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Planning an Informal STEM Event? Try the Assets-based Approach to Planning and Research for Informal STEM Events

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Abstract: A recent literature search indicated a gap regarding informal STEM events program planning and evaluation models represented in research. This paper presents a hybrid program planning model that combines a Logic model and an Assets-Based Community Driven (ABCD) model. The combination of these models provides a basis for the program planning of informal STEM events. To start, the program planning model presented in this paper asks planners to focus on the strengths of the prospective K–12 and postsecondary schools' resources while compiling a list of specific results (outcomes) they want to obtain from a potential event; the outputs correlated to the outcomes, and inputs needed for activities planned for the informal STEM event. Above and beyond this, additional model components should help future informal STEM event planners host an informal STEM event and reflect, modify, and improve their program(s) for future events as they continue research in this field.

Keywords: Logic model; Assets-based Community Driven (ABCD) model; informal STEM events; program planning and evaluation (PPE); assets-based approach.
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Introduction

Background

A search of the literature to plan an informal STEM event for K–12 students revealed disappointing results. Therefore, this short paper intends to provide readers with a basic program planning model to help them determine the necessary components for developing a successful informal STEM event. In addition, by following the guidelines presented in this paper, more consistent research might be conducted and reported for the betterment of all future informal STEM events.

Informal STEM events are done differently from one school program to the next. Meadows et al. (2020) indicated that informal STEM events occur outside regular school hours, in classrooms, outdoors, and in other venues. Allen and Peterman (2019) provided characteristics of informal STEM events in their paper and related evaluation techniques that might promote the future growth of these learning events. In addition, a report from Bell et al. (2016) and a study by Garibay and Teasdale (2019) further specified how informal STEM events should purposefully promote equity and access for all participants.

Since STEM education is still relatively new and the best STEM education practices have yet to be generalized and grounded in research, a program planning model may be a great starting place to emphasize the importance of laying a solid foundation in setting up informal STEM events. If participating school systems use a consistent program planning model to host any informal STEM event, researchers could conduct research and report more generalizable findings. However, how might this feat ever be accomplished without a consistent program planning framework? This lack of a solid foundation may be the catalyst that could help K–12 schools better their STEM education practices.

As program planning and evaluation have become an increasingly important component of research practices and grant writing, many different models have emerged. Logic models prevail within education (Culclasure et al., 2019). However, other models, such as the Kirkpatrick model (Kirkpatrick & Kirkpatrick, 2006), the Context, Input, Process, and Product (CIPP) model (Stufflebeam, 2000), and the Precede-Proceed model (Green & Kreuter, 2004), also exist. These models exist for different groups, such as adult learning, agricultural extension programs, and medical training. In the case of this paper, the authors selected and combined the Assets-based Community Driven (ABCD) model and the Logic model to present an ordered sequence of procedures for future STEM education researchers to follow when planning informal STEM events. These models are further described in the following section as they pertain to this paper's asset-based approach to program planning and evaluation modeling.

The planning program proposed in this paper may help future researchers investigate different aspects of these events that can be generalized for forthcoming events across a more comprehensive array of schools across multiple school systems. Furthermore, as with Culclasure et al. (2019), the proposed program planning model in this paper would serve as a "valuable tool for researchers with the potential to lay a foundation across disciplines for future research that is both rigorous and systematic in its measurement" (p. 36) of, in this case, informal STEM events.

Why STEM Education?

Bybee (2010, 2013, 2018) repeatedly highlighted the need for integrative approaches in STEM education that promote STEM literacy for all. Sanders (2012) also promoted integrated STEM education to promote student success in the 21st-century workforce. Integration is critical to students' future success who must be ready for the 21st-century workforce. Therefore, while planning, the program organizers should identify strengths from each collaborating source and use them to benefit their event while also identifying the best way to integrate STEM education content during the event. Furthermore, planners should prioritize the integrative nature of hosting these informal STEM events to engage and promote participant learning of the content.

