Evaluation Report

National Inventors Hall of Fame Foundation
Club Invention

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Appendix A provides information on the key personnel involved in this project.

TABLE OF CONTENTS

INTRODUCTION

The Club Invention program, created by the National Inventors Hall of Fame Foundation (NIHFF), is an after-school educational enrichment program for children in grades 1-6. The various curricula were designed to further school academics in a fun and informal after-school environment, and they employ the use of hands-on, interactive science and technology explorations and creative challenges. Club Invention activities are designed to enhance school experiences by increasing creative problem solving. The Club Invention program is offered throughout the United States.

This report presents the findings of the evaluation completed by the Bureau of Research Training and Services (Bureau) to assess the contribution and impact of the Club Invention program. The Bureau completed a formative evaluation of the program in 2004; the current report addresses outcome attainment. This report contains a brief summary of the program, a list of the evaluation questions addressing program effectiveness, a detailed summary of the results based on the data collected, conclusions, and recommendations for the future.

BACKGROUND

The NIHFF, located in Akron, Ohio, demonstrates both the history and future of the creative processes of technology and invention. NIHFF has three overarching goals combining the assets of technology and invention that guide the organization's mission and numerous outreach efforts:

1. To inspire people of all ages to use knowledge in creative ways to solve real-life problems.
2. To create positive changes that encourage under-represented populations to succeed in the scientific and technological fields.
3. To encourage participatory and engaging methods of teaching science, technology, and creativity as the foundation for invention.

Launched nationally by the NIHFF in the fall of 2003, the Club Invention program has three major objectives:

1. To encourage risk and search for solution.
2. To provide an open and safe environment.
3. To create an immersive, hands-on learning experience.

The program employs three key teaching strategies: immersion, brainstorming, and create/recreate. "**Immersion**" pertains to the particular problem or challenge that every curriculum has. Environmental changes may be made to the classroom and/or stories told to the students that create scenarios and set the context of the problem posed by the curriculum. This element is not as prominent in Club Invention as it is in Camp Invention, but is still is utilized, primarily in terms of "the story" behind the challenge. "**Brainstorming**" techniques are used to develop ideas. The teacher utilizes

brainstorming techniques to encourage multiple solutions from the students, both in initiating the challenge and throughout the solving process. "**Create/recreate**" refers to a trial and error process of problem solving whereby the student creates a solution, tests it, evaluates it, modifies it if necessary, and retests the modified solution. In addition to the proposed benefits to the student participants, instructors in the Club Invention program receive valuable professional development in that they have an opportunity to learn new teaching methods that they can then apply to their at-school classrooms.

EVALUATION PURPOSE AND STATEMENT OF PROBLEM

A previous evaluation of the Club Invention program performed by the Bureau in 2004 demonstrated that program fidelity was in strong evidence. The 2004 evaluation found that all instructors completed all the suggested activities for the day as given in the curriculum guide, but at times they had to rush to do so and opportunities to execute the discovery process and engage in the create/recreate process were sometimes limited. The former evaluation team's conclusion was, "This approach limited the children's opportunity to see and experience "failure as a part of the learning experience."

The earlier evaluation found that "students were extremely excited and enthusiastic about their experiences at Club Invention. The hands-on nature of the curriculum optimizes the student's ability to recall the activities and any experiences/knowledge associated with those activities." The evaluation team concluded that "Club Invention clearly encourages growth, creativity, and inquiry, while challenging students to explore and experiment within their world in order to understand and imagine how *they* might make it better."

This evaluation builds off the previous evaluation and extends the evaluation focus to include an outcome measurement component. The NIHFF administration expressed a particular interest in determining the changes in participant and instructor perspectives (including attitudes, knowledge, and behaviors) on creativity and science as a result of their involvement in Club Invention. As such, the current evaluation investigates program fidelity and extends to measure the outcomes for Club participants and instructors per the goals of NIHFF.

The components of the evaluation included observations of Club Invention activities, student surveys administered to both primary (grades 1-3) and intermediate (grades 4-6) students, an instructor survey, and a parent survey, which parents were asked to return in self-addressed stamped envelopes. A mixed methods approach was utilized, including elements of both quantitative and qualitative analysis. Sites in Ohio and in San Antonio, Texas, were included in the evaluation. When necessary, parent and student surveys were administered in Spanish. More details regarding the evaluation methodology are given below.

Evaluation Questions

The primary objective of this evaluation was to determine the impact of Club Invention activities on student and instructor knowledge and behaviors regarding creativity and science. To that end, the following four questions were posed to assess outcome achievement:

As a result of their involvement with Club Invention…

1. *Have the student participants experienced a change in their perceptions regarding creativity and science?*

2. *Have the student participants experienced a change in their knowledge regarding creative problem solving in science and technology?*

3. *Have the teacher-participants experienced a change in their knowledge regarding creative problem solving techniques?*

4. *Have the teacher-participants applied (or do they intend to apply) this change in their knowledge regarding creative problem solving in their school-based classes?*

The evaluation team investigated knowledge, attitudes, and behaviors of students and teachers pertaining to scientific inquiry and the creative experience offered by Club Invention by employing several evaluation tools and techniques which are outlined below. In addition, parental input was sought, primarily to gather additional information on their perceptions of their child's outcomes.

The evaluation proceeded with the caveat that there is an overlap in the concepts of "knowledge of creative problem solving" and "perceptions of creativity and science." We defined knowledge as understanding the process as acquired through experience. We defined perception as attitude and opinion.

METHODOLOGY: TOOLS AND TECHNIQUES

The evaluation team modified the four tools developed for Camp Invention in the summer of 2007 to apply to the assessment of Club Invention participants and instructors. All tools and protocols are included in the appendices. Appendix B presents the surveys, and Appendix C presents the observation protocol. The survey instruments include the two student questionnaires designed to address research questions 1 and 2 (a primary questionnaire for grades 1-3, and an intermediate questionnaire for grades 4-6), and the instructor questionnaire designed to address research questions 3 and 4. These three questionnaires contained retrospective items which measured the respondents' perception of change due to participation in Club Invention and the degree of change that occurred for the various respondent groups.

The student questionnaires were also translated into a Spanish version to administer to any student in the San Antonio population who did not read English. The instruction script to be read to the students was also translated into Spanish. Teachers made the determination as to whether to administer the survey in English or Spanish. Questionnaires were administered to students on their last day of Club Invention. The evaluation team administered the student surveys to students in Ohio, whereas Club Invention instructors administered the student surveys in San Antonio. Both sets of survey administrators followed a written script which provided instructions to the students.

In addition, the observation protocol developed for Camp Invention was modified for use in observing Club Invention activities. The protocol included observer instructions on key elements related to participant outcomes: 1) the extent to which and the manner in which the children were engaged in the activity; 2) the strategies the instructor employed that demonstrated inquiry-based teaching; and 3) the efforts the instructor made to motivate students and the effectiveness of such; and 4) activities in which students and instructors were engaged that demonstrated the elements of creative problem solving. Observers were trained in identifying and noting evidence of immersion, brainstorming, and create/recreate in both students and instructors. Observations provided additional qualitative data to address the attainment of the four research questions. Observations of Club sites in Ohio occurred twice in each selected site: once at the beginning of the Club Invention program (either week 1 or week 2, depending on the instructors' preferences), and again on the last day of the program. Thus, change in meeting program objectives over time could be observed and documented for both students and instructors. The same observer(s) visited each site both times in order to minimize observer bias. The San Antonio sites were observed once each.

Finally, the parent survey developed for Camp Invention was modified for use with the parents of student participants in Club Invention. Parent surveys were sent home with students on the last day of their Club Invention program along with a self-addressed, stamped envelope which the parents could use to mail the completed surveys to the evaluators. Parent surveys were administered with the intention of gaining insight into the parents' perceptions of their children's experience at Club Invention. In addition, it provided data related to the attainment of student outcomes. The parent survey contained 22 items addressing satisfaction and perceived benefits to the child, as well as reasons contributing to the parents' choice to enroll their children in Club Invention. In the San Antonio sites, parent surveys were translated into Spanish, and both the English and Spanish versions were sent home with students on the last day of Club Invention. A self-addressed, stamped envelope was included which parents could use to mail back their completed surveys to the evaluators. Instructions contained in the envelope asked the parents to please complete either the English or Spanish version, whichever they chose.

A purposive sample from over 200 sites based on available resources and access to participants was created to ensure coverage by geographic location, curriculum modules, and project budget. Five sites in the Midwest and two sites in the South

participated in the evaluation. Site visits occurred from October 2007 to January 2008. Participation in the evaluation was voluntary. Every parent, student, and site staff was offered the opportunity to participate and was provided consent letters. Parents were asked to complete a consent form prior to their children's participation in the survey completion, and adults and children alike were given a copy of the consent form, in accordance with Kent State University Institutional Review Board requirements (see Appendix D).

RESULTS

Upon completion of the data collection, the evaluation team entered the data and analyzed it using several methods. An integrated methodology including both qualitative and quantitative analyses was employed to determine both program fidelity and outcomes. The results were synthesized using a triangulated technique to determine outcome achievement. The results of each data collection activity are presented herein. Following the presentation of the data by source, a synthesis of the findings is reported in order to address each of the four outcome questions and offer recommendations for program improvement based on the findings.

Observation Results

Introduction

A total of 20 observations (two observations in each of 10 sessions) in Ohio and five observations in San Antonio were conducted during the site visits. In Ohio, a pair of evaluators independently observed the activities at each site at the beginning of the Club Invention program (week 1 or week 2), and the same pair independently observed the activities at the same site at the last or next-to-last meeting of the Club Invention program. Sites in Ohio were observed twice to ascertain the extent of change in creative problem-solving processes in both the teacher and the students. The same pair of evaluators observed the two sessions at one site in order to minimize observer bias. In San Antonio, one evaluator observed the activities in each Club Invention class at one school. Observers were trained to pay specific attention to curriculum delivery, engagement of participants, inquiry based instruction, and evidence of the elements of brainstorming techniques, create/recreate, and immersion for both instructors and students.

Evidence of brainstorming in student participants was operationalized as the observation of the students questioning and answering, showing intent behind what they were doing or building (even if it "did not work"), and giving reasons behind their actions that demonstrate that they have thought through the problem. Evidence of brainstorming in instructors was viewed as the observation of teachers guiding rather than leading the process, asking thought-provoking questions, and encouraging divergent and convergent strategies.

Evidence of create/recreate was viewed for students as their participating in trial and error activities, retrying an activity if the first way did not work, making changes to their products, and questioning why something did not work. The role of the instructor was to guide the students in this process.

Evidence of immersion for the teacher consists of behaviors such as creating a scenario or telling a story to set the context, appearing to be enjoying the activities, and of "being into it." Likewise, students who are "immersed" would be engaged in the activities, would appear to be enjoying themselves, and would appear to have a "spark."

Sites participating in the Club Invention program choose one of five separate modules, each of which consists of five 90-minute lessons. Each site determines the manner in which the lessons will be organized. For example, some sites schedule Club Invention once a week for 90 minutes and complete a lesson each session. Other sites might stretch the meeting time of Club Invention over an eight week period, dividing the lessons into eight one-hour lessons.

The five modules of Club Invention this year included the following titles: *Bolder Builders, E.Z. Science, Passage to Plant ROG, Phys. Ed: Physics in Motion*, and *SOS: Endangered Earth*. In *Bolder Builders*, Club participants join Archie Tek (an engineer, architect, and builder) to restore a town named Unlucky by creating and testing various structures for strength and stability. In *E.Z. Science*, Club participants help E.Z. Science (a dedicated but absent-minded manager of E.Z. Science Journal) to find several misplaced science articles before the magazine's print deadline. This module emphasizes mathematics and science skills, with participants conducting experiments to gather necessary information for the articles and designing and constructing simple machine devices. In *Passage to Planet ROG*, participants travel to Planet ROG and must develop different devices to help them solve problems with their spacecraft and the planet. In *Phys. Ed: Physics in Motion*, participants create games based on the work of various scientists pertaining to how and why objects move, incorporating the laws of gravity, energy, motion, and magnetism. In *SOS: Endangered Earth*, participants are asked by the Saving Our Species organization (SOS) to help protect and save animal homes across the United States by inventing devices that will help save endangered species.

Not all Club Invention curricula were included in the observations. Observed sites were conducting one of three curricula: *Phys. Ed.: Physics in Motion, SOS*: *Endangered Earth*, or *Bolder Builders*. Observations from the teams' visits were then synthesized and qualitatively analyzed to determine the extent to which program objectives were realized. Incumbent to the analysis of the attainment of program objectives is the topic of program fidelity, so that will be discussed below first, followed by the analysis of student and instructor outcomes.

Teams of evaluators visited four Club Invention sites in Ohio, twice each, and five Club Invention sites (classes) at one location in San Antonio. By visiting each Ohio site twice, observers were able to determine the extent of change that occurred over the weeks of Club Invention activities. Sites were visited either the first or second week of

activities and then again (by the same team of evaluators in order to minimize evaluator bias) the last day of Club activities. Practical considerations prevented the evaluators from visiting the San Antonio sites twice. Club Invention classes in San Antonio were observed the second day of their activities. Two evaluators observed each Ohio session, whereas one evaluator observed each San Antonio session.

In Ohio, the curriculum "Phys. Ed: Physics in Motion" was observed in three different sites, all of which included only intermediate-aged students. "SOS: Endangered Earth" was observed at one site, with all intermediate students. Finally, "Bolder Builders" was observed at one Ohio site, in which all participants were primary students. In San Antonio, all five observations were of "Bolder Builders," in which participants ranged from first through fifth grades.

The following summary of the observations will be organized first by state (Ohio and Texas), and then around each specific curriculum at each site. First, within Ohio, observations of "*Phys. Ed: Physics in Motion*" will be discussed, one site at a time. Day 1 observations will be discussed for the first site, followed by day 2 observations for the same site. Evaluation conclusions from the results for that site will then be given. Then day 1 observations will be discussed for the second site, followed by day 2 observations for the same site, etc. This same format will be followed for the other two curricula observed. After that, observations within San Antonio, Texas will be discussed, one class at a time. The separate discussions will then be summarized.

For the sake of ease of reading and in an effort to maintain anonymity of the instructors, all instructors will be referred to in the feminine gender, whether they were female or male. The use of the words "she" and "her" do not necessarily reflect the correct gender of the instructor.

Ohio Sites

Ohio "Phys. Ed: Physics in Motion" – Site 1, Day 1

Fifteen intermediate students were enrolled in this Club Invention group. The first session that the evaluators observed here was session 2 of the curriculum. This lesson pertained to concepts derived from Galileo, in particular the principles of gravity and motion. Objectives for this day included exerting a force (balancing) that opposes gravity, discovering Newton's first law of motion (an object in motion stays in motion in a straight line), and creating ways (friction) to slow down a moving object (ball).

In this particular site, the teacher did not completely follow the curriculum. However, both the teacher and students were engaged in the activities, and students demonstrated a high level of enthusiasm. This session pertained to gravity. The teacher began by asking questions about Galileo and Newton, and about the forces of gravity. Students demonstrated immersion by eagerly providing answers to the teacher's questions. The teacher encouraged brainstorming by accepting all definitions (such as, "It's <gravity's> invisible"). The students were very knowledgeable about definitions

("What's a projectile?") and the laws of gravity and motion. When students did not know a specific answer, they were encouraged to look up the answers. One said, "I'll look it up on the website." Another replied, "I'll do it after Christmas when I get my laptop!"

