahn (2010)
Project Negotiation Process	This is the process of engaging with all key stakeholders, including the community, funding agencies, and technical experts, in a collaborative effort to design and refine program approaches and goals.	Shediac-Rizkallah and Bone (1998)
Political Support	Endorsement and backing from political entities and stakeholders.	Schell *et al.* (2013)
Perceived Value	The extent to which the improved outcomes are seen as valuable by stakeholders and the community.	Thomas and Zahn (2010)
Partnerships	Collaborations with other organisations and stakeholders.	Calhoun *et al.* (2014)
Partnerships	Collaboration with other organisations and stakeholders.	Schell *et al.* (2013)
Partnerships	Partnerships are crucial for sustainability, bringing in additional resources, expertise, and facilitating service delivery.	Bodkin and Hakimi (2020)
Partners	The role of external partners in supporting and sustaining improved outcomes.	Thomas and Zahn (2010)
Partnering	The host organisation's ability to initiate and maintain relationships with multiple partners.	Ceptureanu *et al.* (2018)
Ownership	The project should foster a sense of ownership and motivation among stakeholders.	Loh, Friedman and Burdick (2013)
Nurturing Nonprofit Networks	Building and maintaining a network of nonprofit organisations that work together to coordinate efforts and enhance overall impact.	Altpeter, Schneider and Whitelaw (2014)
Multi-Sectoral Collaboration	Collaboration between different sectors, such as government, non-profit organisations, and healthcare providers, is crucial for program sustainability by providing diverse resources and expertise.	Rubio *et al.* (2022)
Maintaining Community-Level Partnerships or Coalitions	Sustaining the coalitions or partnerships developed during the program, which can lead to new activities or benefits even if the original program does not continue.	Scheirer and Dearing (2011)
Leveraging relationships with intra- and inter-institutional partners	Building collaborations within the institution and with external partners to support program goals.	Cobian and Ramos (2021)
International Links	Establishing and maintaining connections with international networks and organisations, fostering a global perspective, sharing best practices, and promoting cross-cultural learning.	Baum *et al.* (2006)
Host Organization Support	Projects with strong backing from their host organizations are more likely to survive.	Stevens and Peikes, 2006)

Factor	Description	Reference
External Support	The level of support from external stakeholders and the community.	Calhoun *et al.* (2014)
External Support	The project should have financial support from national/regional/community government agencies, policies and program support from various government agencies, support from other organizations, and socio-economic support/financing.	Loh, Friedman and Burdick (2013)
External Environment	The influence of external policies, economic conditions, and societal factors that can impact the program's sustainability.	McCreight *et al.* (2019)
External Championship by Community Leaders	Support from local leaders provides critical resources and advocacy for the project.	Stevens and Peikes (2006)
External Championship by Community Leaders	Support from community leaders who can link projects to new resources, provide advice, and deflect criticism.	Stevens and Peikes (2006)
Effective Collaboration	By engaging community members, organizations, and other relevant parties, the program can build a broad base of support. Collaborative efforts lead to shared responsibilities and resources, enhancing the program's ability to address challenges and leverage opportunities. This network of support is crucial for sustaining the program over time.	Mancini and Marek (2004)
Education by Local Foundations	Training and education provided by local foundations on raising funds and managing money.	Stevens and Peikes (2006)
Dissemination of Success Stories	Publicising project successes helps in attracting new donors and supporters.	Stevens and Peikes (2006)
Continuous Communications	Maintaining ongoing communication among all stakeholders to ensure alignment and address issues promptly.	Altpeter, Schneider and Whitelaw (2014)
Community Participation	Active involvement and engagement of the community in the design, implementation, and evaluation of programs are essential for sustainability.	Shediac-Rizkallah and Bone (1998)
Community Ownership	When community members feel a sense of ownership over a program, they are more likely to support it and ensure its longevity.	Rubio *et al.* (2022)
Collaboration and Partnerships	Building strong collaborations and partnerships among researchers, practitioners, and policymakers enhances resource sharing and support.	Rhoades, Bumbarger and Moore (2012)
Collaboration among stakeholders	Active cooperation and coordination among all parties involved in the program.	Wiltsey Stirman *et al.* (2012)
Capacity Building	Building the capacity of local stakeholders, including training and resources, to manage and sustain the program independently.	Sarriot *et al.* (2008)
Backbone Support Organisations	Establishing central organizations that provide support and coordination for collective activities and mutual goals.	Altpeter, Schneider and Whitelaw (2014)