In addition, the authors of this study suggest that the nature of most informal STEM education events is multidisciplinary or transdisciplinary, depending on the collaborating hosting sources. Colakogulu (2018) defined multidisciplinary as "people from different disciplines working together, each drawing on their disciplinary knowledge,... [and transdisciplinary as] creating a unity of intellectual frameworks beyond the disciplinary perspectives" (p. 100). While the collaborating sources might not formally identify a unifying framework for their integrative approaches toward STEM, their work in STEM areas might naturally lend itself to conveying a transdisciplinary approach to STEM content during the informal event.

Program Planning and Evaluation

Early pioneers of program planning indicated that best efforts to "achieve an effective educational program... is made possible by following the most appropriate practices and procedures that allow for utilization of the concepts implied in an acceptable program planning development framework" (Boyle, 1981, p. 42). Buskey and Sork (1982) defined program planning as "a set of steps, tasks, or decisions which, when carried out, resulted in the design of an educational programme [*sic*] for an adult client group" (p. 2). These concepts are also needed in planning and facilitating informal STEM education events. The theories associated with adult education versus K–12 education may differ, but planning is vital to hosting a successful program in both fields.

Logic Model

Logic models embed evaluation, reflection, and improvement into a strategic plan to allow the event coordinator(s) to improve each iteration of this event (Harvard Family Research Project, 2002). Culclasure et al. (2019) stated, "Logic models represent a powerful way to succinctly and communicate the core components of a program or approach to communities of practitioners, researchers, and other stakeholders" (p. 37). This model will provide a base for all future potential STEM education stakeholders by providing a consistent approach and language for planning, facilitating, and evaluating informal STEM events.

ABCD Model

Bergdall (2003) stated that Asset-Based Community Development (ABCD) models "focus on the strengths and capacities of local communities" (p. 1). Instead of assuming that a deficit might exist in the collaboration of K–12 and postsecondary schools (as is the nature of the Logic model), what if the planner(s) recognized the strengths that might already exist within these school systems/community programs to implement a successful informal STEM event? In this program planning and evaluation approach, K–12 districts will collaborate with postsecondary institutions to develop (an) informal STEM event(s). This paper identifies potential strengths that the local communities and their school systems possess and suggests multiple strategies to develop a viable program plan for future STEM educators' use.

Assets-based Approach

McLaughlin and Jordan (2015) provided several benefits of using a Logic model. It is a tool for (1) consistent data collection and analysis, (2) assistance with organization, and (3) strengthening communication. These three tools are vital for planning successful informal STEM events. Scott et al. (2020) provided insight into an asset-based approach to planning. The asset-based approach associates the community's advantages while acknowledging that anyone outside the community might also be a basis of support. This concept pairs well with the three Logic model components. Furthermore, this second approach highlights the need for reciprocating relationships. The pairing of these two models provides the basis for the model presented in this paper.

Program Evaluation Theory

System Theory

Frye and Hemmer (2012) also indicated that "most persons participating in educational programs—including learners, teachers, administrators, other health professionals, and a variety of internal and external stakeholders—do so because they are interested in change" (p. 290). STEM education is no exception to this rule. As such, all faculty, staff, volunteers, and even participants and their parents seemingly engage in the ever-changing field of STEM education. Of the three common evaluation theories suggested by Frye and Hemmer (2012), System theory parallels the dynamic components present in STEM education. This theory can be described as a "system [that] comprises the parts, the organization of the parts, and the relationships among those parts and the environment; these relationships are not static but dynamic and changing" (Frye & Hemmer, 2012, p. 290). Along with being easily incorporated into STEM education program planning evaluation purposes, System theory also works well with Logic and ABCD models (Frye & Hemmer, 2012; Fullan, 2006).

Change Theory

Fullan (2006) indicated that theory alone for program practices and evaluation is insufficient for program planners. To promote change, there must be a theory related to the active engagement and promotion of change. All contributors and other resources must be dedicated to change for the betterment of—in this case—STEM education.