The first activity involved having the students select two items and run with them without using their hands. The objective was for students to keep the objects from falling (gravity). The teacher gave students some of the rules (e.g., do not use hands), but not all of them (e.g., students were not told that they were to carry the item between knees and on head). Thus, most students, who by the way chose balloons as their object, carried the item under their arms. Because the teacher did not follow the set curriculum, the opportunity to learn about balancing as a force to restrict the effects of gravity was lost. In addition, since most students were able to hold the balloons under their arms, the opportunities for brainstorming and recreating solutions were highly limited. In fact, the teacher did not facilitate brainstorming or problem-solving conversations. She seemed more intent on simply having a fun, physical activity rather than on using the activity as a means to problem solve. One group solved the problem by taping the balloon to their bodies, which was in direct violation of the "rules of the game" as stated in the curriculum.

The teacher attempted to have the students solve the problem themselves ("I'm not going to tell you how to keep it from being dropped. You're going to have to brainstorm to figure it out."), but she did not facilitate the brainstorming process at this point. She told the students to devise a plan (in groups) and then test it. She asked them what worked best, but she did not direct the conversations to include any discussion of the principles of gravity or the center of gravity. Furthermore, she did not provide any opportunity for students to modify their attempts once they ran the race. However, the teacher did allow the students time to test their ideas prior to the race, and evidence of brainstorming and create/recreate could be observed during this time. Again, however, most students settled on the single solution of carrying the object under their arms. On the positive side, the students were quite engaged in the activity and appeared to enjoy it.

A side-note is that the evaluators observed that the instructor was very intent on maintaining classroom control. The evaluators felt that the instructor might have been somewhat intimidated by their presence and felt that she had to maintain control and exercise "good discipline" because she was being "evaluated."

The second activity of the day seemed to produce more problem solving. Students were divided into two groups. Each child had a beanbag. Their task was to run (relay style) the length of the gym and, on the way back, without stopping or slowing, toss the bag into one of four buckets placed on the floor along the track. The intention was for them to discover Newton's first law of motion that objects in motion stay in motion in a straight line unless an outside force acts on them. The teacher demonstrated the task, and when she did so, she stopped at a bucket and dropped the beanbag into it. She did instruct them, though, that they were not to stop. Again, she seemed to put too much emphasis on the activity as a physical activity and a competition, but she did encourage brainstorming for solutions on this activity. ("Why didn't the bags fall into the

buckets?") Unfortunately, she appeared to be unfamiliar with the purpose of the lesson and with Newton's third law of motion. She kept asking them, "What is it about the bean bags? The mass and the weight?" Several students discovered the principle ("You have to throw it ahead of you because it doesn't drop down straight"), but they were never reinforced for their answers, and the instructor did not help them make the connection between what they discovered and Newton's first law of motion.

Ohio "Phys. Ed: Physics in Motion" – Site 1, Day 2

The same team of evaluators revisited this site on the last day of Club Invention. The lesson on this day involved the properties of magnets, and was session 5 of the curriculum. Objectives for this day included discovering objects that are attracted to magnets, observing the poles of magnets, and demonstrating how magnets attract iron filings. As an aside, the last activity was not attempted. It is unknown if the teacher deliberately disregarded that activity, or if there was to be another Club session added on that would include this activity. (There had been some delays in the after school program due to the fact that students at this school were moved into a new building midway through the school year.)

The instructor began the lesson without any background information or discussion of ideas. Instead, she immediately introduced the first activity. It is possible that an introduction to the activity was accomplished at the end of the previous session. Each group of students was given magnets, and students were instructed to write down what they thought the magnets would attract within their large room. The students demonstrated good brainstorming activity within their groups. Next, the students were given time to test their predictions and record their findings on a clipboard. The students remained engaged in the activity, especially considering they were in a large gym. The teacher remained available for questions, but she did not become otherwise actively involved with this phase of the activity. At the end of this phase of the activity, the teacher asked the students, "What kinds of things do magnets stick to?" Evidence of good brainstorming occurred, as the students responded with various answers to the question posed by the teacher.

The next activity involved designing a maze to move an object (paper clip) through with a magnet. Students and the instructor appeared very engaged in this project, and evidence of attainment of program objectives was very evident. First, students, in groups, brainstormed ideas pertaining to their mazes. They moved their paperclips through their maze, discovering what worked and what did not. They made adjustments as necessary, demonstrating good create/recreate strategies. Students appeared excited about showing each other their ideas and trying each other's mazes. Some of the children developed themes for their mazes, complete with appropriate drawings. This demonstrates creativity and immersion.

Ohio "Phys. Ed: Physics in Motion" – Site 1 Conclusions

This Club Invention group of students appeared to be a very bright group of students who were able to create and work on their own with minimal guidance from the instructor. The instructor seemed to enjoy the activities, although she did not always follow the procedures as stated in the curriculum guide. The evaluators believe that because of the lack of adherence she paid to the curriculum, certain learning and discoveries did not occur which might have otherwise. However, that did not prevent the students from having a positive experience. They all seemed immersed in their activities and energetically pursued solutions through brainstorming and recreating strategies, when time allowed. Because they were bright (an identified "gifted and talented" group of students), they were able to work more independently of the teacher.

The encouraging thing about this site is that the evaluators were able to observe participant growth in outcome achievement over the weeks between their observations. By the end of Club Invention, students demonstrated a growth in their abilities to brainstorm (even without teacher input) and to retry solutions. This shows a growth in creative problem solving.

Ohio "Phys. Ed: Physics in Motion" – Site 2, Day 1

Two members of the evaluation team observed a second site in Ohio that participated in the "*Phys. Ed: Physics in Motion*" curriculum. Twenty-four intermediate students were enrolled in this curriculum at this site. The first session that the evaluators observed was the first day of the curriculum. This lesson pertained to Newton's concept of gravity. Objectives for this day included balancing an irregular-shaped object in order to determine how to find the center of gravity, changing another object's center of gravity, and creating a tower using shaving cream and index cards in order to discover that tall objects have a high center of gravity.

Unlike Site 1, the teacher at this site closely followed the curriculum, which is reflected in the achieved results. From the beginning, the teacher set the tone that the purpose was to learn and think while having fun. For the most part she allowed students to discover things while having fun, but she maintained classroom control. This is an important point because, due to her superior classroom management, all students were on task the entire session, right up to the clean-up time at the end of the meeting. In her introduction, the teacher asked about gravity, and students raised their hands to respond. She encouraged and supported all answers. She encouraged "piggy-backing" on each other's ideas. The students were all involved in the activities, and they seemed to enjoy every activity.

The first activity directed the students to draw an irregular shape on an index card, predict the center of gravity on the shape, cut it out, and then test their hypotheses by trying to balance it on a shape (such as a cone) that they created from construction paper. The teacher gave clear instructions to the students on expectations. All students became involved in drawing their shapes and making and revising their holders. Students then

discussed why or why not they were able to balance their shapes. The teacher was a bit directive in this activity rather than permitting students to discover on their own. Her emphasis was on "what worked" and why, and she did not really explore the reasons behind why certain structures did not work. She did not let students experiment (recreate) with their cone holders enough. She made too many concrete suggestions toward the "right" solution. For example, she was heard to say, "It's going to stand better if what? If the base is what? Wider!" She did not give the student a chance to discover the solution through trial and error or brainstorming. Furthermore, she turned every activity into some sort of competition, with the winners getting a treat (actually, all students received the treat, but the winners were permitted to choose theirs first). Because of the competitive aspect, students were a little too intent on getting the "correct" solution quickly, rather than spending time in trial-and-error and discovery processes.

Despite this emphasis on completion, the students did demonstrate the elements of creative problem solving, such as brainstorming and create/recreate, and they were very involved in the activity. They were able to verbalize what they had learned about the center of gravity. One of the observers asked one of the students, "Why did you cut the top of the cone?" The student had a purposive answer: "Because I wanted to make it flat. It works better." Another student explained why his cone was having difficulty standing: "Because the base is too thin."

The second activity of the session was focused on students changing the center of gravity of an object. They taped container lids together, insides facing each other, and rolled them down an incline (a book leaning at an angle to form a ramp). Then they were to open the lids, add marbles to change the center of gravity, tape the lids together again, and then see how they rolled down the incline. They were then questioned as to the effects of placement and number of the marbles.

Students worked in pairs to accomplish this task. Every pair created something different. Some taped their lids in a criss-cross fashion, some taped them all the way around, and some taped them with a couple of pieces going across. They rolled them down the ramp, and then described the way they rolled using adjectives: fast, straight, crashed, smooth, wobbly, etc. When the students added the marbles, the teacher had them keep diagrams of their solutions. She asked questions about what worked best. Students discovered the scientific principle: "It worked better when the marble was in the center." When questioned why, the student replied, "Because the center of gravity was there and it worked better without wobbling."

One of the observers talked with individual groups of students while they were experimenting. The students were able to provide reasons for what they were doing. They tried other solutions that did not work, and then they devised a new plan to improve their solutions. They explained their plan and what worked. Students appeared to enjoy this activity very much. At the conclusion of this activity, one student exclaimed, "Whew! That was fun!"

The third activity of the day was to build the tallest structure they could using shaving cream and index cards. The purpose was to discover what happens to the center of gravity when a structure becomes taller. Again, the teacher turned this into a competition among groups, and the focus became more on winning than might have been optimal for achieving the learning objectives. However, the students appeared to immensely enjoy this project. When their towers fell, they worked at trying new ways to build them tall again in a different manner. Some groups used the index cards as braces to support their towers, while others used them as beams in the towers. Most discovered that widening the base of a tall structure helped it stand better. Students worked together well in teams, and demonstrated create/recreate problem-solving skills. They discovered the scientific principles of center of gravity on their own. This appeared to be a highly successful activity, and extremely fun for the students and teacher alike. At the end, all students cooperated very quickly in cleaning up.

In summary, this session met most of the goals of Club Invention. Students and the teacher were immersed and involved, all engaged in brainstorming, and students used create/recreate to solve problems. However, the teacher was a bit too directive in helping the students complete their projects rather than letting them continue to retry solutions. Her emphasis on competition detracted a small amount from the willingness of students to construct an "incorrect" solution and then work on ways to modify it. Also, another hitch was that a box of supplies was missing, but the teacher did her own problem solving and made the activity work with what she had on hand. All in all, the curriculum was adhered to in an appropriate way, and desired outcomes were met.

Ohio "Phys. Ed: Physics in Motion" – Site 2, Day 2

The same two evaluators visited this site again on the last day of the Club Invention program here. The session observed was session 5 of the curriculum and was the same session as described for Day 2 of Site 1, as described above. The lesson on this day involved the properties of magnets. Objectives for this day included discovering objects that are attracted to magnets, observing the poles of magnets, and demonstrating how magnets attract iron filings.

The teacher got the students immediately immersed in the session by saying that they were all "investigators." She facilitated brainstorming, encouraging everyone to respond, and providing positive feedback to everyone. The students paid close attention, focusing on the activities. Everyone looked like they were having a very enjoyable experience. The observers noticed one girl enjoying herself working as part of a group, whereas this same girl had worked alone during the first observation. The students did a good job of investigating what magnets attracted and did not attract, demonstrating immersion in the project. They stayed on task, testing and recording their findings. They indicated any surprises with an asterisk.

For the maze activity, students worked in pairs instead of individually. Students made creative mazes. One student made a penguin trying to get to an igloo. They made sure there were "tricks" in their mazes, and they made them colorful. The teacher had

them switch mazes and try each other's mazes. Again, the teacher had them race through the mazes, turning it into a competition, and somewhat defeating the purpose of the activity. However, she did question students as to principles of magnets and properties of poles attracting and repelling, allowing them to brainstorm.

The next activity involved making a picture (face, flower, animal, etc.), covering it with a vinyl sleeve containing iron filings pasted down, and using a donut magnet attached to a pencil to move the metal filing around to change the design of the picture. Again, every student was eagerly immersed, concentrating on their projects. They discovered the principles of magnetic fields, and they laughed at their different designs.

The final activity of the day was to design a magnetic game board using provided materials, including magnetic strips and paper cups, which would attract objects (paper clips) that are tossed to it. The students demonstrated much create/recreate with this activity by employing creative solutions, such as "What if we just put duct tape here and get things to stick to it!" Likewise, most of the students discovered that their initial solution of tossing the paper clips into the cup did not work because the paper clips bounced out of the cups too easily. As a result, they quickly figured out that they needed magnets to cover the surface in order for the paper clips to stick.

In summary, this session met most of the goals of Club Invention. Students and the teacher were immersed and involved in the session activities, all engaged in brainstorming, and students used create/recreate to solve problems. The teacher used less competition-based activities in this session, and students were better able to explore creative solutions to the problems at hand. Brainstorming was more fluid during this session than in the first one observed, with the teacher providing less direction and the students exploring more on their own. It appeared that both the teacher and the students were more comfortable and better able to solve problems using the principles of brainstorming and create/recreate than they had been a few weeks earlier, although they demonstrated those qualities in the first session, too, just to a lesser extent than in the final observation.

Ohio "Phys. Ed: Physics in Motion" – Site 2 Conclusions

Attainment of the goals of Club Invention was very evident at this site for both teachers and students. The teacher was very enthusiastic about all the activities, and at the same time maintained control of the class. She did an excellent job of setting the stage for all activities and of positively reinforcing all students. She used good questioning techniques, encouraging brainstorming. All the students participated with interest and eagerness and stayed on task nearly 100% of the time. Students were given the opportunity to try new ideas and test them. Students were able to explain their findings and draw conclusions. The fact that the teacher turned nearly every activity into some type of competition detracted somewhat from the intent of the activities, putting the focus on winning rather than on problem solving on discovering. This was not a serious problem, however, as it appears that the learning objectives were achieved by the students.

Student growth in creative problem solving was observed from the first session to the last. Although this group demonstrated good brainstorming and create/recreate skills in the beginning, they showed even better such skills at the end.

At the conclusion of the last session, students expressed disappointment that Club Invention was over. One student said, "I wish we could come back after Christmas!" Likewise, the teacher expressed great enthusiasm for the Club Invention program. She stated, "This program fits right into my style of teaching. This is the way we all should be teaching."

Ohio "Phys. Ed: Physics in Motion" – Site 3, Day 1

The evaluation team observed a third site in Ohio that participated in the "*Phys. Ed: Physics in Motion*" curriculum. Nine intermediate students were enrolled in this curriculum at this site. The first session that the evaluators observed at this site was actually session 4 of the curriculum. This lesson pertained to principles of air pressure. Objectives for this day included observing how changes in air pressure cause objects to move, creating parachutes testing the effect of air resistance with the goal of creating the slowest parachute, and exploring ways to move objects using air.

The first activity observed involved an experiment in which the children blew on a ball in a cup in order to observe it lift out of the cup. All students appeared to be involved and immersed in the activity. The teacher asked the students why it worked. Students responded with ideas and theories, such as "more air moves the ball faster or stronger." The teacher kept the brainstorming activity going by repeatedly questioning them about their theories and having them explain their reasoning. The teacher allowed all ideas, and then tied them together by explaining air pressure theory.

The next activity involved making a parachute. The students appeared to be excited and enthusiastic about participating in this activity. The object of the activity was for each group to use the materials provided to make a parachute and compare across groups to determine whose parachute fell the slowest. The students began by brainstorming in their groups, drawing out their ideas, testing which materials fell the slowest (e.g., tissue paper or garbage bags). One group folded the garbage bag and attached paperclips. They also tied yarn to their invention multiple times. Another group attached yarn to the bag and put weights inside the bag. While the students were brainstorming and testing their ideas, the teacher walked around and asked what their ideas were and the reasons behind the ideas. She provided positive reinforcement to all students. They continually questioned themselves and each other, such as, "Does that sound like a good idea?" "Do you want to help clip?" "Why's it next to each other?" One student explained that the reason he was putting string through a washer hole was because "it'll help when it drops."