COMMUNITY AND RESOURCE DIMENSIONS: Community and societal factors

Factor	Description	Reference
System Change Approaches	Sustainability may be influenced by broader systemic factors, including environmental and financial contexts in which the program operates.	Scheirer and Dearing (2011)
Understanding the Community	Programs that respect and involve community members can better mobilise local resources and support, ensuring that the program remains relevant and valued, thereby sustaining its operations.	Mancini and Marek (2004)
Understanding the community	The program's ability to identify and integrate community needs and resources.	Ceptureanu *et al.* (2018)
Strongly Supported Community Involvement	Active and sustained engagement of community members, ensuring their participation in decision-making, implementation, and evaluation of the initiative.	Baum *et al.* (2006)
Socioeconomic and Political Stability	Stability and favourability of external socioeconomic and political factors.	Scheirer (2005)
Scaling Deep	This involves changing people's values, norms, and beliefs through the work of the initiative.	Lam *et al.* (2020)
Recipient Characteristics	The demographics, needs, and engagement levels of the program's target population.	McCreight *et al.* (2019)
Public Awareness of the Social Problem	Increased public awareness creates a supportive environment for the project.	Stevens and Peikes (2006)

Factor	Description	Reference
Public Awareness and Recognition	Public awareness of the social problem and recognition of the project as a solution.	Stevens and Peikes (2006)
Project Effectiveness	Programs must be perceived as successful and impactful to gain community support.	Shediac-Rizkallah and Bone (1998)
Population Targeted for Project	The project should clearly define the population targeted for intervention, ensuring its communication plan informs key stakeholders and fosters significant community participation.	Loh, Friedman and Burdick (2013)
Model Adapted to Local Conditions	A flexible and adaptable framework that can be tailored to meet the specific needs and context of the community, embracing local realities and resources.	Baum *et al.* (2006)
Locally Led Processes	Sustainability depends on local ownership and leadership. Addressing power imbalances between global north and south partners is crucial to ensure that interventions are relevant and adaptable to local contexts.	Arbelaez-Ruiz *et al.* (2021)
Inspiring Evangelists	Creating meaningful experiences for volunteers and supporters to inspire them to become advocates for the cause.	Altpeter, Schneider and Whitelaw (2014)
Factors in the Community Environment	Partnerships leading to non-monetary support and the availability of other funders or funding sources in the community contribute to program sustainability.	Scheirer and Dearing (2011)
Factors in the Broader Community Environment	Socioeconomic and political conditions within the community, such as poverty, unemployment, and political instability, can significantly impact program sustainability.	Shediac-Rizkallah and Bone (1998)
Dense Networks of Social Service Organisations	A resource-rich environment with many social service organizations that can provide support.	Stevens and Peikes (2006)
Cultural Relevance	Ensuring that programs are culturally relevant and tailored to the local context.	Sarriot *et al.* (2008)
Community Support	Support from external community leaders and other stakeholders in the community	Scheirer (2005)
Community Support	Engagement and backing from the community served by the program.	Schell *et al.* (2013)
Community support	Community involvement in providing additional resources, such as financial contributions.	Ceptureanu *et al.* (2018)
Community participation	Community awareness and involvement in program planning and implementation.	Ceptureanu *et al.* (2018)
Community Ownership and Participation	Ensuring that the local community has a sense of ownership and actively participates in the program.	Sarriot *et al.* (2008)
Community Ownership	Ensuring that the community feels ownership over the project, increasing their commitment to sustaining it.	Abson *et al.* (2017)
Community Fit	The degree to which improved outcomes align with community needs and values	Thomas and Zahn (2010)
Community Engagement	Involving the community in the planning, implementation, and evaluation of programs is crucial for fostering ownership and long-term sustainability.	Rubio *et al.* (2022)
Community Engagement	The involvement and buy-in of the community in the program's implementation.	Hodge and Turner (2016)
Community context	Contextual factors affecting the community, such as relations with government and social inequalities.	Ceptureanu *et al.* (2018)
Community Capacity	The community's ability to provide additional financial resources and support decision-making processes.	Stevens and Peikes (2006)
Community capacity	Community capability in terms of target group availability.	Ceptureanu *et al.* (2018)
Community and Stakeholder Engagement	Involving community members and stakeholders in program planning and implementation increases local investment, relevance, and support.	Rhoades, Bumbarger and Moore, (2012)
Advocacy Mechanisms	Developing structures to advocate for community issues, generate necessary legislation, and secure resources.	Altpeter, Schneider and Whitelaw (2014)