As such, Johnson (2012) indicated that Fullan's Change theory might be employed to work within System theory. Johnson (2012) indicated that this change theory is comprised of seven components: "(a) motivation, (b) capacity building focused on results, (c) learning in context for those enacting reform, (d) capacity to change the larger context, (e) reflective action (f) tri-level engagement, and (g) persistence and flexibility" (p. 46). While Johnson's (2012) study focused on change within schools, Fullan (2006) indicated that this change theory might be used district-wide and state-wide with the examples provided.

Since this program planning model works within communities, this change theory could also work well within informal STEM event program planning and evaluation research frameworks. Since Fullan (2006) provided ample support for this theory to be used within the parameters of system theory in education, it should also be noted that this change theory works well within the combined Logic and ABCD models employed in this paper.

Conclusion

Although multiple evaluation rubrics exist to assess the effects of STEM education events (Allen & Peterman, 2019; Bell et al., 2016; Garibay & Teasdale, 2019; etc.), a planning model for an informal STEM event would allow STEM educators to be more proactive in planning informal STEM events that engage K–12 students and their community in STEM content. Informal STEM event facilitators, stakeholders, and researchers need a program to help them successfully host informal STEM events. They need clear communication, aligned outcomes, and purposeful approaches to meet these demands. The assets-based focused model that combines the Logic and ABCD model provided in this paper hopes to remedy this gap in the literature by presenting a program planning model for future informal STEM education researchers to use in their work.

The Assets-based Model

As described above, this planning model combined the ABCD and Logic models. Figure 1 illustrates this paper's assets-based program planning model. Steps 1–3 follow the prescription of a traditional Logic model with reported outcomes (Step 1), outputs (Step 2), and activities and inputs (Step 3). However, the authors replaced the traditional needs-based assessment in traditional Logic models with an assets-based assessment of K–12 schools' strengths (in tandem with postsecondary schools) to provide successful programs for informal STEM events.

When planning for an informal STEM event, you should first collaborate between K–12 and postsecondary schools to develop a strong program for the event. With this collaboration and communication, you may determine the strengths of each other's resources. McCawley (2001) suggested that an inverted Logic model allows planners to "create a forum for new ideas" (p. 2). Instead of starting this model with a traditional needs-based assessment, the authors propose an assets-based assessment to begin developing an informal STEM event.

An assets-based assessment or asset-based evaluation focuses on the "development of both internal (within the person) and external (outside the person) characteristics" (Reed & Brown, 2001, p. 289). The personification of this assumption would lend itself to the relevant characteristics found in K–12 and postsecondary school assets. Internal qualities may include available funding or social networks, while external assets include physical technology or other equipment available to the varying schools. This evaluation (in place of the needs-based assessment) allows planners to "build [on] people's [and program resources] strengths" (Reed & Brown, 2001, p. 289). These strengths are vital to successfully facilitating any informal STEM event.