Students demonstrated good create/recreate and brainstorming skills by adjusting their creations after experimenting with them. They adjusted by cutting the garbage bag to make it shorter, or securing the parachute with additional paper clips. One group

experimented by having one child hold one end of the bag, two others holding the open end and blowing in to see how the bag blows up. One student said, "It's probably not going to work because you're not using a floating substance like air to make it work. I just realized that." Another student explained the changes he made: "We put the weight on top instead of making it dangle. The time got shorter."

The students and teacher alike were immersed in this project, demonstrating good creativity and problem solving skills. The elements of brainstorming and create/recreate were in high evidence. In addition, the children were also very interested in observing others' creations.

The third activity of the day involved using air pressure to move plastic eggs and on the floor from the starting line to the finish line. Rules stated that the egg was not to be touched, the objects had to be moved only by air pressure, and each team member was to use a different method to move the egg during the relay race. Students could use materials provided in their solutions (paper plates, foil, balloon, construction paper, straw, and an air pump).

It was difficult for teams to develop different ideas for each team member, although evidence of brainstorming was present. Many students had similar ideas. Most students wanted to use the balloon to release air onto the egg to move it. Some blew it across the finish line with their mouths. The teacher encouraged modifications and did a good job of facilitating that process. The teacher felt that this activity "didn't go as well as the others."

In summary, observation of this Club Invention session showed high evidence of achievement of the major objectives of the program. The teacher and students were highly and appropriately engaged. They used good brainstorming techniques and the create/recreate process, thus demonstrating creative problem solving skills. Students participated and helped each other, showing interest in others' ideas and results. The teacher encouraged a great deal of brainstorming and was persistent in asking the students for explanations for why something worked or did not work. Throughout all the activities, the teacher was supportive of the students and their ideas and efforts.

Ohio "Phys. Ed: Physics in Motion" – Site 3, Day 2

The same evaluation team revisited this site the following week, which was the last session. This session pertained to magnets, as described above. At this site, the teacher began by providing background information on magnets. Students appeared to be very interested, paying close attention, and excited to "play" with the magnets. The teacher then instructed them to find five materials that will and five that will not be attracted by the magnet. Students asked questions during the activity, demonstrating immersion and brainstorming. They helped each other and showed each other what worked and did not work, demonstrating trial-and-error problem solving. The teacher kept them focused throughout the activity, and kept track of the time. When the class reconvened as a group, they shared their findings and their theories, with the teacher

listening to all ideas. They formed generalizations such as magnets do not attract paper, plastic, wood, straw, cotton, cloth, skin, and marble, but they do attract metal. They then tested the magnet on a box of paper clips, discovering that the force can go through the paper and through air.

That led to the second activity, in which students made individual mazes to run objects through using a magnet. All students appeared to be excited about this activity. They made creative and complicated mazes. One student installed traps that made the players go back to "Start" when they were caught. Another built king's shields in the maze. Magnets became the warriors. Another added a key to the maze, requiring players to have the key in order to get through the door. Another added a hidden, inaccessible room with flowers, within his overall design of a mansion. All added colors and designs to their mazes. This demonstrates immersion and creative problem solving. In addition, when students tried their mazes, they made adjustments, demonstrating create/recreate. At times, some students had trouble getting their mazes to work properly, but the teacher encouraged them to try again. They appeared to be excited about switching mazes and having others try theirs.

In summary, it appears that the goals of Club Invention were met in this session. The teacher set the tone by being enthusiastic about the projects, and she was very interactive with the students. She was supportive and continually encouraged the students to think. The students enjoyed the activities. They were eager to test their ideas and see the results, and they made adjustments as needed. Teachers and students alike were immersed and involved, and demonstrated creative problem solving techniques such as brainstorming and create/recreate. Students were able to discover many properties of magnets through their projects, with a little background instruction from the teacher.

Ohio "Phys. Ed: Physics in Motion" – Site 3 Conclusions

Attainment of the goals of Club Invention were evident at this site for both teachers and students. The teacher provided background information, and then allowed the students to discovery principles on their own, all the while providing encouragement and positive reinforcement. She led some brainstorming activities, and students became proficient enough to brainstorm on their own when they were involved with their projects. Students also demonstrated create/recreate skills throughout their activities, further showing creative problem solving skills. Unfortunately, the evaluators were unable to observe this site at the beginning of the Club Invention program here, so the extent of change that occurred is unknown. However, it is safe to say that the program here was successful in accomplishing the goals set forth in the curriculum.

Ohio "SOS: Endangered Earth"—Site 1, Day 1

Fourteen intermediate students were enrolled in this Club Invention class. The first session that the evaluators observed was session three of the curriculum. This lesson pertained to concerns animals face when attempting to cross highways. The goal of this session was to encourage students to explore how increased road and land development

affects animals across the country. From this exploration, students are to list different kinds of natural or manmade obstacles that might be found on, near, or around highways. Then, students are divided into teams that will create two obstacles to place on the divided highway. The second activity from this session also pertained to highway safety. Remaining in the same teams, the students are instructed to create new inventions that must get the animals safely across the divided highway.

In this particular site, the teacher followed the curriculum thoroughly. The session began with discussion of the activity in which the teacher asked the students what animals live near houses. The students were highly engaged and the teacher asked enticing questions to encourage brainstorming. Additionally, the teacher asked what types of objects are found on the road on a daily basis, and why animals would want to cross these roads. For example, the teacher asked students, "What could be in a deer's way crossing the road?" and students responded with "Cars, trucks, garbage…" To further encourage brainstorming related to other obstacles in the road, the students paired up and thought of more obstacles.

Once students thought of some obstacles, they were allowed to begin creating them. Students selected their own materials and began building their obstacles to place in the road. Examples of obstacles produced by students included holes, walls (made from Styrofoam plates and tape), roadblocks, median and light poles (with cardboard tubes and straws), trees, trash cans (colored and cut paper), rocks (made from Play-Dough), water, and telephone towers. The teacher was very encouraging, making remarks such as, "That's good, I hadn't thought of that," as she walked from group to group. When she asked them to explain their creations, they did so in detail. She also asked them, "Do you think people think of this when they build?", and the students replied, "No."

The teacher once again facilitated brainstorming and immersion by asking the class how the animals could get to the other side of the road without touching it. The students brainstormed ideas quickly, some of which were hot air balloons, "animal only" bridges, tunnels, shoot animals across the road with a canon and trampoline, and traffic lights that stop cars. One student said he can make them slide across, like an elevator on the ground. On occasion, the teacher helped the student fix their designs instead of allowing them to recreate them themselves. Although she did not pressure the students to make projects, all the students were attentive, building designs, and asking questions.

As time went on, some students became disinterested. Whereas some students took the lead in their groups, others simply taped things together and did not follow directions. It was observed that sometimes students let their partners do all the work and did not participate. However, most students worked persistently with positive attitudes. They often got together and compared their ideas with other students, and everyone appeared to understand the purpose of the project.

Once the allotted amount of time elapsed, students gathered on the carpet to compare ideas and discuss what they learned that day. Children were eager to share their ideas and projects, and they were not critical of one another. There were no incorrect

answers and teacher praised responses of all kinds. Both the environment and the teacher encouraged brainstorming and ingenuity, and the children were almost always engaged in the process. The students appeared to enjoy their time at Club Invention and seemed upset when they were told Club Invention was canceled for the following week.

Ohio "SOS: Endangered Earth"—Site 1, Day 2

The same team of evaluators revisited this site during session four of the *SOS: Endangered Earth* curriculum. The lesson for this day involved researching the effects of oil spills on freshwater and marine animals. The teams of students then examined various methods in cleaning up oil spills, and eventually created their own invention to aid the clean-up process. The purpose of their inventions is to help rescue ducks, birds, and sea otters affected by a recent oil spill.

To prepare students for the activities, the teacher gathered them around a table and held a discussion. She defined terms for them and asked questions such as, "What animals live on water?" She explained to them the three main methods to clean up oil: absorption, vacuum, and a boom. She asked the class, "What is something that absorbs?" and they responded with, "a vacuum." She explained that a vacuum "sucks it, I'm looking for something like a paper towel," and another student responded with "sponge," which was correct. The students appeared to be fully immersed, demonstrating eagerness to see what the teacher was going to do with the materials on the table.

The teacher then showed the students a duck's clean feather, and then she dipped another feather in oil. She probed the class by asking, "What is the difference between the two feathers?" and they said, "[The one with oil is] heavier, gross, and sticks to another feather!" The students were disgusted by this oily feather. The teacher then dropped the feather and asked if the duck could fly with feathers like this, and the class shouted "No!"

The teacher then placed the feathers into a pan of water. She gathered napkins and skimmed the water, but oil still existed in the water. Students appeared to be engaged in this process by the attention they paid to the teacher and the comments they made. The students pointed out that the technique the teacher had employed worked somewhat, but the water was still oily. The teacher then made a "lasso" from string and explained it as a boom. "This device collects the oil from the water and drags it to one corner." Last, she introduced a sponge and asked students, "What class type of tool is this?" Several students replied, "Absorber," which was the correct response. The teacher then cut up two sponges and placed them into the oily water. Then, she allowed a student to remove the sponges and squeeze the liquid from the sponge into a bowl. The students appeared to be very impressed with the sponge when they saw how much oil was squeezed out with the water collected by the sponge.

During the last demonstration, the teacher poured baking soda into the water and it absorbed the oil. She scooped it out and displayed all the tools used in one central location. While continuing to hold student attention, she asked them, "Which tool would

be best to use?" Students agreed that the sponges and the baking soda worked the best. She then asked students, "How do you clean up an oil spill in the ocean?" They suggested a "submarine or a boom to rope oil in." She asked students for different scenarios of oils spills and students responded to her eagerly.

The discussion ended and the activity began. Students were asked to invent a tool to clean up the oil, and the teacher emphasized, "To clean up, not prevent." Students gathered in teams and shared the water pans to test their inventions. Students all participated intently in the activity and demonstrated instances of create/recreate when their inventions did not pull the oil from the water. The teacher further encouraged immersion and brainstorming by walking from group to group, asking them about their inventions and persuading them to explain why their inventions were or were not successful, a task they sometimes appeared to find difficult to do.

The students were creative and built inventions such as a robot with absorbers, huts, scoops, and giant straws to suck out the oil. When students' ideas for cleaning up the oil did not work, they made new creations, but they sometimes got distracted and began splashing water or making paste.

Ohio "Bolder Builders" – Site 1 Day 1

Fifteen primary students were enrolled in this Club Invention class. Two evaluators observed the Club Invention program on this day. The first session that the evaluators observed here was session 4 of the curriculum. In this session, students explore different shapes, colors, and textures of both the inside and outside of buildings. The objectives include going on a scavenger hunt to search for different shapes found in buildings, and then creating functional and aesthetically pleasing buildings. The setting is the town of Unlucky, whose inhabitants lost their homes in a hurricane.

The teacher began this session by referencing past sessions and connecting concepts to the present lesson. All the students were seated around one table, along with the teacher. The teacher moved into a brainstorming session, asking the students what would make a building interesting. All students raised their hands and seemed excited to answer. The teacher encouraged all answers. This demonstrates both immersion and brainstorming.

The task the students were given was to do a scavenger hunt to find different parts of a building (wood, plaster, glass, etc.). The teacher asked the students where they thought they would find these materials, and again, the students brainstormed answers. Then the teacher added an element to the scavenger hunt – texture. She asked the students what texture was, but they were uncertain. She demonstrated by using a crayon on a piece of paper that was lying on a piece of burlap. After that, the children seemed to understand the concept. She then gave the students their scavenger hunt sheets and pencils, and the students went into the hall and proceeded to look for the items.

The children were active in looking for the items and textures. They expressed excitement when they located something: "Oh, I found something!" They had some difficulty with finding some of the shapes, and the teacher helped them look, keeping them focused. She would ask questions such as, "What shape is the room?" "What about the texture of the carpet?" "What do you like about his building?" Students demonstrated a high level of immersion in this activity.

When they returned to the room, they briefly talked about the hunt, but then they quickly moved on to the building activity. The teacher used examples to explain beams, arches, different types of doors, and decorative elements. She made sure students were listening and paying attention. They worked in pairs to first draw out what kind of building they wanted to build. They brainstormed with each other: "Where are we going to put the doors?" "How are people going to get upstairs?" "We need a big, beautiful window." Students also brainstormed with each other about what types of materials to use when they began building. One group used Styrofoam for the walls because it was strong. Another used pipe cleaners to make the arch of the roof. Another wanted to use clay to cover the outside of the building to make it more stable. One group built a cupcake restaurant; they had the inside of the restaurant filled with tables (condiment cups) before they had the walls built! Another group placed feathers on their roof.

The buildings they made had varied and creative purposes. The cupcake restaurant was mentioned above. When completed, it had heart-shaped doors. Other buildings included a doggie hotel with a door that looked like a dog's mouth, an art museum with a cowboy hat window and roof sculpture, a bird museum, and a hospital. They brainstormed and added other creative elements to their buildings. "We're making a balcony for children in the hospital to get fresh air." "We're putting stairs outside the church to get to the second floor where the bell is." One group put chimneys on their museum "because it's cool."

Regarding the demonstration of creative problem solving skills, the children were able to brainstorm fairly well and their solutions were innovative. However, they did not explore multiple solutions (create/recreate). Although their ideas were creative, when the buildings appeared to be unstable (such as the bird museum which kept falling over), no rebuilding was observed. As a result, an opportunity to employ the create/recreate problem solving scheme was missed. When adjustments were made, it was largely because the teacher directed them to the "correct" solution, or at least suggested a solution. She was also insistent that they complete certain steps in order. For example, she said, "You need to work on your structure before texture." Another example was her comment to the students who put the tables inside the cupcake restaurant before they built the walls: "Don't you need to do the building first?" She suggested to another group, "Instead of using Styrofoam trays, use papers with texture and tape it to the pipe cleaners." Other example of how she did not let the students complete the projects on their own were these comments: "I love your walls. Are you going to make a slit?" "Your door doesn't touch the floor. Why don't you add stairs?" Then she showed them how to make stairs. The emphasis was on the building rather than on problem solving and discovery.

Perhaps part of the problem was time. The teacher continually reminded the students that they needed to hurry and finish their buildings. Indeed, one group was still building their walls when it was announced that it was time to clean up. Another difficulty was that the teacher was off-task much of the time. She was on the internet, and then she texted on her phone and talked on it for approximately ten minutes.

The group concluded the session by sharing their buildings with the class. The teacher was encouraging and showed enthusiasm about their buildings, praising their creativity.

In summary, during the first activity of today's session, the children appeared to be fully engaged and excited to learn about texture. They actively participated in the scavenger hunt, despite the fact that they sometimes did not pay full attention to all the items. When they gathered for the second activity, the children once again actively participated and brainstormed some very creative ideas for their buildings. The teacher facilitated brainstorming by praising students' responses, but she limited brainstorming by "correcting" impractical or out of sequence ideas. Once the students began constructing the buildings they had drawn, they encountered some difficulties, but they did not "recreate" the idea and try something else. It appears that the teacher did not fully understand the purpose of the program. She directed the children too much, making suggestions instead of letting them explore the possibilities. All in all, the students displayed high levels of engagement and brainstorming, but did not recreate building ideas that were not working as planned.

