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What Makes a Great Science Experience? A Program Planning Checklist for Educators

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Abstract
The Science & Technology Program Work Team at Cornell University wanted to know what constitutes a fun, exciting, and successful science-based learning experience for young people. In 2002, 4-H Educators and youth were engaged in the Concept System process that generated 144 unique ideas. These ideas were distilled into 15 clusters, all of which linked to three principal elements of program design: Content, Context, and Delivery. Those results were translated into a checklist for planning science programs, available at <http://www.hort.cornell.edu/gbl/groundwork/activitychecklist.pdf>. In 2005 and 2006, the team recommended adapting it to other interactive learning experiences and for program evaluation.

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Introduction and Background

4-H Youth Development in New York has several program areas that serve as focal points for project activities and as points of convergence for staff with varied subject matter interests, yet a desire to work together. One of these program areas, Science and Technology, has generated enthusiasm and commitment from a number of dedicated individuals for nearly two decades. Under the umbrella of science and technology, Cornell Cooperative Extension (CCE) educators and campus-based faculty and staff have planned conferences and in-service trainings, collaborated on curricula and educational materials, and learned from one another's trials and successes, first as an informal group meeting occasionally over lunch and then as an official program work team.

In 2002, members of the 4-H Science and Technology Program Work team (PWT) initiated a group process to understand more about what constitutes a fun, exciting, and successful science-oriented learning experience. While historically, project efforts have been based on assumptions about what makes a great science experience, this group sought to move beyond these assumptions to explore the question more seriously and reflectively, using well-established methodology. The goal was to compile findings into a program-planning tool that would assist educators in being more deliberate as they renew existing and develop new science and technology programs.

Methods and Results

The PWT employed a group decision-making tool called the Concept System®

<http://www.conceptsystems.com/ConceptMapping/ConceptSystem.cfm> to structure the process in order to better understand the audience and to begin with a question of general interest. This tool employs a group process, decision support, and a software package/program to assist groups in moving from an individual to a collective understanding of questions and issues. The process was administered online, allowing participants at a distance to provide input.

To begin the process, the PWT invited Extension educators and staff to complete the following prompt during an on-line group brainstorming process:

> "One specific technique, tool, approach etc… that I employ to engage the young people in my program in a science-oriented learning experience is..."

Simultaneously, children and youth were invited to respond to a slightly different prompt through several facilitated group discussions:

> "One specific thing that makes science fun and interesting is..."

More than 220 statements were generated and distilled (edited for content and duplication) into a final list of 144 unique ideas. Ideas were ordered randomly from 1 to 144 and grouped into 15 clusters. Each idea was rated from 1-5 to demonstrate its importance or prioritization relative to other statements in the same cluster. Table 1 demonstrates how five ideas were rated and grouped into the Real World Science Cluster.

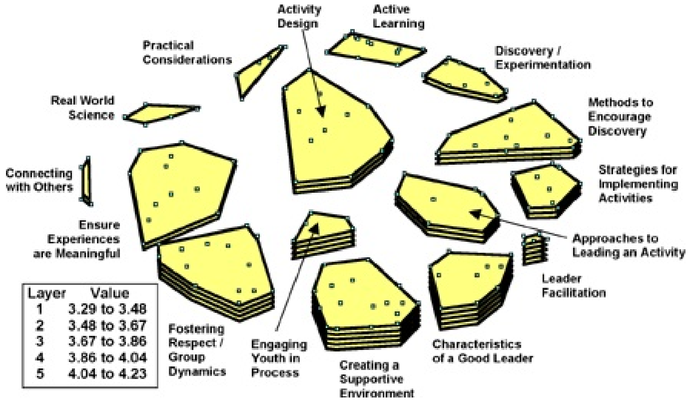
Table 1.
Real World Science Cluster

Idea No.	Idea	Rating
16	Relate science concept to an everyday, familiar thing	4.16
113	Link kids' research with "real" research	3.34
109	Explain how science affects technology and medicine	3.25
13	Do something with real scientists	3.21
128	Encourage a science focus on the power of youth campaign	3.00
	Average Rating	3.39

The end result was the Final Cluster Rating Map (Figure 1), which depicts 15 groupings of ideas. Each small square within the clusters represents one of the 144 ideas generated by the brainstorming activity. The relationship of any one idea to the rest of the ideas in the map is determined by how close that idea is to the others; ideas that are closer together are conceptually more similar than ideas that are further away.

The orientation of the map is not relevant because the distance of any one idea to the rest would remain the same if the map were rotated or flipped. The cluster layers represent the group prioritization of the ideas as an average; the more layers to a cluster, the higher the prioritization of the ideas in that cluster relative to the other clusters. The legend in the bottom left-hand corner of the figure provides the range for the average priority of the cluster layers expressed on a 1 to 5 scale.

Figure 1.
Final Cluster Rating Map



Translation of Results into a Checklist Tool for Program Planning

To interpret these results, PWT members reviewed the ideas located in each cluster and studied the relationships between clusters. What stories describe these relationships? What is meaningful about the location of each cluster or set of ideas relative to the other clusters? How might these results be used to contribute to the planning efforts of the PWT? How can 4-H educators benefit from this study?

The PWT members noted that all 15 clusters fell within three broad principles/elements of program design: Content (science), Context (audience and environment), and Delivery (educators). Content refers to the learning objectives of the program/activity and how to achieve them. What is the purpose of the program/activity? How can educators ensure that the learning objectives are achieved? The context is the environment for the learning objectives. In most cases, the audience is paramount when thinking of the context, but the atmosphere, tone, and approach will affect the overall experience of the audience. Delivery refers to the manner in which the learning objectives are achieved. The educators are critical to ensuring that the integrity of the content and the context are maintained.

Although it is important to note that the ideas within the clusters fell neatly into the program design principles of content, context, and delivery, the Science and Technology PWT was reluctant to further consolidate the findings as might have been the case had the committee wanted to identify and set committee priorities. Given the time dedicated to this effort and the depth of information in the findings, the PWT chose, instead, to develop the information into a checklist to assist Extension educators in the planning and delivery of science programming.

Using the Checklist

The checklist was posted online, introduced at 4-H science and technology events, explained in educator trainings, and distributed via newsletters. The intention was that educators would refer frequently to this checklist as they developed new programs and planned new events, making needed adjustments to ensure that their science offerings were indeed fun, exciting, and successful.

A 2005 survey of 24 New York 4-H educators showed that most recognized its validity, but felt they had internalized the ideas and did not need to constantly refer to the checklist. The checklist was most frequently used when training new volunteers and staff. Some respondents suggested shortening the checklist or adapting it for other types of programs. Others wondered if the checklist might also be an effective evaluation tool.

In 2006, at the New York statewide 4-H educator's conference, participants were asked to use a modified version of the checklist to reflect on a program or project of importance in their counties. This program did not have to be about science. The purposes were: 1) to evaluate the program/project in terms of content, context, and delivery, 2) to align the program/project with at least one of the National 4-H priorities, and 3) to generate discussion about the effectiveness of the checklist as a planning/evaluation tool.

Conclusions

The What Makes a Great Science Experience checklist <http://www.hort.cornell.edu/gbl/groundwork/activitychecklist.pdf> is a useful tool for 4-H educators who are developing a new program or adapting, revising, or evaluating an existing program. Designed specifically for science experiences, it can be used for other activity-based learning with modest modifications. Readers are invited to access this tool online and suggest ways to increase it usefulness.

Acknowledgments

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