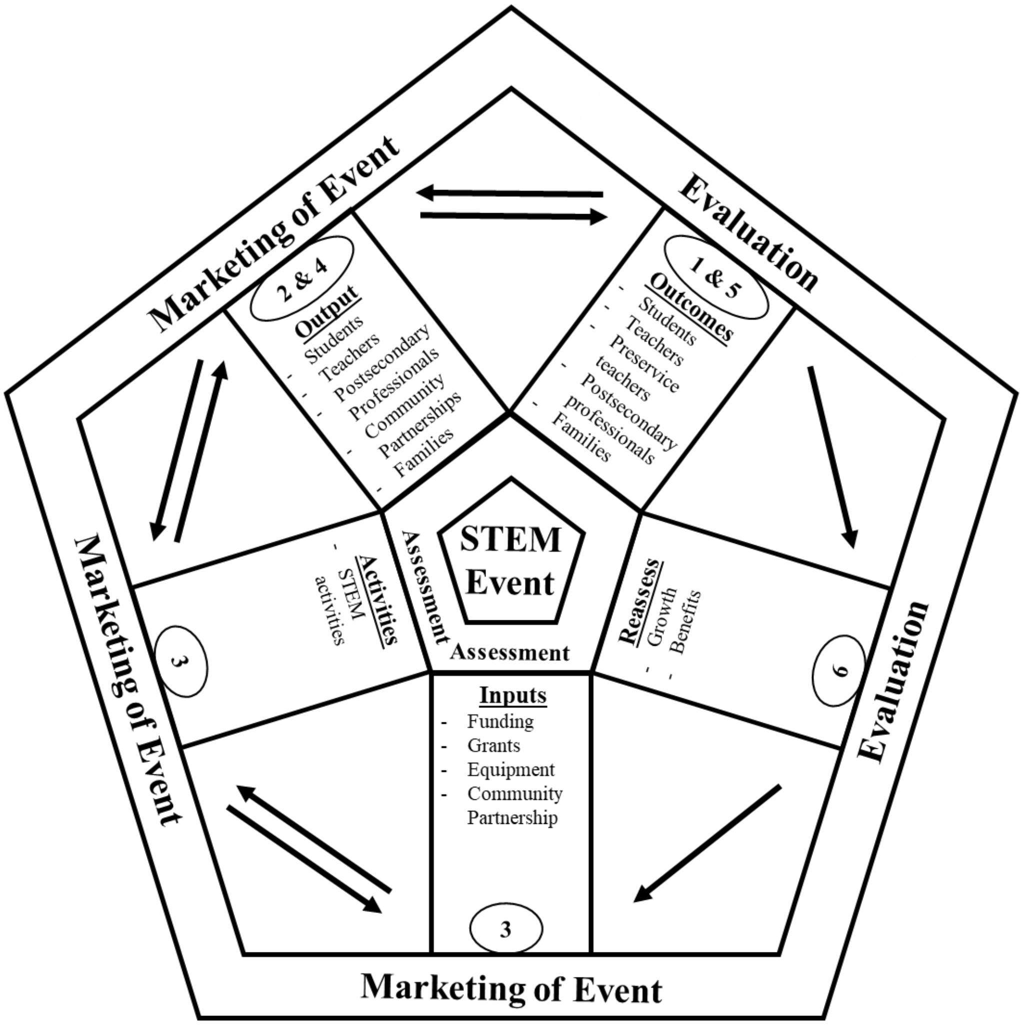
By personifying the school systems involved in developing a STEM night, assumptions might be modified to indicate the approach of building on the strengths of the current assets the schools already possess. These assets may be equipment, human capital, funding, networks, and other potential assets needed to host a successful STEM night. When planning an informal STEM event, begin with each school system's strengths while composing the outcomes hoped for from the proposed event.

Outcomes (Step 1)

Oliva (2009) reported in-depth about composing goals and objectives, which this study will refer to as outcomes. The author (Oliva, 2009) indicated that you should start by writing the program goals by answering a general question like, what is the purpose of the proposed, in this case, informal STEM event? Goals are not based on achievement and, as such, are not measurable. However, Oliva (2009) stated that you could turn goals into program objectives by following three elements: (1) performance/behavioral terms, (2) mastery level, and (3) what condition the learner might take in if it is not already obvious based on the program goals. One can measure objectives by employing performance indicators to measure how well the proposed program may do.

Figure 1

Informal STEM Event Model



The Harvard Family Research Project (2002) provided a link within their online article for a Logic model worksheet. This worksheet offers additional information about writing outcomes and further discusses writing indicators that quantitatively measure the existing data to “track community-wide progress toward results. They require community-wide effort to move and reflect substantial changes across a community” (Harvard Family Research Project, 2002, p. 2). This highly recommended worksheet document is helpful for any beginner program planner who wants to write and develop program outcomes for their proposed informal STEM event.