Ohio "Bolder Builders" – Site 1 Day 2

The same two evaluators returned to this site the following week. They observed session 5 of the curriculum, which was developed around the concept of structures occurring in nature. The objective's for this lesson included building a spider web to catch and hold a plastic insect (applying the principle of balance of tension), creating an animal burrow or tunnel (unobstructed path), and building a nest able to support a live load (weight-bearing principles).

The session began with the children sitting at a table listening to the teacher as she introduced the lesson. When she talked about spiders (after quieting down the groans from the students who did not like spiders), she asked questions about their webs: "Why are they so sturdy?" "What are they made out of?" The children eagerly answered her questions. "It's like glue – it's sticky."

The first activity was to make a web from a skein of yarn and legs of a stool. When the webs were completed, the teacher was going to test to see if they could hold a plastic insect. Three groups of students were formed. They all talked to each other about how to anchor the string, how to start it, etc., demonstrating good brainstorming techniques. "Let's weave it, to make it even stronger." "We can use the top." "Tell me what your idea is." "We'll do two layers so it'll be stronger." "I think this thing could

hold me!" During the testing phase, the insect bounced out of two of the webs, or got caught on the bottom layer. It went through the third group's web. The teacher did not suggest that the students make adjustments to their webs, nor did the students attempt to do so. Instead, they began sitting on their webs to see if they were strong enough to hold them. They became a little rambunctious, and the teacher had to assert control.

The second activity was making tunnels out of cardstock and masking tape. The tunnel was to have two turns in it, and when completed, allow a marble (representing an animal) to roll through it unobstructed. Again, the teacher began by asking the students questions about "Who makes tunnels?" The students demonstrated involvement by eagerly providing answers. She then showed them a model tunnel that she had constructed, indicating the requirements (two turns). She showed them how she had made the curve in her tunnel. Students returned to their groups and proceeded to work on building the tunnels. For the most part, they worked well together. "I see a spot you don't see." Some groups argued over how to make the curves in the tunnel, but this is a good indication of immersion, brainstorming, and creative problem solving. One student was off-task, wandering around the classroom. The teacher redirected him.

The students appeared to have fun testing their tunnels. One of the groups had attached their tunnel to the table and had put a small cup under the end of their tunnel. When the marble was placed into the tunnel, it got stuck on some tape three quarters of the way down. The members of the group were very quick to figure out why the marble did not go all the way down, and they fixed it. This was a good example of create/recreate. The marble made it through the other tunnels without obstruction.

The third activity was building a bird nest on a paper plate from materials given. Students were instructed that they could weave, twist, or tie the materials, but the nest should be able to hold its shape. Then they were to slide the nest off the paper plate onto two parallel dowel rods that were suspended four inches apart, with their ends taped to the top of two tables, so that the nest resembled being in a tree. They then were to test their nests by placing stones into them one by one without breaking the nests.

The teacher began this activity as those preceding it, by asking questions to set the stage: "What goes into a nest?" "What shape are they?" "What do birds use them for?" The children answered her questions enthusiastically, and the teacher praised them for their answers. The materials the children were given from which to build their nests included pipe cleaners, feathers, cotton, clay, tissue paper, etc. The teacher explained to them that what they built had to fit onto a paper plate. The children appeared to have a difficult time understanding the directions. They used the plate as a base for the nests and glued objects to it rather than building upon it. They kept asking, "How do we make a nest?" The teacher finally made an example, which appeared to help the students understand the activity. One group had to split up because one of the girls in the group was directing all the activity and not considering any suggestions from the other two in the group. Time was running short, and the teacher told the children to hurry, which made the activity seem rushed. They ran out of time before they could test the nests. They did, however, have time to share their designs with each other.

In summary, the students seemed immersed in the day's activities. At times, their behavior became a bit unruly, but the teacher was able to redirect them. The students answered questions eagerly, actively brainstorming ideas and then creating them in innovative ways. A few instances of create/recreate were demonstrated by the children, but not to a large extent. When the students experienced difficulty, the teacher showed them what to do rather than facilitate re-creation or allow them to try out different ideas.

Ohio "Bolder Builders" – Site 1 Conclusions

This was the only primary Club Invention class observed in Ohio. The teacher expressed her frustration that some of the activities seemed too difficult for this level, or at least that it was too difficult to keep the children behaving properly. Despite her concerns, however, attainment of some of the goals of Club Invention was evident at this site for both the teacher and students. The teacher did a good job of eliciting ideas and concepts related to the background information without merely "lecturing" the students. Her technique of brainstorming appeared to work well with this group. She positively reinforced students for their responses and efforts and displays of creativity, and she allowed students the opportunity to brainstorm on their own. She did not, however, encourage a trial-and-error learning process, losing the opportunity to develop that aspect of creative problem solving. Students can be directed to retry something through a series of questions without being directly told how to do it. This seems to be a skill not utilized here. It seems the teacher may not have been aware of that particular objective, or did not fully understand the nature of creative problem solving. It does not matter that the children are young. They can still employ elements of creative problem solving. Also, the evaluators were unfortunately unable to observe this site at the beginning of the Club Invention program, so the extent of change that occurred is unknown.

San Antonio Sites

An evaluation team consisting of three evaluators visited one site in San Antonio, Texas. There were three separate sessions of Club Invention going on, which included an enrollment of 75 primary and 50 intermediate students. All sessions were conducting lesson 1 of the *Bolder Builders* curriculum. To differentiate among them, they will be referred to as Class 1, Class 2, etc., to Class 5.

San Antonio "Bolder Builders" – Class 1

Twelve students were enrolled in this Club Invention class, all fifth graders. One evaluator observed the program, which was lesson 1 of the *Bolder Builders* curriculum. In this session, students explore the concepts of form and structure through the building of tents. They design blueprints for a tent and build the tent using the materials provided. These structures are then tested by "the elements" – wind, rain, and hail. Through this activity, the students are to discover how concepts such as tension, structure, and function affect the durability of a structure.

The observer was late to the session so she missed the first activity, blueprints, and the explanation of the second activity, tent building. When the observer arrived, the students were already working in groups of two or three at different tables around the room, constructing their tents. The teacher had a timer set so that the students could keep track of how long they had to finish their task.

The examples of different tent shapes and the requirements were up on the board for the students to see. The students were actively engaged in putting the final touches on their structures in preparation for the first round of testing. The teacher in this room followed the curriculum closely. She kept the students on task but also set the tone as one of learning, exploring, and having fun. While students were working on their tents, the teacher and the aide asked the students questions about what they were doing and why, giving them positive feedback.

When the time for the task was up, the teacher called all the students to the middle table and asked for volunteers to test their tents. All the students clamored to go first and the teacher chose a group. The tents were tested three different ways. The first test was a wind test, which was done using a blow dryer to simulate wind. The second test was rain which was simulated by a spray bottle. The last test was a hail test, the hail being pinto beans that were dropped from a cup above the tents.

There were five groups in the classroom with tents. Each tent was a different design, and when asked what kind of tent they had, students gave answers such as, “dome made into a teepee”, “half dome,” “half teepee,” “mostly dome,” etc. They were required to put cotton balls in the tent to simulate people inside the tent. Some groups added more to the inside. For example, one group added furniture and a doormat.

When each group came up to test their tent, the teacher asked them questions such as, what kind of tent they had, what they thought would happen, and after the test, what do you think you could improve? All the students appeared to be actively engaged in providing answers for their group and the other groups. They would name parts that needed improvement, and when asked, would say how the suggested improvement would help. The teacher’s questions were sometimes leading, “Were you trying to strengthen the center?” but overall, the questions left plenty of room for brainstorming and creativity. When all the tents had been tested, the students were given 15 more minutes to make adjustments to their tents, demonstrating the create/recreate process.

All the students were actively working on their tests during the time they were given to make improvements. Most of the groups were adding more tape, straws, and layers of plastic wrap to shore up their tents. When one group was asked about why they were overlapping the straws they were putting in the tent, they responded, “to make it stronger.” And when the straws did not fit, they cut them down to make them fit. The groups were making the improvements they and the other students had come up with, but they were also cognizant of the activity’s requirements. One of those requirements was that light had to be able to get into the tent, so none of the groups covered their tents completely with tape. When the time for improvements was up, the teacher called them

back into the middle of the room. They had to be asked a couple of times because the groups still wanted to make more adjustments to their tents. This demonstrates immersion.

The second test was similar to the first test, with the teacher asking questions about the tents to each group. She asked questions such as what improvements the students made to their tents and why those kinds of improvements. The majority of the groups' tents performed better under the rain test than they had the first time with the wind test. In the cases where there were still problems, the students were quick to come up with solutions. The teacher had positive comments for each group and facilitated the test skillfully.

After the test, the teacher gathered the group at the front of the room and asked them what they felt they had learned in this session. None of the other classrooms that were observed did this activity. The students appeared eager to answer, and they came up with some great answers that really showed the goals of the program – brainstorming, create/recreate, and immersion. These were some answers that were given: "Don't need instructions to build a tent" (Note: The teacher did not give them specific instructions), "Imagination can conquer all," "Teamwork," "How to support a tent," and "You can make something not from the store."

In summary, this session met the goals of Club Invention. The teacher and the students appeared to be immersed in the activities, they engaged in brainstorming, and they used create/recreate to solve their problems. The teacher did an excellent job of facilitating the conversation and letting the students figure out how to solve problems. Overall, the curriculum was followed correctly and the desired objectives of the program were met.

San Antonio "Bolder Builders" – Class 2

Twenty fourth-grade students were in this classroom, and they were also doing session 1 of the *Bolder Builders* curriculum. This lesson focuses on building tents and testing to see how well they stood up to the elements. Through this activity, the students are to discover how concepts such as tension, structure, and function affect how durable a structure is.

The observer was late to the session so he missed the first activity, blueprints, and the explanation of the second activity, tent building. When the observer arrived, the students were in pairs working on their tents. The structures of the tents were varied, with teams choosing one of the three types of tents or a hybrid of the three. The teacher went around the room checking the progress of the teams, asking questions, and checking to see whether they were following the guidelines of the task. She gave them encouragement, and when asked what to do about a problem with the tents, she told them, "Improvise!"

The students appeared to be very thorough in testing their tents themselves before they subjected them to the elements test. They were shaking them and even flipping them upside down to check for stability. They also came up with innovative ways to fix or avoid problems. A common problem among the students was the use of too much duct tape on a tent model, weighing it down. To address this problem, they added more straws inside the tent for support. Students also devised novel ideas of how to avoid problems during the elements test. One student explained about attaching strings from the top of his teepee to the cardboard to protect it against the wind. Another detailed how she was using straws to conduct water from the top of the tent to the bottom to prevent water from getting into the tent. The students were engaged with the activity and seemed to be considering the implications of their building design.

The testing of the models was done in front of the whole class. At the beginning of the tests, the teacher asked why they were using a hairdryer instead of real wind. The students responded that it was because you can't control the weather and the teacher acknowledged their answer as correct. She then explained that because these tents were models, using a simulation of real wind was more appropriate than the real thing.

A unique feature that this teacher added to the testing was to have the students give a thumbs up or down after each test. This added a level of involvement but may have discouraged those students who received thumbs down when their tent did not pass a test. Also, the tents were not anchored in any way so they would sometimes fly across the floor during the wind test causing a "thumbs down" reaction from the class. A better way to test this would have been to hold them down, as the movement of the tents across the floor is not an indicator of the stability of the tent. The majority of the tents passed the tests and the students really seemed engaged and excited about the whole process. They ran out of time to improve their tents and retest them. Many students expressed a strong desire to keep working on them.

Overall, this session met the objectives of Club Invention. The students were immersed in their activities and showed great creativity and intelligence in the construction of the tents. The teacher did a great job of facilitating the discussion without being too leading and really let the kids get creative with their projects.

San Antonio "Bolder Builders" – Class 3

This and the remaining two classes were observed by the same evaluator. The observer split her time among the three different classrooms and hence did not observe all the activities. These three classes in San Antonio, as well as the two already discussed, were participating in the first session of the *Bolder Builders* curriculum. This observation was of first grade students.

In this classroom, the teacher explained that she had begun the session by talking about the real world problems that occur with construction. Utilizing a slide show, the teacher had led a discussion on Hurricane Katrina. The instructor asked about the effects the hurricane had on land, buildings, etc. This was a creative addition the instructor

utilized to involve the children and to make the activity more meaningful to these young children.

The evaluator observed the activity in which the children were testing the tents they had constructed and were making adjustments. The children appeared to be immersed and excited about their projects. They had brainstormed ideas, and were highly engrossed in making adjustments as needed. However, the teacher often provided solutions rather than trying to elicit them from the children. For example, she would say, "You can tape this here to make it stronger." Another example of a solution provided by the teacher was, "Air and water are going through here. Get more wax paper and tape it here." It is possible the teacher was directive because the children were so young. However, the teacher could have used a questioning technique to stimulate creative ideas regarding solutions rather than just providing them herself. Indeed, at times she did: "Imagine you're under there. What would it be like?" To which the child responded, "It would be a little windy!" Then the teacher instructed, "Try again and see how strong you can build it." What was really positive about this session was that time was spent on rebuilding the tents, on making adjustments. The children learned the process of "redoing" something to make it better, and they appeared eager to do so.

San Antonio "Bolder Builders" – Class 4

This was a classroom of second grade students. The evaluator observed the students in the process of testing the tents they had built. The tests included wind and rain; the teacher had decided not to use the beans (hail) because of the mess it would cause. The students appeared excited about this activity, demonstrating much activity and eager conversation. They were coming up to the teacher one by one to test the tents they had constructed. A second teacher was circulating around the classroom assisting the children. As the groups interacted with the teachers, there was a lot of feedback from the other students and from both teachers: "Cute decorations," "Good job," "This one did very well in the rain." The children were obviously engrossed and invested in their projects. One indication of this was that they had their fingers crossed and would cover their mouths while the teacher was testing the tents, hoping that theirs would "pass!" If something did not work quite right, the teacher would instruct them, "You need to fix that," and would send them back to work. The students would then try something else, indicating create/recreate problem solving techniques.

San Antonio "Bolder Builders" – Class 5

The evaluator who was observing three separate classes at the San Antonio site spent the majority of her time observing this particular class of third graders. The teacher began by asking the class if any of them had ever set up a tent. She then had them stand and lock hand together to demonstrate the principle of tension to make it strong. She went over all the materials for the lesson, giving the students a couple ideas of how to use the materials (e.g., poking something into the clay or cutting notches into the top of straws). She cautioned the students over the use of materials, such as to make sure they

shared, to not wrap their bodies up in the tape, to not open the clay until they began. She had excellent control over the class and used humor throughout the entire day's activities.

The students were attentive and involved. They interacted among themselves, talking with each other about ideas for their designs and what materials to use. They appeared excited about getting started on their projects. The teacher set the stage very well. She also talked about real world problems in construction. She encouraged creative problem solving among the students by letting them solve their own problems.

The teacher showed immersion in the projects: "After you're done with your tents, you'll have two itty bitty people – cotton balls – inside the tent. The people have to stay dry when it rains." She encouraged the students to name the people, put faces on them, etc. She explained that the tents would have to withstand strong wind: "We're going to try to blow your tent down like the three little pigs!" Then she explained that the tent would have to withstand a hailstorm – represented by beans – so it would have to be strong enough for that. Then she reviewed with the class what they needed to do. The children listened attentively, giggled, and answered her questions.