STRATEGIC FOUNDATION: Leadership and governance

Factor	Description	Reference
Supervision and Peer Support	Regular supervision and peer support mechanisms for staff.	Hodge and Turner (2016)
Strong Project Management	Effective management is crucial in securing local philanthropic support and developing revenue-generating activities.	Stevens and Peikes (2006)
Strong Project Management	Effective management that secures local philanthropic support, develops revenue-generating activities, builds donor pools, and capitalises on technical assistance.	Stevens and Peikes (2006)
Strong Leadership	Leadership that can embed the project in local networks of supporters and use evaluation results for marketing.	Stevens and Peikes (2006)
Sharing of Leadership	Leadership is distributed among various stakeholders, blurring the lines between internal and external boundaries. This involves collaborative decision-making and shared responsibilities.	Altpeter, Schneider and Whitelaw (2014)
Senior administrative support	Gaining buy-in and active support from high-level institutional leaders.	Cobian and Ramos (2021)
Program Champions/Leadership	Strong and influential leaders who advocate for the program and its continuation are vital for sustainability	Shediac-Rizkallah and Bone (1998)
Program champions	Individuals or organizations who promote the program in the community	Ceptureanu *et al.* (2018)
Program Champion	Presence of a strategically placed individual who can foster program continuation. Well defined roles of a program champion who drives the program forward.	Scheirer (2005)
Program Champion	This refers to an influential individual who advocates for the program's success, often securing resources and advocating for its continuation	Bodkin and Hakimi (2020)
Organisational Support	Strong support from the organisation's leadership and management, including provision of resources, encouragement, and advocacy for the program.	McCreight *et al.* (2019)
Leadership Competence	Effective leadership is critical for maintaining the direction and focus of a program. Competent leaders can articulate a clear vision, ensure proper planning, and oversee implementation. They secure necessary resources, manage finances effectively, and support and supervise staff. Strong leadership fosters a culture of continuous improvement and adaptation, which is essential for the long-term sustainability of the program.	Mancini and Marek (2004)
Leadership and Administrative Support	Effective leadership and administrative support are crucial for guiding and maintaining program goals, securing resources, and fostering an environment conducive to program success.	Rhoades, Bumbarger and Moore (2012)
Leadership	The presence of committed leaders who drive the sustainability agenda and inspire others	Thomas and Zahn (2010)
Leadership	The host organisation's ability to establish organiational goals, integrate program development, and be proactive in achieving those goals.	Ceptureanu *et al.* (2018)
Inspirational Leadership	The presence of passionate and dedicated leaders with the skills, experience, and vision to guide and motivate the initiative towards its goals.	Baum *et al.* (2006)
Effective Management and Leadership	The project should have the correct staff at appropriate levels for long-term support, significant management and operational support, and a leader in a position of management/authority.	Loh, Friedman and Burdick (2013)
Effective leadership and management	Leaders who are committed to the program and possess the skills to manage and sustain it.	Wiltsey Stirman *et al.* (2012)

STRATEGIC FOUNDATION: Policy and legislative support

Factor	Description	Reference
Supportive policies and legislation	Presence of policies and legal frameworks that support the ongoing implementation of the program	Wiltsey Stirman *et al.* (2012)
Scaling Up	This involves changing the rules or logics of incumbent regimes (e.g., through policy changes) to codify the impact of initiatives.	Lam *et al.* (2020)
Political Support	This refers to the political environment surrounding the program, including both internal and external support.	Bodkin and Hakimi (2020)
Political legitimation	The program's ability to adapt to relevant policies and regulations.	Ceptureanu *et al.* (2018)
Political and Institutional Support	Gaining support from local and national political and institutional entities to ensure program alignment with broader policies and priorities.	Sarriot *et al.* (2008)
Policy-Oriented Research	Broader policy environment, including changes in federal funding policies, can impact the sustainability of specific health programs.	Scheirer and Dearing (2011)
Policy Integration	Aligning the project with existing policies and regulations to ensure it is supported and facilitated by the broader policy environment.	Abson *et al.* (2017)
Policy and Funding Alignment	Ensuring that policies and funding streams are aligned with program goals supports sustainability by providing a stable framework and resources.	Rhoades, Bumbarger and Moore (2012)
Maintaining New Organisational Practices, Procedures, and Policies	The extent to which new practices, procedures, and policies initiated during the program are maintained within the host organisation.	Scheirer and Dearing (2011)
Government Policies	The influence of government policies and regulations on the sustainability of outcomes.	Thomas and Zahn (2010)