K–12 schools and postsecondary institutional collaboration are vital to informal STEM Events success within this program planning model. Table 1 provides multiple outcome examples to help initiate the discussion regarding short-, mid-, and long-term outcomes. The outcomes listed in Table 1 may inspire further discussion on this topic and vary with each unique informal STEM event experience. The outcomes listed in Table 1 focus on collaboration, communication, and networking among the participants and stakeholders and improved knowledge of STEM-related academic and career paths available to all K–12 students. They should be modified to fit future informal STEM events.

Table 1

Informal STEM Event Outcomes

Range	Outcomes
Short-Term (1–4)	1. The program will increase K–12 student engagement in STEM education activities and practices. 2. The program will increase teacher collaboration with coworkers, administration, and postsecondary collegiate professionals. 3. The program will expose more K–12 students to STEM-related careers. 4. The program will expose K–12 students to role models (college students) volunteering at the informal STEM event.
Mid-Term (5–7)	5. More K–12 students will pursue STEM-related academics. 6. The program will improve communication and working networks among participating teachers, postsecondary collegiate professionals, and businesses. 7. Improved relationship of K–12 schools with families within their communities.
Long-Term (8–10)	8. The program will require more integrative teaching practices among STEM content, non-STEM content, and special education teachers at the participating schools. 9. The program will increase collaboration and communication among postsecondary colleges, K–12 school professionals, businesses, and families. 10. More K–12 students will pursue STEM-related careers.

Output (Step 2)

Once the key stakeholders have planned the outcomes, they may start listing the outputs for the Logic model aspect of this proposed model. The outputs should directly align with the outcomes. Therefore, Table 2 delineates multiple outputs for planning an informal STEM event that aligns with each outcome described in Table 1. Of course, these outputs may be added to, modified, or taken away to fully personalize and align each informal STEM event to different school systems, their postsecondary and community collaborations, and families. Furthermore, “x” should be replaced to fit the unique numerical characteristics of each planned informal STEM event’s location and demographics.

Table 2

Informal STEM Event Outputs

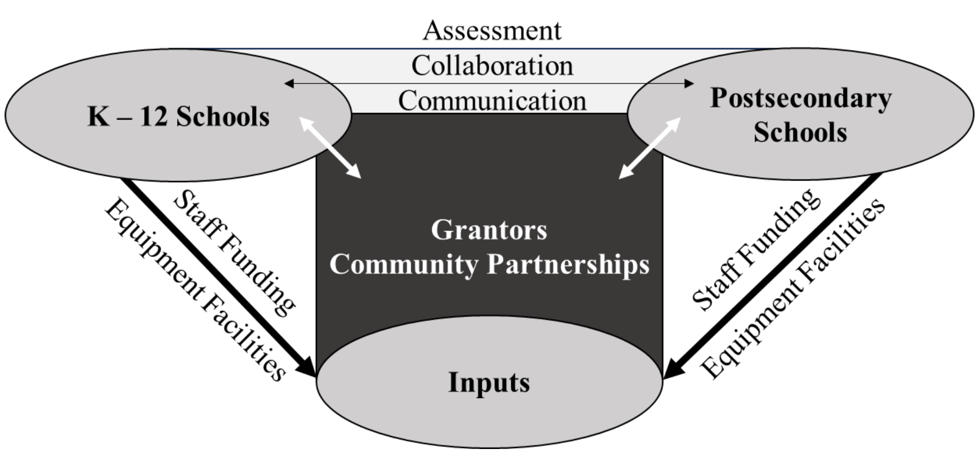
Participant	Outputs	Outcome (#)
Students	- *x* K–12 students will participate in the informal STEM event. - *x* collegiate students will volunteer for the informal STEM event.	1 4
K–12 School Staff	- *x* STEM content teachers, non-STEM content teachers, special education teachers, and administrators will collaborate and host the informal STEM event.	2, 8
Postsecondary Professionals	- *x postsecondary professionals will collaborate with K -12* schools and assist with hosting the informal STEM event.	6, 9
Community Collaborations	- *x* community businesses will collaborate with school districts to support the informal STEM event and expose students to STEM careers.	3, 5, 6, 9, & 10
Families	- *x* families will participate in the informal STEM event.	7

Activities and Inputs (Step 3)

K–12 and postsecondary school staff need to plan activities that promote the success of each output described in Table 2. Figure 2 depicts how planners could visualize K–12 administration, teachers, other pertinent stakeholders, and postsecondary professionals who might come together to identify the inputs needed to host successful, engaging activities.