The teacher put up the posters of the different kinds of tents and the class talked a bit about them. She explained that, "Your campers like to read so we have to have something inside your tents so your campers have light and can read." Again, this demonstrates immersion on the part of the teacher.

The students proceeded to gather their blueprints (which they had made in an introductory session as part of their overall after school program) and get their materials. They talked with each other about what they were doing, giving each other directions ("Cut this." "Don't squish it.") This demonstrated immersion and brainstorming.

The teacher did an excellent job of encouraging create/recreate activities and of having the children solve their own problems. The children demonstrated good problem solving techniques as a result. "This is a great shape! This is working!" "We just chucked our whole tent. This one is easier." "What would make this stronger?" One student showed the evaluator what went "wrong" with his tent: "It got wet. I should have done this…" and then he proceeded to demonstrate what he felt he should have done by taping something down. They piggybacked on each other's ideas, sometimes without knowing that they were doing so: "We're just borrowing ideas!"

The teacher summed up the objectives of the program quite eloquently: "The nature of this class is explorative. I try to tell them as little as I can. There is not enough of that in regular school."

Observation Summary and Conclusions

Evidence of creative problem-solving activities, such as brainstorming, create/recreate, and immersion was observed for both teachers and students at all sites, especially if the curriculum was followed as intended (as it was in most cases). In the

instances in which sites were visited twice, once in the beginning and once toward the end, growth in problem-solving activities was observed. Teachers were proficient at guiding brainstorming activities, and toward the end of the Club Invention program, students led themselves in brainstorming activities, including, at times, building upon the ideas of others. Students were somewhat on the impatient side when it came to recreating projects that needed adjustments, but when they were encouraged to do so by their teachers and when time allowed, they did so. There were many instances, however, in which the teacher showed too much leading in the recreating process rather than guiding the students in solving the problem themselves. There were also instances in which too much emphasis was placed on competition and/or having the project "work," as opposed to the process of problem solving and creating.

Teachers, for the most part, were very good at classroom management and at "teaching." They were quite proficient in conducting brainstorming sessions and utilizing a question/answer technique to elicit creative ideas. They were very encouraging and provided a great deal of positive reinforcement. Every single teacher made sure the students were having fun.

Where some of them were a bit lacking was in their ability to stimulate the create/recreate process whereby the students would attempt to solve problems on their own and make discoveries through a system of trial and error. This is probably because teachers are accustomed to a more directive style of teaching. They are probably more concerned with the product than with the process. They are not as familiar or comfortable with facilitating discovery learning, which is the crux of the creative problem solving process. This is evident with the type of instruction they provide students during a potential "recreate" situation. For example, they might direct a student to "try using glue instead of masking tape," instead of asking them, "What idea do you have about what might stick better?" Indeed, having teachers become more proficient in the inquiry based style of Club Invention is one of the goals of Club Invention. It is difficult to ascertain change over the course of just a few weeks, especially since the number of sites observed that way were few in number. This data must be evaluated in conjunction with the survey data presented below.

Survey Results

Primary Student Survey Results (Grades 1-3)

Demographics

Although schools were selected to include both primary (grades 1-3) and intermediate (grades 4-6) students, only three primary students – all of them third-grade girls – in the Ohio sites completed the primary survey. In one of the schools, the third graders were included with the intermediate students, and all students there completed the intermediate student survey. Those third graders will be included in the results for the intermediate students.

A total of 89 primary students from San Antonio completed surveys. This included 34 boys, 54 girls, and 1 who did not specify. The distribution across the primary grades in San Antonio was fairly even, with 25 first-graders, 39 second-graders, 23 third-graders, and two who did not specify grade.

Student Outcomes

Five items on the survey asked questions regarding the primary learning outcomes for Club Invention. These items attempted to ascertain the extent to which students perceived a change in the way they viewed science and creativity. The results from the Ohio younger children's survey responses are presented in Table 1. It can be seen that all three children responded favorably to all five items. It is difficult to make generalizations based on only three children, but to the extent that that is possible, it can be said that primary students in Ohio indicated that they felt that, after attending Club Invention, they were better able to solve problems and stick with hard problems, they are more comfortable coming up with new ideas, they can use everyday items in new and different ways (an indication of creative problem-solving), and they feel at least somewhat more curious about things.

The results from the San Antonio younger children's survey responses are presented in Table 2. It is evident that nearly 90% or more of the San Antonio primary students responded favorably to all five items.

In addition to the items assessing perceptions of creative problem solving, students were asked to respond *yes* or *no* to the item, "I would like to come back to Club Invention again." This item assesses satisfaction with the program. All the Ohio students and 92% (of the 88 who responded) of the San Antonio students indicated that yes, they would like to come back to Club Invention next year. This indicates that primary students were satisfied with their experiences at Club Invention.

Primary Student Survey Summary

Although only three primary students from Ohio responded to the survey, their responses are similar to those found for the 89 primary students in San Antonio who responded to the survey. Five survey items attempted to assess student perceptions of change in creative problem solving since attending Club Invention. Approximately 90% of primary students responded favorably to all items. The findings would indicate that the student objectives for Club Invention – a change in perceptions regarding creativity and science and a change in knowledge regarding creative problem solving – were met for primary students.

Table 1. Percentages of Responses to Each Item
Primary Student Survey: Ohio Sites

		PERCENTAGES		
ITEM	**N**	**A LOT**	**LITTLE**	**NOT AT ALL**
Club Invention has helped me learn how to solve problems better.	3	66.7	33.3	0.0
Club Invention has helped me feel more comfortable coming up with new ideas.	3	66.7	33.3	0.0
Club Invention has helped me think about how to use everyday items in new and different ways.	3	100.0	0.0	0.0
Since I've been at Club Invention, I feel more curious about things.	3	33.3	66.7	0.0
Since I've been at Club Invention, I stick with a problem even if it's hard.	3	66.7	33.3	0.0

Table 2. Percentages of Responses to Each Item
Primary Student Survey: San Antonio Sites

		PERCENTAGES		
ITEM	**N**	**A LOT**	**LITTLE**	**NOT AT ALL**
Club Invention has helped me learn how to solve problems better.	89	83.1	11.2	5.6
Club Invention has helped me feel more comfortable coming up with new ideas.	88	73.9	23.9	2.3
Club Invention has helped me think about how to use everyday items in new and different ways.	87	64.4	25.3	10.3
Since I've been at Club Invention, I feel more curious about things.	88	65.9	22.7	11.4
Since I've been at Club Invention, I stick with a problem even if it's hard.	86	73.3	14.0	12.8

Intermediate Student Survey Results (Grades 4-6)

Demographics – Ohio

A total of 42 students from Ohio and 35 from San Antonio responded to the intermediate student survey. There was some confusion in one of the Ohio sites, and a group of third graders was inadvertently given the intermediate survey instead of the primary survey. This group of third graders did not appear to have any difficulty with the survey, so their responses are included with the intermediate students. Unfortunately, however, this had the effect of considerably reducing the number of primary surveys completed by Ohio students.

The number of students represented at each grade level in Ohio was almost identical across third, fourth, and fifth grades. Three students did not indicate grade level or gender because they did not answer any questions on the back page of the two-page survey. There was a total of 12 third-graders who completed the survey, 13 fourth-graders, 13 fifth-graders, one sixth-grader, and three who did not indicate grade. Likewise, boys and girls were represented almost equally. There were 18 boys and 21 girls who indicated their gender. This data is presented in Table 3.

Table 3. Demographic Data of Students Responding to the Intermediate Survey from Ohio

	Frequency	Percentage
Grade		
3rd	12	30.8
4th	13	33.3
5th	13	33.3
6th	1	2.6
Gender		
Boy	18	46.2
Girl	21	53.8
Main Reason for Attending Club Invention		
I like science	6	15.8
I thought it would be fun	15	39.5
My mom or dad made me	2	5.3
I like to invent things	15	39.5
Would Come Back - Yes	38	94.9
Total Number of Students	42	

Demographics – San Antonio

Thirty-five intermediate students from San Antonio responded to the survey, and their demographic data is presented in Table 4. The number of students represented at each grade level in San Antonio was relatively even across fourth and fifth grades, with 20 fourth-graders and 15 fifth-graders completing the survey. There were 15 boys and 20 girls.

Table 4. Demographic Data of Students Responding to the Intermediate Survey from San Antonio

	Frequency	Percentage
Grade		
4th	20	57.1
5th	15	42.9
Gender		
Boy	15	42.9
Girl	20	57.1
Main Reason for Attending Club Invention		
I like science	10	28.6
I thought it would be fun	14	40.0
I like to invent things	6	17.1
Because my friends were coming	1	2.9
Because I needed somewhere to go after school	4	11.4
Would Come Back - Yes	28	80.0
Total Number of Students	35	

Main Reason for Attending Club Invention

Students were asked on the survey to indicate the main reason they had attended Club Invention. These results are also presented in Table 3 for Ohio and Table 4 for San Antonio. It can be seen that there were two primary reasons intermediate students in Ohio indicated that they attended Club Invention: They like to invent things (39.5%) and they thought it would be fun (39.5%). The primary reason given by intermediate students in San Antonio was to have fun (40.0%). In San Antonio, the second largest reason given was because the students liked science (28.6%). The options, "Because my friends were coming," and "Because I needed somewhere to go after school" were not selected by any Ohio students, but they were by the San Antonio students.

Would return next year

The question, "Would you like to come back to Club Invention next year?" was intended to provide an indication of satisfaction with the program. Findings indicated that students at both sites were very satisfied. Nearly 95 percent of Ohio students and 80 percent of San Antonio students indicated that they would indeed like to return to Club Invention next year if they had the chance.

What students liked best about Club Invention

Ohio. An open-ended item asked students to write their responses to the question, "What have you liked best about Club Invention?" The students were free to supply their own responses. All 42 intermediate students in Ohio wrote a response to this item, and several of them provided more than one thing that they liked best. Twenty-eight of them specifically replied that they liked "to invent things," or to "build stuff." Some of them named the specific inventions they liked the best. The two that were mentioned most frequently were the miniature golf courses and the parachute. The tower of shaving cream and "stopping the animals from crossing the road" were also mentioned as favorite activities. In addition to inventing, "doing experiments" was listed as a favorite activity.

Eight students replied that what they liked best about Club Invention was being with friends. This included such responses as, "I liked working with other people," and "The way we work together." Eight students specifically mentioned that they have fun and/or get to play. For example, one student said, "I liked…playing with science." Another said, "I liked that we have fun." Another said, "I like how we got to run around the school without getting in trouble and all the neat activities." Three students replied that what they liked best was their teacher. Two students mentioned that they liked science: "I liked how it made science fun and easier to learn!" One student gave a simple reply: "Everything."

Two students provided more abstract responses that demonstrate that student outcomes had been met. One said, "That I learn more things to do than just one way." Another said, "I like to make things and then modify them." These two students were able to verbalize that they had learned some of the principles of create/recreate and brainstorming.

San Antonio. Thirty-four students from San Antonio responded to this question. Similar to their counterparts in Ohio, the San Antonio students cited "inventing" most frequently as what they liked best in Club Invention. Comments included, "That you can create different things," and "I like to make the inventions." Twenty-seven students referred specifically to inventing things as what they liked best, and two additional students referred to "all the cool experiments" as what they liked best. The San Antonio students were more specific, however, as to which invention they liked best. Nine students said they liked making the tents the best, with two additional students referring to making "the buildings" as what they liked best. Two liked building the bridges. Three students said that what they liked best was exploding or imploding things.

Also similar to their Ohio counterparts, the San Antonio students spoke about Club Invention being "fun." Comments included, "…fun things after school," and "We do a lot of things and it's fun. Playing with friends was only mentioned once.

Four students made comments that lend support to meeting the objectives of the project in terms of perceptions toward science and creativity. One student said, "There are new things I have never knew, now I know more." Another said, "You create stuff that I never done before." Three students specifically mentioned a change in their learning about science. One said, "I like how we learn more about science." This sentiment was shared almost verbatim by another student: "That you can … learn more about science." Finally, one said, "*Hacer projectos y aprender diferentes cosas sobre la ciencia*." (*To make projects and learn different things about science.)*

S***tudent Outcomes***

Eight items on the survey asked the students to respond to their (the students') perceived changes in creative problem solving and perceptions of science since attending Club Invention. Response categories included "A lot," "Some," and "Not at all." The results of the responses of Ohio students are presented in Table 5 and illustrated in Figure 1, and the results of the responses of San Antonio students are presented in Table 6 and illustrated in Figure 2.

The survey items were developed to address the research questions, that is, a change in students' perceptions regarding creativity and science and an increase in their knowledge of creative problem solving. It was determined that the most efficient way to address change was to ask the students if they themselves believed that there was a change since coming to Club Invention. It would have, perhaps, been methodologically sounder to administer a survey prior to their experiences at Club Invention and then again at the end of Club Invention, but practical reasons prevented that. In light of that caveat, informal conversations with the students revealed that they understood what was meant by "before coming to Club Invention," and were able to assess whether or not they had "changed."

The two research questions are somewhat interdependent. A "knowledge of creative problem solving" is logically related to one's perceptions of creativity. The items in the survey reflect that interdependence. An effort was made to define knowledge as experienced-based understanding of the process, and perception as opinions and attitudes. Items that *primarily* addressed changes in perceptions regarding creativity and science included items 3 (*better at coming up with new ideas*), 4 (*solving problems is more of an interesting challenge*), 5 (*more curious about things*), 7 (*more interested in science*), and 8 (*better at solving problems*). Knowledge of creative problem solving was addressed by items 1 (*stick with a hard problem more),* 2 (*try more than one way to solve a problem more than before*), and 6 (*use everyday items in new and different ways more than before*).