STRATEGIC FOUNDATION: Integration and alignment

Factor	Description	Reference
Systems Perspective	A holistic view that considers the interconnectedness of financial, economic, social, environmental, and institutional capacities. This perspective ensures that all aspects of the system are supported and can sustain the program's benefits.	Arbelaez-Ruiz *et al.* (2021)
Strategic Planning	Long-term planning to guide program development and sustainability.	Calhoun *et al.* (2014)
Organisational Fit	How well the improved outcomes align with the organisation's mission, values, and priorities.	Thomas and Zahn (2010)
Organisational Fit	Alignment with the organisation’s mission and operating procedures.	Scheirer (2005)
Mutually Reinforcing Activities	Ensuring that the activities of various organisations complement and support each other.	Altpeter, Schneider and Whitelaw (2014)
Integration with Local Systems	Programs should be integrated into existing local systems and structures rather than functioning as standalone projects.	Sarriot *et al.* (2008)
Integration with Existing Programs/Services	Programs that seamlessly integrate with existing health systems and services are more likely to be sustained.	Shediac-Rizkallah and Bone (1998)
Integration of the program into organisational policies	Embedding the program into the organisation’s standard policies and practices.	Wiltsey Stirman *et al.* (2012)
Institutional Support	Establishing and maintaining strong support from local institutions, including political and administrative bodies, to ensure long-term sustainability.	Abson *et al.* (2017)
Fit of the program or intervention with the organisation	The program’s compatibility with the organisation's mission, values, and operations.	Wiltsey Stirman *et al.* (2012)
Efforts to align the intervention with the setting	Adjustments made to fit the program within the specific context of the organisation or community	Wiltsey Stirman *et al.* (2012)
Common Agenda	Creating and adhering to a shared vision and goals across all participating organisations.	Altpeter, Schneider and Whitelaw (2014)
Alignment	This refers to the program's alignment with the organisation's mandate, community needs, and priorities.	Bodkin and Hakimi (2020)

STRATEGIC FOUNDATION: Organisational capacity and infrastructure

Factor	Description	Reference
Workplace Support	The extent of organisational support for the program, including resources and encouragement from management.	Hodge and Turner, (2016)
Workforce characteristics, including skills, stability, and attitudes	A skilled, stable workforce with positive attitudes towards the program, ensuring consistent implementation.	Wiltsey Stirman *et al.* (2012)
Transition from Project to Approach	Evolving from a time-limited project to a sustained approach, integrating the initiative's principles and values into the broader community's long-term development and becoming a core element of the community's way of working.	Baum *et al.* (2006)
Training and Technical Assistance	Providing ongoing training and technical assistance to program implementers ensures they have the necessary skills and knowledge to deliver programs effectively.	Rhoades, Bumbarger and Moore (2012)
Training and Capacity Building	Ongoing training and development opportunities for staff to enhance their skills and knowledge.	McCreight *et al.* (2019)
Training	Providing professional and paraprofessional training to program staff can foster long-term program success. This ensures that trained personnel can continue to provide program services, train others, and build a constituency in support of the program.	Shediac-Rizkallah and Bone (1998)
Support and Training	Continuous support and training for staff implementing the program.	Hodge and Turner (2016)
Staff Involvement and Integration	When staff are involved in decision-making, they are more committed to the program's success.	Mancini and Marek (2004)
Staff involvement and integration	Involving qualified staff in all program stages.	Ceptureanu *et al.* (2018)
Staff Competence	The skill and confidence of staff in delivering the program.	Hodge and Turner (2016)
Staff	The engagement and capabilities of staff members who are responsible for sustaining outcomes.	Thomas and Zahn (2010)
Stabilising	This refers to making initiatives more resilient and ensuring they last longer by capitalising on existing opportunities, increasing membership, and professionalising practices.	Lam *et al.* (2020)
Program integration with the host organisation	The degree of dependence of the program on the host organisation.	Ceptureanu *et al.* (2018)
Positive organisational culture and structure	An environment that values and supports the program, including a clear organisational structure that facilitates program activities.	Wiltsey Stirman *et al.* (2012)
Organisational system	The host organisation's procedures and systems regarding HR and financing.	Ceptureanu *et al.* (2018)
Organisational stability	The host organisation's ability to integrate new elements and adapt its procedures and systems.	Ceptureanu *et al.* (2018)
Organisational Infrastructure	The structures, processes, and resources within an organisation that support sustainability.	Thomas and Zahn (2010)
Organisational Capacity	This refers to the program's ability to effectively manage resources and personnel.	Bodkin and Hakimi (2020)
Organisational Capacity	The underlying capacity of the organisation, often indicated by its longevity.	Scheirer (2005)
Organisational Capacity	The internal capabilities of the organization to manage and sustain the program.	Calhoun *et al.* (2014)
Organisational Capacity	The ability of the organisation to effectively implement and sustain the program.	Schell *et al.* (2013)
Organisational and infrastructural changes	Implementing structural changes within the institution to support long-term program goals.	Cobian and Ramos (2021)
Neutrality	A perception of impartiality and neutrality, creating a platform for diverse stakeholders to engage in constructive dialogue and collaboration, fostering a sense of trust and shared purpose.	Baum *et al.* (2006)
Mentors and Role Models	Providing mentors and role models fosters student engagement, offering guidance and inspiration that supports continued participation and success.	Bennett *et al.* (2015)