Figure 2

Informal STEM Event Model to Assess Assets



The planners must consider multiple items to plan the activities, such as location, equipment, staff, funding, etc. Furthermore, the planner should also contemplate the time needed and content for each scheduled activity. These activities may be short five- to 10-minute stations (or longer sessions with more involved activities). The activities may relate to more siloed fields of science and mathematics or be more integrative with engineering and technology. Planners should discuss and delineate among these details concerning postsecondary and K–12 school collaboration with other involved stakeholders.

Postsecondary schools may have equipment that may be used for the STEM activity event but only sometimes have the facilities at a convenient location to host the event that would be convenient travel distances for the targeted attendees. Content-specific teachers in K–12 schools might be excited and eager to host informal STEM events at their local K–12 schools. Still, they lack time to develop the activities needed for a successful event. Therefore, postsecondary professors could listen to the K–12 teachers (and possibly get ideas from K–12 students). The postsecondary professionals could create the activities themselves, find already developed activities, or find collegiate-level students who might like to volunteer their time and make additional activities needed for a successful informal STEM event. Furthermore, collegiate students and postsecondary staff may donate their time during the event to ensure all activities run smoothly.

In addition, fiscal funding may come from K–12, postsecondary schools, community collaborations, or grantors. Administrators and K–12 level teachers must communicate effectively with postsecondary schools to determine possible funding sources. The postsecondary school could write a grant to obtain the monetary funding needed for the informal STEM event if additional funds are needed. In contrast, it is possible that the K–12 school has strong ties with the community and could solicit support from their business community collaborators to help host the informal STEM event. These community collaborations could contribute financial or human capital to ensure the informal STEM event benefits students from their communities.

Furthermore, it is also possible that the K–12 and postsecondary schools may already have the needed resources and not need to contact businesses to find additional capital to subsidize their event. The collaboration between the K–12 and postsecondary schools would assess each institution’s strengths to host a successful informal STEM event. Once these conversations have started, they may continue until both parties have determined the types of activities, number of stations, location, equipment, and staff needed to produce a productive informal STEM event.

Outputs (Step 4) and Outcomes (Step 5)

As the planners implement their carefully constructed inverted plans, they will start using their inputs to enact their model’s proposed activities. Once they have executed the activities, the planners will see if they meet their specified outputs. Finally, if the expected participants attend and participate, outcomes will follow. The planners will investigate these outcomes (good or bad), which will be discussed more fully in this next section.

Evaluation

To ensure the "value or worth of a program," you may want to use both summative and formative assessments (Sork & Caffarella, 1989, p. 241). Sork and Caffarella (1989) described "formative evaluations… [as] improving programs, and summative evaluations… [as] measuring and appraising the results or outcomes of programs (p. 241). To ensure the outcomes are met, provide a survey (a summative evaluation) that asks questions related to the informal STEM event. Share the survey with multiple stakeholders to get feedback on what they want to learn from the informal STEM event and incorporate their input into the survey. Finally, complete the survey to ensure clarity and ease of use for participants to complete without getting bored quickly.

Also, remember that not all participant feedback, such as the survey, needs to be formally collected. Sork and Caffarella (1989) stated that you might collect data from formal and informal collection evaluation practices. Therefore, it will be vital to the continued success of future STEM nights to listen during the planning, implementation, and post-event to see if everything is meeting or exceeding carefully planned outcomes. You want to ensure that participants can access each activity and talk (hopefully positively) about the activities. Furthermore, record and evaluate the informal feedback obtained from K–12 teachers, K–12 students, businesses, and other stakeholders to improve future iterations of the informal STEM event. The formative evaluations could help bring awareness of a need to change the program while it is in progress, or these responses could be used to supplement the summative evaluation findings. This formative feedback is critical to future iterations of this event.