Table 5. Percentages of Responses to Each Item
Intermediate Student Survey: Ohio Sites

		PERCENTAGES		
ITEM	**N**	**A LOT**	**SOME**	**NOT AT ALL**
I can stick with a hard problem better than I could before I came to Club Invention.	41	39.0	56.1	4.9
Club Invention has taught me to try more than one way to solve a problem.	42	71.4	28.6	0.0
I feel I am better at coming up with new ideas than I was before I came to Club Invention.	42	59.5	28.6	11.9
Club Invention has shown me that solving problems is an interesting challenge.	42	66.7	33.3	0.0
I am more curious about things than I was before I came to Club Invention.	42	50.0	38.1	11.9
Club Invention has taught me to use everyday items in new and different ways that I did not do before.	42	81.0	16.7	2.4
I am more interested in science than I was before I came to Club Invention.	38	55.3	34.2	10.5
I feel I am better at solving problems than I was before I came to Club Invention.	39	46.2	43.6	10.3

Figure 1. Illustration of Percentages of Responses to Each Survey Item for Intermediate Students in Ohio

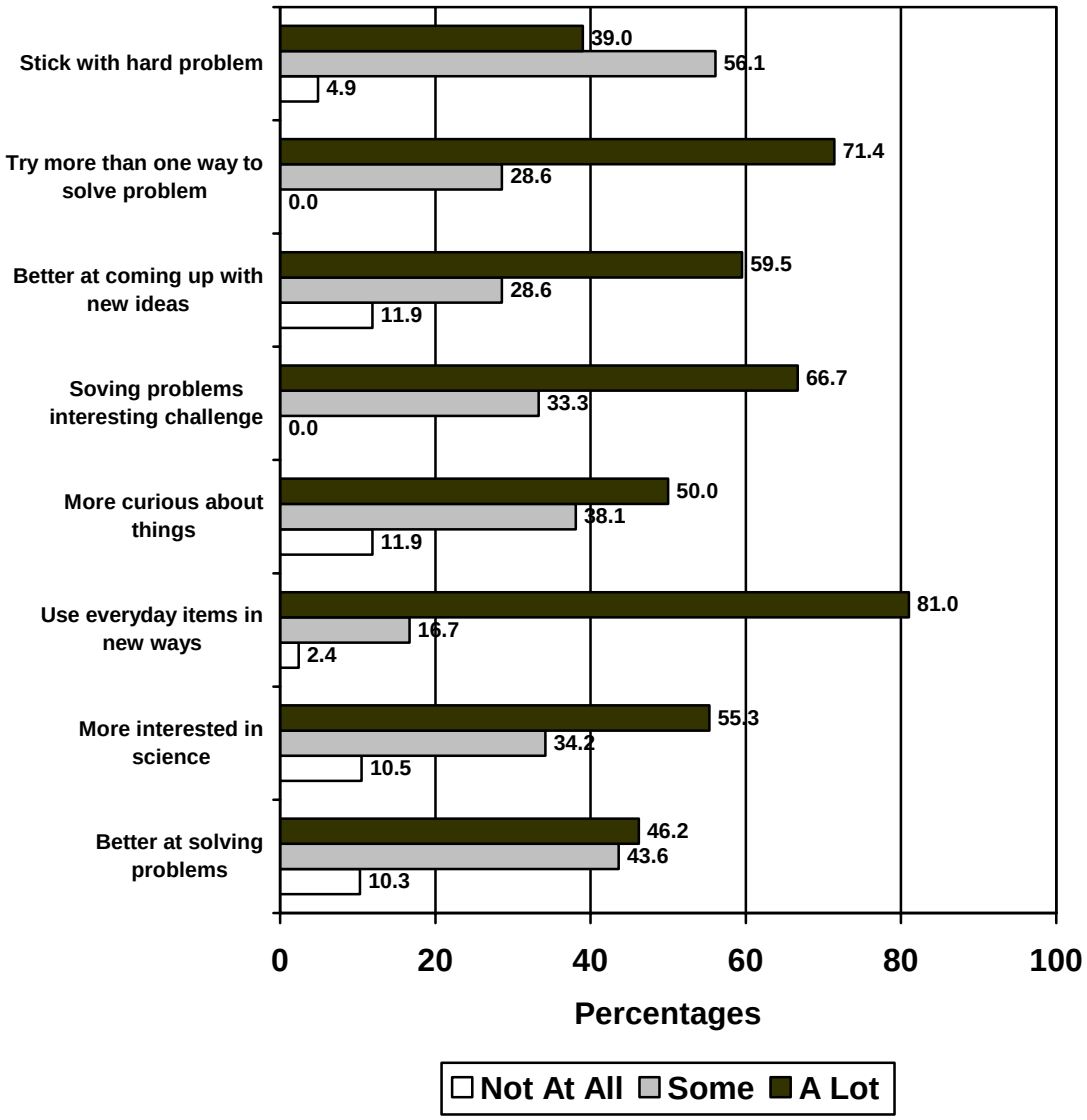
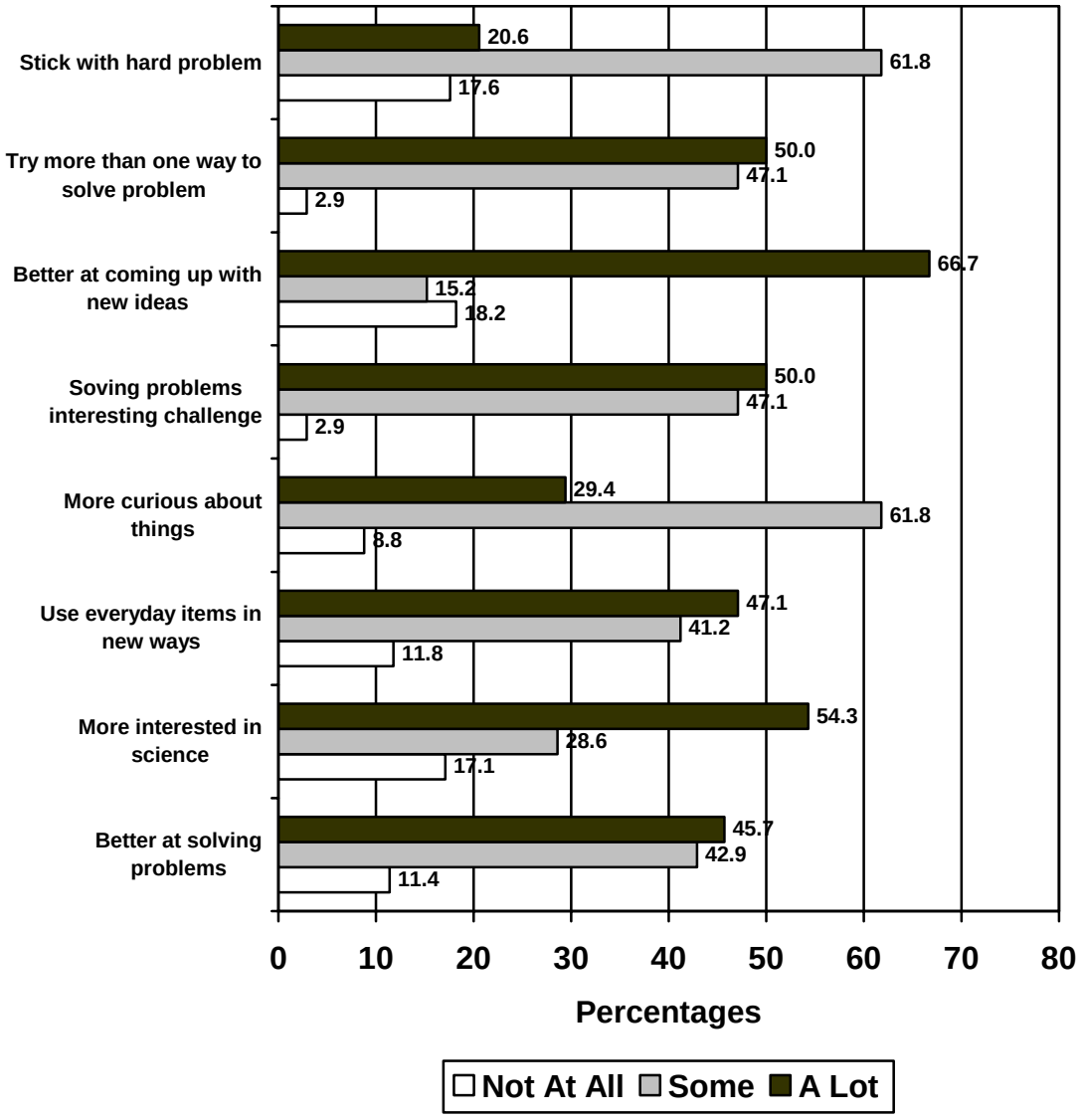


Table 6. Percentages of Responses to Each Item
Intermediate Student Survey: San Antonio Sites

		PERCENTAGES		
ITEM	**N**	**A LOT**	**SOME**	**NOT AT ALL**
I can stick with a hard problem better than I could before I came to Club Invention.	34	20.6	61.8	17.6
Club Invention has taught me to try more than one way to solve a problem.	34	50.0	47.1	2.9
I feel I am better at coming up with new ideas than I was before I came to Club Invention.	33	66.7	15.2	18.2
Club Invention has shown me that solving problems is an interesting challenge.	34	50.0	47.1	2.9
I am more curious about things than I was before I came to Club Invention.	34	29.4	61.8	8.8
Club Invention has taught me to use everyday items in new and different ways that I did not do before.	34	47.1	41.2	11.8
I am more interested in science than I was before I came to Club Invention.	35	54.3	28.6	17.1
I feel I am better at solving problems than I was before I came to Club Invention.	35	45.7	42.9	11.4

Figure 2. Illustration of Percentages of Responses to Each Survey Item for Intermediate Students in San Antonio



Results of Intermediate Survey Items Related to Student Outcomes. This section discusses the results of the intermediate survey items presented in Tables 5 and 6 and Figures 1 and 2, above. These items addressed the student objectives, as explained above. Results pertaining to the items addressing perceptions of creativity and science will be discussed first, followed by those pertaining to knowledge of creative problem solving.

Three- fourths of the students in both Ohio and San Antonio felt they were better at coming up with new ideas than they were before they attended San Antonio. Well over half of them felt they were *a lot* better at coming up with new ideas. This indicates that students' perceptions of their own creativity improved since attending Club Invention. A component of creativity is curiosity. In terms of increasing students' curiosity, half of the Ohio students and slightly more than a quarter of the San Antonio students felt that they were a lot more curious since attending Club Invention. Over 80 percent of students in both areas felt that they were at least somewhat more curious about things than they were before they came to Club Invention. Thus, this result indicates that, again, Club Invention increased students' perceptions of their own creativity.

Another item assessing perceptions of creative problem solving asked, "Club Invention has shown me that solving problems is an interesting challenge." Except for one student, <u>all</u> students agreed with this item. Two-thirds of the students in Ohio felt this was true "a lot" for them, whereas half the students in San Antonio felt this was true "a lot," and the other half felt this was true "*some*." In conjunction with this, almost half the students in both areas felt they were *a lot* better at solving problems than they were before they came to Club Invention, and another 40% felt they were somewhat better at solving problems. The results of these two items indicate that Club Invention has impacted students' perceptions of creative problem solving.

Children's perceptions of science also appeared to be changed by Club Invention, even though many students chose to attend Club Invention because they liked science, as indicated by their survey responses. Over 80% of students felt they were at least somewhat more interested in science than they were before they came to Club Invention, and over half of them said they were *a lot* more interested in science. This indicates that Club Invention impacted students' perceptions of science.

Knowledge of creative problem solving was addressed by three items. One aspect of knowledge of creative problem solving pertains to perseverance with difficult problems. Knowing that one should persevere with his/her efforts with trying to solve a difficult problem indicates that one knows at least one aspect of creative problem solving as a process. Over a third of Ohio students and a fifth of San Antonio students felt they could stick a lot with a hard problem better than they could before they came to Club Invention, and another half or more said that they could do so "some." These findings indicate that knowledge of creative problem solving increased at least somewhat as a result of attending Club Invention.

Another aspect of knowledge of creative problem solving deals with knowing that one needs to try more than one way to solve a problem. Almost three-fourths of Ohio students and half the San Antonio students felt that Club Invention had taught them *a lot* to try more than one way to solve a problem. Only one student (in San Antonio) believed that Club Invention had not at all taught him/her to try more than one way to solve a problem. This finding strongly suggests that Club Invention impacted knowledge of creative problem solving.

Knowing to use everyday items in new and different ways is another indicator of knowledge of creative problem solving. Over 80% of Ohio students felt that Club Invention had taught them *a lot* to do this in ways that they had not done before, and over 80% of San Antonio students felt that Club Invention had taught them at least somewhat to use everyday items in new and different ways. This lends further support to Club Invention's impact on student knowledge of creative problem solving.

Intermediate Student Survey Summary

Forty-two students in Ohio and 35 in San Antonio responded to the intermediate survey. In Ohio, there were 12 students in third grade, 13 in each of fourth and fifth grades, one in sixth grade, and three who did not indicate grade level. Eighteen of the Ohio students responding were boys, and 21 were girls. In San Antonio, there were 20 students in the fourth grade and 15 in the fifth grade. Fifteen students were boys and 20 were girls.

The primary reasons Ohio students gave for attending Club Invention was that they liked to invent things and that they thought it would be fun. San Antonio students gave similar reasons. Their first reason was that they thought it would be fun, followed by they liked science. An overwhelming majority of students in both sites indicated that they would like to return to Club Invention next year if they had the choice. This is a strong indicator of satisfaction.

Student outcomes included a change in perceptions regarding creativity and science and a change in knowledge regarding creative problem solving. Responses to the items addressing change in perceptions regarding creativity and science indicated that a vast majority of students' perceptions of their own creativity improved since attending Club Invention. Responses to the items addressing a change in knowledge regarding creative problem solving also revealed that the vast majority of students indicated an increase in knowledge of creative problem solving since attending Club Invention. Thus, according to indicated intermediate student perceptions, the stated outcomes of Club Invention were achieved.

Instructor Survey Results

Demographics

A total of 7 instructors responded to the instructor survey from the Ohio and Texas sites. The majority of the survey responses came from Ohio while only one response was received from Texas. The instructors participated in three topics: *Bolder Builders*, *Phys. Ed: Physics in Motion*, and *SOS: Endangered Earth*. Four instructors noted that this was their first year teaching Club Invention, while three said they had previous experience. Of those with previous experience, two had taught one previous session, and one had taught three previous sessions. Classroom teaching experience ranged from 2 years to 23 years, with a mean of 14.83 years. Four of the seven teachers indicated that they were teaching science this school year.

Program Outcomes for Students as Perceived by Instructors

Four items in the survey asked the instructors to rate how much growth students had demonstrated since the first day of Club Invention. The items assessed growth in creative problem solving skills, such as utilizing trial and error (create/recreate), brainstorming, building upon ideas of other students (another component of brainstorming), and focusing on ideas to develop a plan of action. The response categories included "Not at all," "A small extent," "A medium extent," and "A great extent." The results of the responses of the instructors are presented in Table 7 and illustrated in Figure 3.

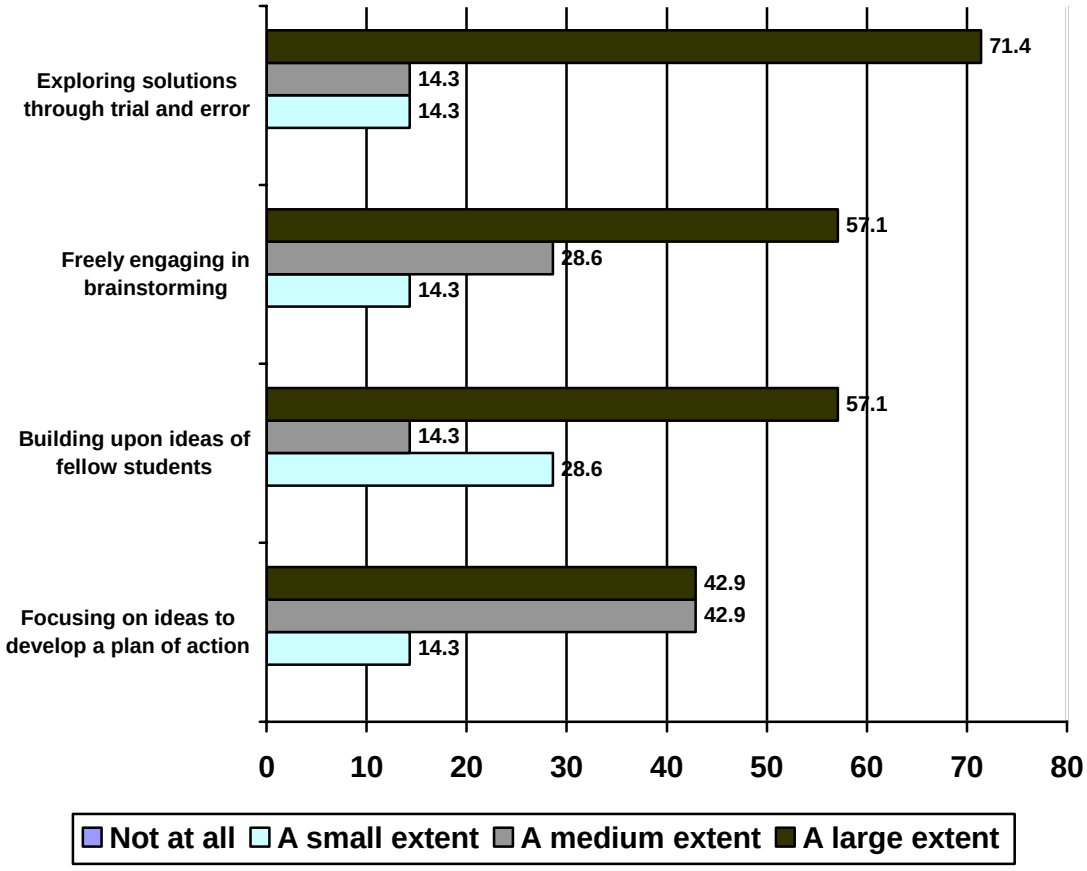
It can be seen that the instructors felt that all students had made at least some growth in the all four areas of creative problem solving skills, with more than half the responses indicating that instructors felt that students had made a *great extent* of growth in three areas (exploring solutions through trial and error, freely engaging in brainstorming, and building upon ideas of fellow students). Over 85% of the instructors felt that students had shown a *moderate* or *great extent* of growth in three of the areas: exploring solutions through trial and error, freely engaging in brainstorming, and focusing on ideas to develop a plan of action. The weakest areas of student growth, as seen by the instructors, were building upon ideas of fellow students, and focusing on ideas to develop a plan of action.