Factor	Description	Reference
Longevity	How long the program or innovation has existed	Scheirer (2005)
Institutional Strength	A strong organisational structure with a well-defined mission, clear goals, and strong leadership are crucial for program sustainability.	Shediac-Rizkallah and Bone (1998)
Inclusive and Collaborative Structures	Sustainable transitions to locally led development require inclusive and less hierarchical structures that promote mutual capacity development and ensure local voices are heard and valued.	Arbelaez-Ruiz *et al.* (2021)
Implementation and Sustainability Infrastructure	The systems and processes in place to support the ongoing operation and adaptation of the program.	McCreight *et al.* (2019)
Host Organisation Support	Support from the organization hosting the project, including cross-subsidies and administrative backing.	Stevens and Peikes (2006)
Factors in the Organisational Setting	The fit between the intervention and the host organization's mission, the presence of internal champions, organizational capacity and leadership, and the perceived benefits by key staff or clients contribute to sustainability.	Scheirer and Dearing (2011)
Developing and maintaining infrastructure and structural operations	Creating physical spaces, policies, and operational structures to support long-term program functioning.	Cobian and Ramos (2021)
Coordinator competence	The ability of the program coordinator to set realistic goals, develop plans, and engage in the participatory process.	Ceptureanu *et al.* (2018)
Continuity of Staff	The project should ensure continuity of staff or contractors, identifying long-term project champions.	Loh, Friedman and Burdick (2013)
Capacity Building	Enhancing the skills, abilities, and resources of individuals and organisations involved in the project to ensure they can sustain activities after external support ends.	Abson *et al.* (2017)
Capacity Building	Developing the organisational capacity to manage and sustain programs over time through training, technical support, and infrastructure development.	Rhoades, Bumbarger and Moore (2012)
Capacity Building	This focuses on building sustainable skills, organisational structures, and commitment to program success.	Bodkin and Hakimi (2020)
Addressing hiring, policies, and reward systems at the institution	Modifying institutional practices to align with program goals and incentivize faculty/staff participation.	Cobian and Ramos (2021)
Institutional Support	The project should be supported by the institution, meet institutional requirements, and have adequate institutional capacity and support over time.	Loh, Friedman and Burdick (2013)

As Australia's national science agency and innovation catalyst, CSIRO is solving the greatest challenges through innovative science and technology.

CSIRO. Unlocking a better future for everyone.

Contact us

1300 363 400
+61 3 9545 2176
csiro.au/contact
csiro.au

C**SIRO Education and Outreach**
https://www.csiro.au/en/Education

For further information

CSIRO Education and Outreach
Dr Christopher Banks
+61 7 3833 5999
christopher.banks@csiro.au
https://www.csiro.au/en/Education

CSIRO Education and Outreach/Digital Office
Dr Jen Parsons
+61 7 3833 5561
jen.parsons@csiro.au
https://www.csiro.au/en/Education