For example, at each informal STEM event, planners might ask each participant, as they leave, what their favorite activity was and why it might be their favorite. This informal procedure gives the planners and other stakeholders authentic data during the event to immediately act on for future improvement of the event. In addition, volunteer feedback might also be solicited. Their feedback about their time volunteering for the event also provides pertinent feedback to improve the informal STEM events as needed.

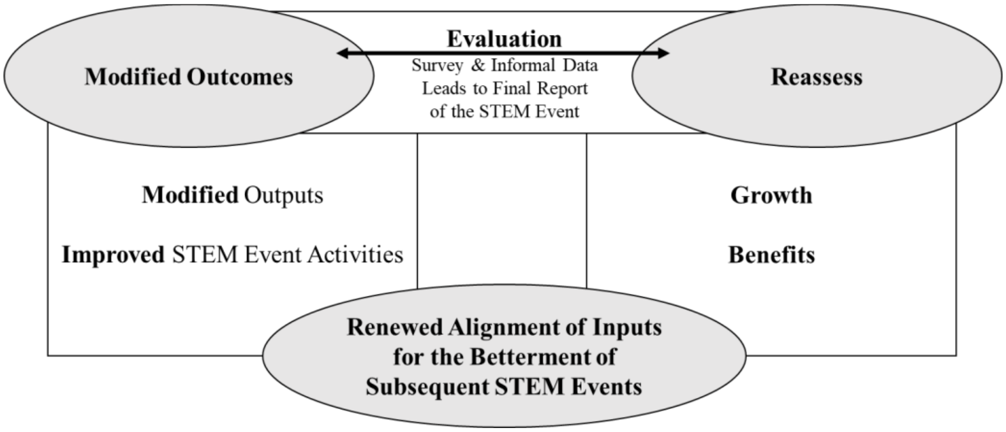
Reassessment

Finally, the reassessment stage (Figure 3) should thoroughly involve the reports gleaned from evaluating the informal STEM event. The survey and data gleaned from the event participants and stakeholders will serve the purpose of helping the K–12 and postsecondary staff improve the informal STEM event for future iterations. This reassessment cycle should continue every year to ensure that the academic needs and interests of the students are met; equity in accessing the event and completing the activities are available to all students and their families; the future workforce of the community is inspired; and so on.

Furthermore, this program involves ever-changing science, technology, and engineering content. The planners must remember this and be flexible regarding the station activities from one informal STEM event to the next. Therefore, the planner must know or have someone on their team current on recent STEM education trends and issues to ensure the event promotes current best STEM practices in education. Furthermore, each informal STEM event will be unique to the location. Address the potential collaborations among K–12 and postsecondary schools and other community organizations to discern distinctive attributes that could increase the engagement of the community and encourage K–12 students to pursue STEM in ways that may benefit their community in the long run.

Figure 3

The Reassessment Cycle for the Improvement of Subsequent Events



Conclusion

This model reflects the culmination of the authors' combined (10+ years) expertise and is based on two affluent program planning and evaluation models: the Logic and ABCD models. However, as with all good program planning design processes, the assets-based model approach presented in this paper is flexible. Considering technological advancements, fluid domains in education, and even societal change (to name a few reasons to be flexible) may require aspects of this model to grow along with these natural progressions. The authors' desire to share their work is to stimulate growth in this area of research so that educators may continue to serve their communities and increase all student interest in STEM education and future careers.

Implications

Informal STEM events are as varied and diverse as their participants, and it is not easy to research this area of STEM education to promote policy and practice further. The authors focused on building this program planning and evaluation model for future STEM education investigators interested in researching informal STEM events. They hope the informal STEM event model aids future research by providing a solid foundation for planning any informal STEM events for future research.