In summary, according to the instructors, Club Invention impacted students' growth in knowledge of creativity and creative problem solving. Club Invention desired outcomes focused on elements of brainstorming techniques and create/recreate for both instructors and students. The survey results showed evidence that all instructors felt there was improvement in students' brainstorming techniques and create/recreate activities. Perhaps students need a bit more training in piggybacking techniques and on focusing ideas to develop a plan of action.

Table 7. Percentages of Responses to Instructor Survey
How much <u>growth</u> have students demonstrated in the following areas…?

		PERCENTAGES			
ITEM	**N**	**NOT AT ALL**	**A SMALL EXTENT**	**A MEDIUM EXTENT**	**A GREAT EXTENT**
Exploring solutions through trial and error.	7	0.0	14.3	14.3	71.4
Freely engaging in brainstorming.	7	0.0	14.3	28.6	57.1
Building upon ideas of fellow students.	7	0.0	28.6	14.3	57.1
Focusing on ideas to develop a plan of action.	7	0.0	14.3	42.9	42.9

Figure 3. Illustration of Percentages of Instructor Responses to How Much Growth Students Have Demonstrated in Each Area



Program Outcomes for Instructors

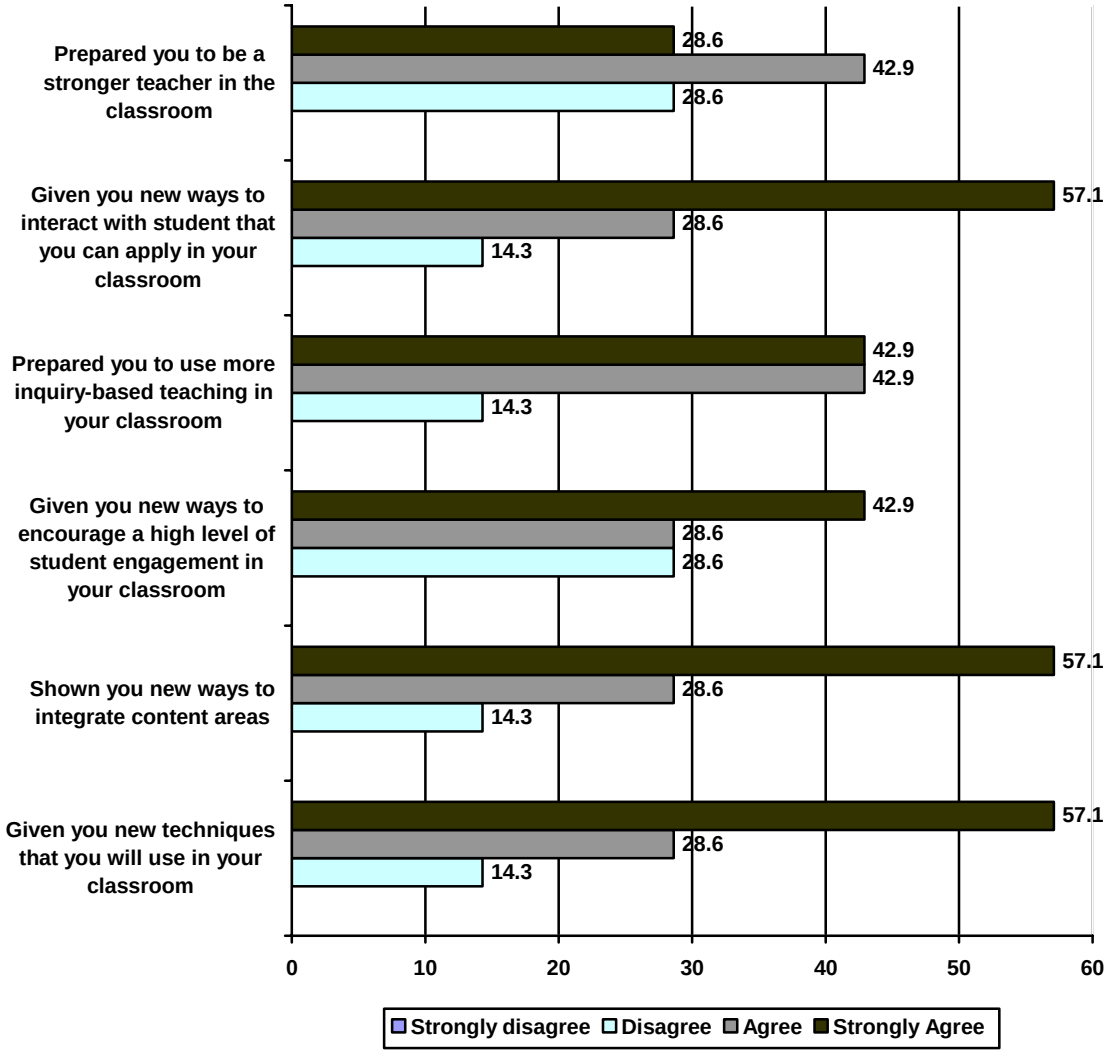
The expected program objectives for instructors was that they would experience a change in their knowledge regarding creative problem solving techniques and that they would apply this change in their school-based classes. The survey included six general items that addressed instructor perceptions of the impact of Club Invention on giving them ideas regarding their teaching that utilize creative problem solving skills. Instructors were asked the extent to which they disagreed or agreed with each item. Response categories were "Strongly disagree," "Disagree," "Agree," and "Strongly agree." The results of the responses of the instructors – as well as the items themselves – are presented in Table 8 and illustrated in Figure 4.

Table 8. Percentages of Responses by Instructors

"To what extent do you agree or disagree that your experiences with the Club Invention Program have done each of the following…"

		PERCENTAGES			
ITEM	**N**	**STRONGLY DISAGREE**	**DISAGREE**	**AGREE**	**STRONGLY AGREE**
Prepared you to be a stronger teacher in the classroom.	7	0	28.6	42.9	28.6
Given you new ways to interact with students that you can apply in your classroom.	7	0	14.3	28.6	57.1
Prepared you to use more inquiry-based teaching in your classroom.	7	0	14.3	42.9	42.9
Given you new ways to encourage a high level of student engagement in your classroom.	7	0	28.6	28.6	42.9
Shown you new ways to integrate content areas.	7	0	14.3	28.6	57.1
Given you new techniques that you will use in your classroom.	7	0	14.3	28.6	57.1

Figure 4. Illustration of Percentages of Responses by Instructors Regarding the Extent to Which They Agree or Disagree that Club Invention Has …



In addition, the survey included 18 items addressing specific components of creative problem solving techniques that they have or intend to incorporate into their classrooms. Specifically, these items asked the instructors to respond to what extent their classroom teaching practices have changed this year – or will change for those who were not currently teaching in a classroom – in each area as a result of their experiences with Club Invention. Response categories included "Not at all," "A small extent," "A medium extent," and "A great extent."

The components of creative problem solving techniques pertain to specific elements of brainstorming techniques, specific components of the create/recreate problem-solving process, and other creative problem solving components such as encouraging students to identify challenges and instructional techniques such as allowing productive noise in the classroom and having students work together in teams to solve problems.

The results of the responses of the instructors to these specific components are presented in Table 9 and illustrated in Figure 5. The results indicate that at least 70% of the instructors felt that their classroom teaching practices had changed this year (or would change) at least to a medium extent in every area. Half or more than half the instructors indicated their classroom teaching practices had changed to a great extent in ten of the areas.

The areas in which instructors felt they had changed the most in their classrooms seemed to pertain to brainstorming methods of creative problem solving, such as using interactive questioning, helping students piggyback on each other's ideas, and encouraging students to look at information and challenges from a variety of angles. They also felt they had changed in their classroom teaching in using trial and error. Areas of less change included the higher levels of inquiry teaching such as encouraging students to identify challenges, guiding students through their own independent observations and investigations, and allowing students to devise their own procedures to investigate a problem. There was some change in these areas, which is a positive finding.

A caution must be exerted here in that only seven instructors responded to the survey. However, based on their response, the results of the instructor survey indicate that the teacher outcome of the impact of Club Invention on changing classroom instruction was met. Evidence from the survey shows that the instructors felt Club Invention gave them new ideas for teaching and activities in the classroom.

Table 9. Percentages of Responses to Instructor Survey

To what extent have your teaching practices in the classroom changed (or will they change) in each of the following areas as a result of your experiences with Club Invention?

		PERCENTAGES			
ITEM	**N**	**NOT AT ALL**	**A SMALL EXTENT**	**A MEDIUM EXTENT**	**A GREAT EXTENT**
Using everyday materials to come up with something new.	7	0	28.6	0	71.4
Allowing "crazy" ideas as part of brainstorming.	7	14.3	0	14.3	71.4
Encouraging students to express ideas in a variety of ways.	7	0	28.6	14.3	57.1
Using trial and error.	7	0	28.6	0	71.4
Using interactive questioning for understanding, prediction, and explanations.	7	14.3	0	42.9	42.9
Encouraging multiple ideas and approaches to solving a problem/challenge.	7	14.3	0	42.9	42.9
Encouraging students to identify challenges.	7	0	28.6	14.3	57.1
Guiding students through their own independent observations and investigations.	7	0	28.6	14.3	57.1
Helping students identify the goal or direction in solving a problem.	7	14.3	14.3	42.9	28.6

		PERCENTAGES			
ITEM	**N**	**NOT AT ALL**	**A SMALL EXTENT**	**A MEDIUM EXTENT**	**A GREAT EXTENT**
Helping students generate multiple new and unusual ideas.	7	0	28.6	14.3	57.1
Structuring instruction to allow students to work in teams to solve problems.	7	28.6	0	28.6	42.9
Helping students find alternative ways to solve a problem.	7	14.3	0	28.6	57.1
Facilitating students for the purpose of their acquisition of knowledge of new principles.	7	14.3	14.3	28.6	42.9
Allowing students to devise their own procedures to investigate a problem.	7	14.3	14.3	42.9	28.6
Allowing productive noise in the classroom.	7	14.3	0	42.9	42.9
Helping students focus their ideas into the most promising ones.	7	0	14.3	57.1	28.6
Helping students “piggy-back” on each other’s ideas.	7	0	14.3	28.6	57.1
Encouraging students to look at information from a variety of angles.	7	0	14.3	14.3	71.4

Figure 5. Illustration of Percentages of Instructor Survey Responses Regarding Changes to Classroom Instruction Due to Experiences in Club Invention

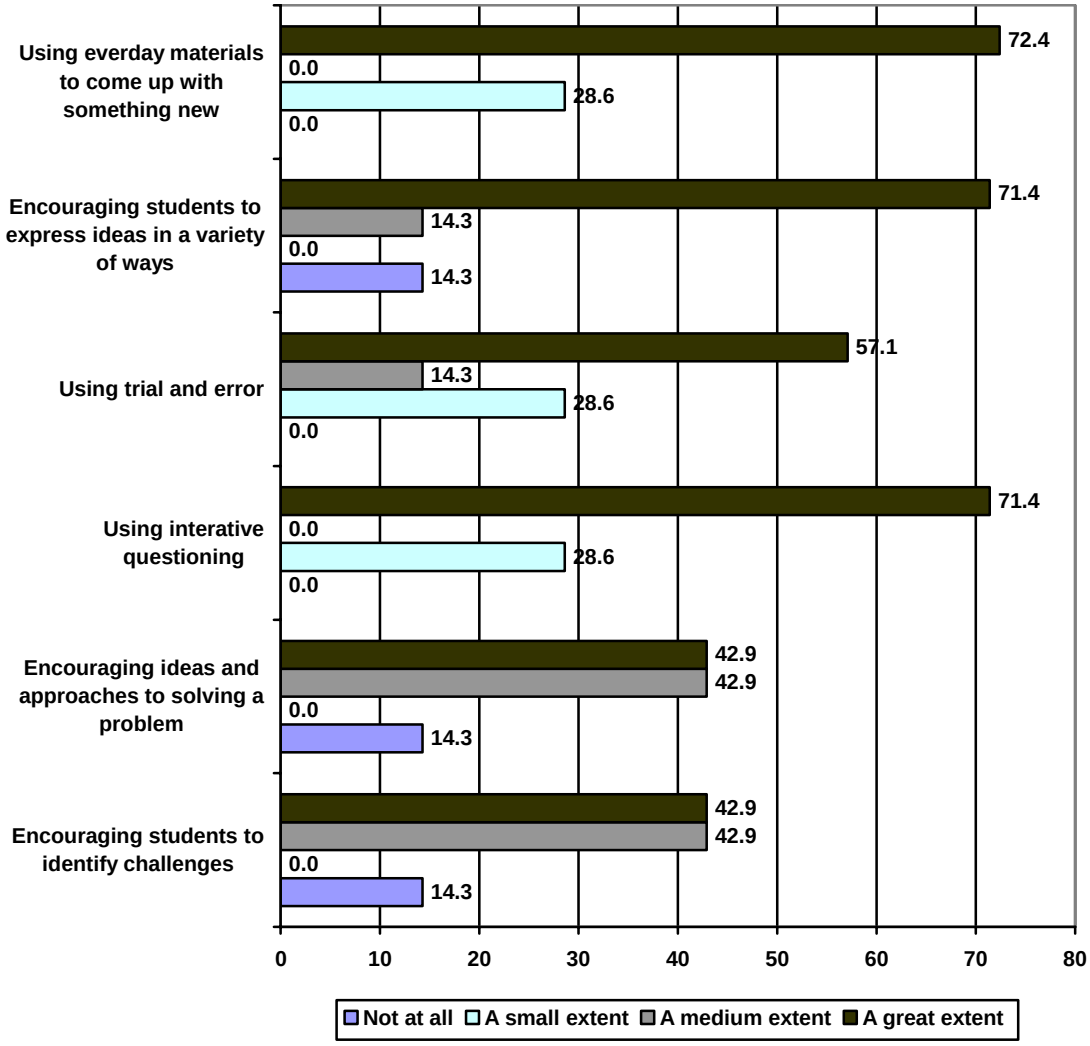


Figure 5. *Continued*. Illustration of Percentages of Instructor Survey Responses Regarding Changes to Classroom Instruction Due to Experiences in Club Invention