In addition, the authors hope that future investigators who potentially use this model will differentiate this model and include STEM education engagement efforts for participants with disabilities. Bargerhuff (2013) and, more recently, Basham et al. (2020) indicated that individuals with disabilities are underrepresented in the various STEM career fields. These representation inequities in the STEM workforce are still pressing (Siregar, 2023). Hosting informal STEM events, such as the one presented in this paper, adapted to fit the needs of *all* participants, is needed so that *all* young individuals (including those with disabilities) might be engaged and excited to learn about STEM content. Further research is needed to increase students with disabilities' engagement with STEM content to enrich and promote the STEM workforce.

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Appendix

Table 3

Checklist of Program Planning Model

#	Task Checklist
1. ☐	Write the program's intended short-, medium-, and long-term outcomes.
2. ☐	Write the aligned outputs needed to corroborate with the program's intended outcomes.
3. ☐	Identify *all* informal STEM event activities. These activities should accommodate the outputs and align with the program's intended outcomes.
4. ☐	List inputs (underlined and listed below) by K–12 schools, postsecondary schools, and other collaborating businesses, respectively, for quicker reference as you plan your event. The inputs should specifically support each activity and only that activity. a. ☐ Identify funding sources (e.g., grants, community sources, etc.) and use financing appropriately. b. ☐ Identify potential <u>collaborations with community businesses</u> (if applicable to your event) and their roles in supporting the event (e.g., monetary, on-site staff, etc.). c. ☐ Identify <u>staff/volunteers</u> willing to host events (e.g., postsecondary professionals; K–12 teachers; volunteers; etc.). *i.* ☐ Assign roles for all staff after identifying their unique strengths (assets assessment). Furthermore, please place them in positions that best suit these strengths. *ii.* ☐ Inform staff of longer time commitments to set up and tear down the event to ensure the program has enough help to do both efficiently and so that the location is clean (if not cleaner) than before hosting the event. d. ☐ Identify and confirm the *best* <u>location/facilities</u> to host the event. (Account for the needed room(s) and space for various activities.)

i. ☐ Confirm parking is available and allowed near the event's location for the proposed dates. Pose appropriate staff at parking locations to ensure participants receive parking passes (if needed).

ii. ☐ Identify and confirm the event time with pertinent stakeholders to decrease the number of schedule conflicts and increase maximum attendance.

iii. ☐ Assign rooms and times for activities, presenters, staff, and/or volunteers. Be sure all activities/tasks have the personnel needed to enact them. (Also, do a mock run-through of your event to ensure that all space, time, and staff are appropriate for each activity/task.)

e. ☐ Identify <u>equipment</u> needed for activities hosted during the event.

i. ☐ Identify additional equipment needed for technological assistance (e.g., cameras for recording events, microphones, etc.)

ii. ☐ Identify staff/volunteers to help presenters and the primary staff with general technological and logistical troubleshooting.

5. ☐ Create a marketing plan with an appropriate timeline.

a. ☐ List social media/other marketing venues available to your location and contact and notify appropriate personnel of the event location and date to inform the community in a reasonable amount of time.

b. ☐ Create a form (using Google Forms, Qualtrics, or equivalent) for registration.

6. ☐ Create the survey. (Ensure you write this survey with sufficient time to complete the following before giving it after the informal STEM event.)

a. ☐ Ask pertinent stakeholders (e.g., participating schools, businesses, etc.) for feedback about the survey. (Be aware that the same survey may not work for *all* participating stakeholders, and always ask for input from *all* stakeholders.)

b. ☐ Incorporate the feedback and send the survey back to the stakeholders for their final thoughts and to check that you incorporated their feedback appropriately and correctly.

c. ☐ Give the survey after the informal STEM event.

d. ☐ Document any informal feedback from all stakeholders, participants, and staff to include in the final report.

7. ☐ Document the progress of the informal STEM event before (planning stages), during (implementation), and after the event. Maintain, reflect on, and incorporate this information into the final report and use it to modify your plans for the next informal STEM event.

8. ☐ Start over at #1 and incorporate reported, pertinent suggestions to modify/replace aspects of the planning you did for the first informal STEM event.

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