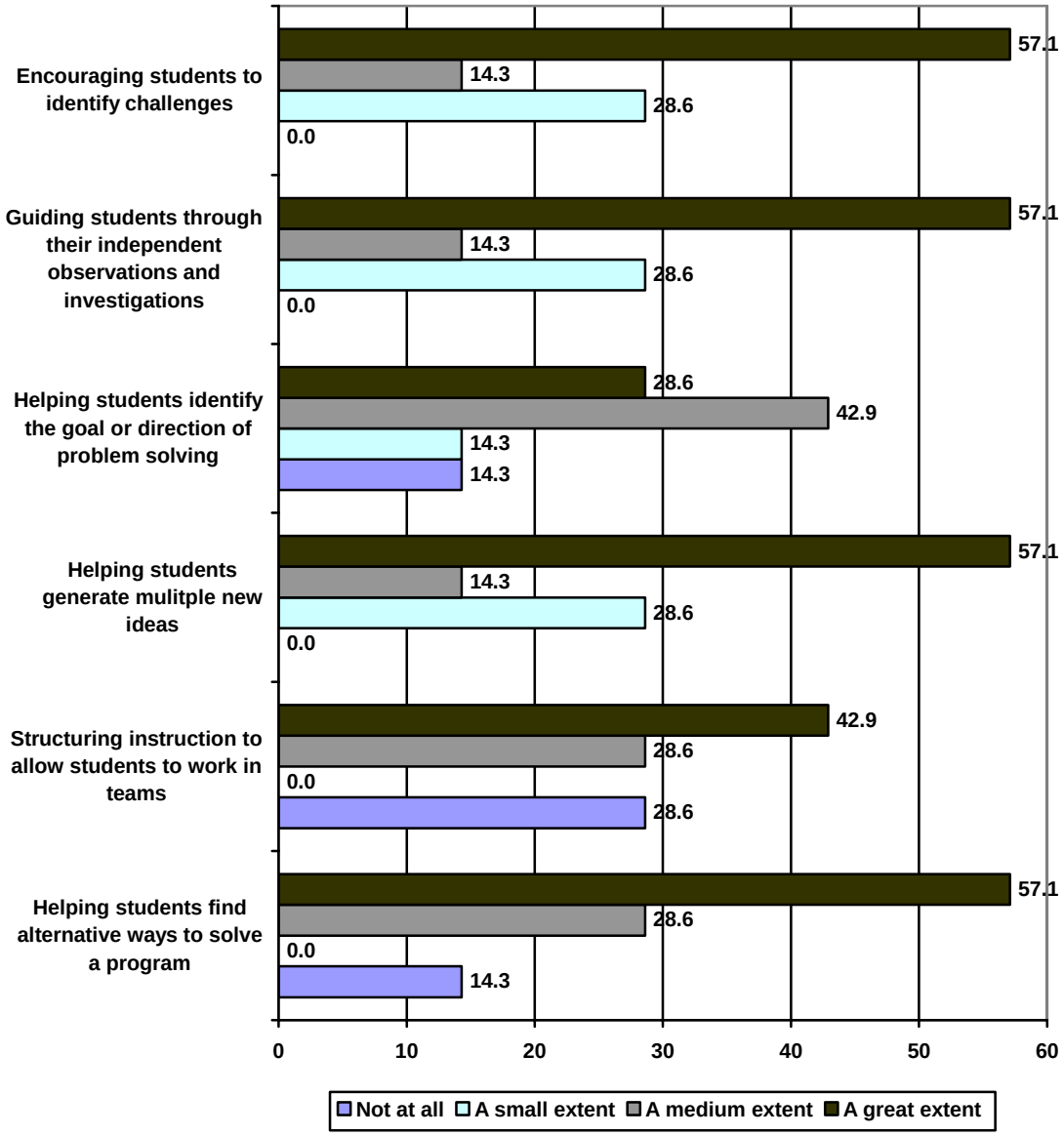
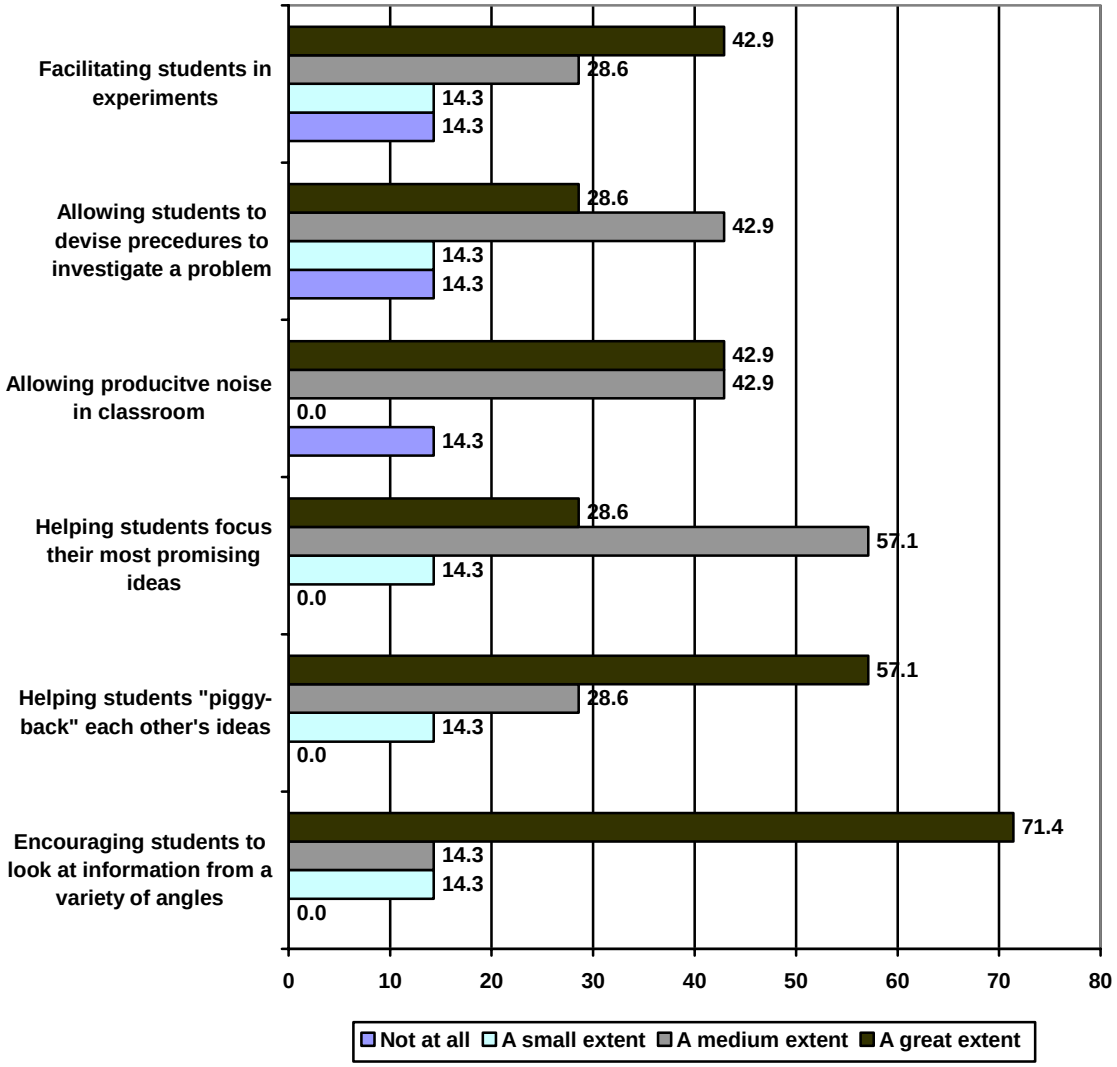


Figure 5. *Continued*. Illustration of Percentages of Instructor Survey Responses Regarding Changes to Classroom Instruction Due to Experiences in Club Invention



Parent Survey Results

Sixty-four parents from the Ohio (n=37) and San Antonio (n=27) sites combined responded to a parent survey designed to assess both satisfaction and parents' perceptions of the impact of Club Invention on their children's perceptions of science and creative problem solving. Of those responding, 81.3% were the mothers of the Club participant, 7.8% were fathers, 4.7% were grandmothers, and 6.3% were grandfathers.

Fifty-nine parents indicated the ethnicity of their child attending Club Invention. The breakdown of ethnicity given by the parents is presented in Table 10.

Table 10. Percentages of Children's Ethnicity

Ethnicity	Number	Percentage
African American	1	1.7
Caucasian	31	52.5
Hispanic	21	35.6
Mixed	4	6.8
Other	2	3.4

As a point of interest, parents were asked how many sons and how many daughters they had attending Club Invention. This data is presented in Table 11. Thirty-two parents had one son, whereas only two parents had two sons. Twenty-five parents had one daughter, ten parents had two daughters, and two parents had three daughters attending Club Invention.

Table 11. Number of Parents with 1, 2, or 3 Sons and Daughters Attending Club Invention

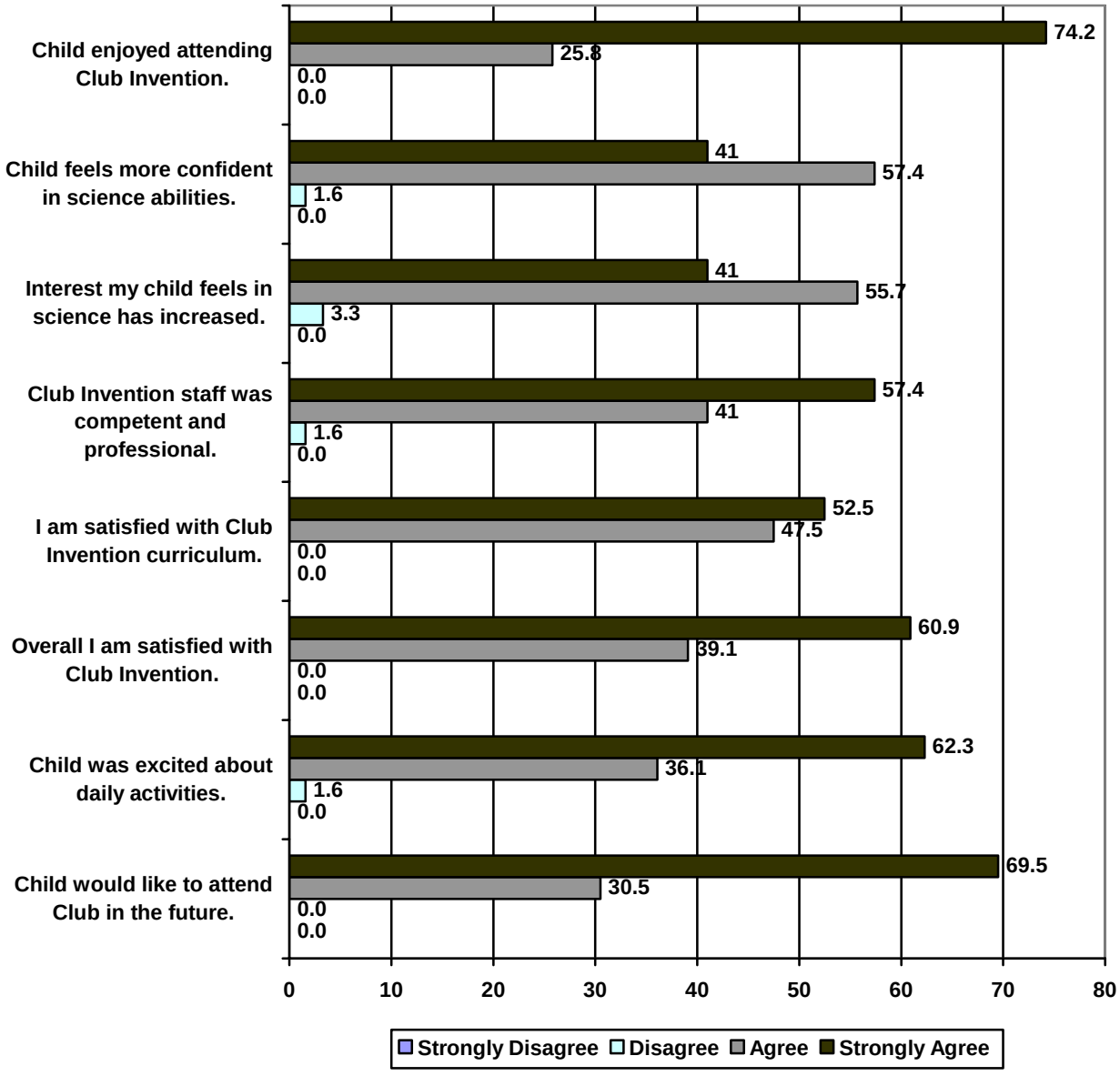
Number of Sons		Number of Daughters		
1	**2**	**1**	**2**	**3**
32	2	25	10	2

The first set of items asked parents the extent to which they agreed or disagreed with each item. The items assessed parents' perceptions of their children's enjoyment and satisfaction, the parent's satisfaction, and parents' opinions of their children's perceptions toward science, which speaks to the first research question and first goal of this project. The response categories were "Strongly agree," "Agree," "Disagree," and "Strongly Disagree." Table 12 presents a summary of the responses parents gave to these items, and Figure 6 illustrates this.

Table 12. Summary of Parent Responses to Items Assessing Satisfaction and Children's Perceptions toward Science

		PERCENTAGES			
ITEM	**N**	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**
My child(ren) enjoyed attending Club Invention.	62	74.2	25.8	0.0	0.0
My child(ren) feels more confident in their science abilities.	61	41.0	57.4	1.6	0.0
The interest my child(ren) feels in science has increased.	61	41.0	55.7	3.3	0.0
The Club Invention staff was competent and professional.	61	57.4	41.0	1.6	0.0
I am satisfied with the Club Invention curriculum.	61	52.5	47.5	0.0	0.0
Overall, I am satisfied with the Club Invention program.	64	60.9	39.1	0.0	0.0
My child(ren) was excited about the daily activities at Club Invention.	61	62.3	36.1	1.6	0.0
My child(ren) would like to attend the Club Invention program again in the future.	59	69.5	30.5	0.0	0.0

Figure 6. Illustration of the Extent to Which Parents Agreed or Disagreed with Items Assessing Satisfaction and Children's Perceptions toward Science



It can be seen that parents were very satisfied with the Club Invention program. Almost all parents responded either agree or strongly agree to every item. Nearly three quarters of the parents strongly agreed, and 100% at least agreed, that their child or children had enjoyed Club Invention and would like to return again in the future. One hundred percent also agreed or strongly agreed that they were satisfied overall with Club Invention and with the Club Invention curriculum. Almost 100% agreed or strongly agreed that their child or children were excited about the daily activities at Club Invention. Also, nearly 100% agreed or strongly agreed that the Club Invention staff was competent and professional.

As far as parents' perceptions of benefits to their children, almost 100% agreed that their child or children feel more confident in their science abilities and that their interest in science has increased since attending Club Invention. This is another measure of attainment of the goals of Club Invention, namely that the student's perceptions toward science would change. Their parents overwhelmingly agreed that this is true.

The second set of items asked parents the extent each of the given reasons had contributed to their decision to enroll their child or children in the Club Invention program. The list included suggestions ranging from the fact that parents needed after school care to they wanted to spark an interest in their child for science. The response categories were "A Lot," "Some," "Very Little," and "Not at All." Table 13 presents a summary of the responses parents gave to these items, and Figure 7 illustrates this.

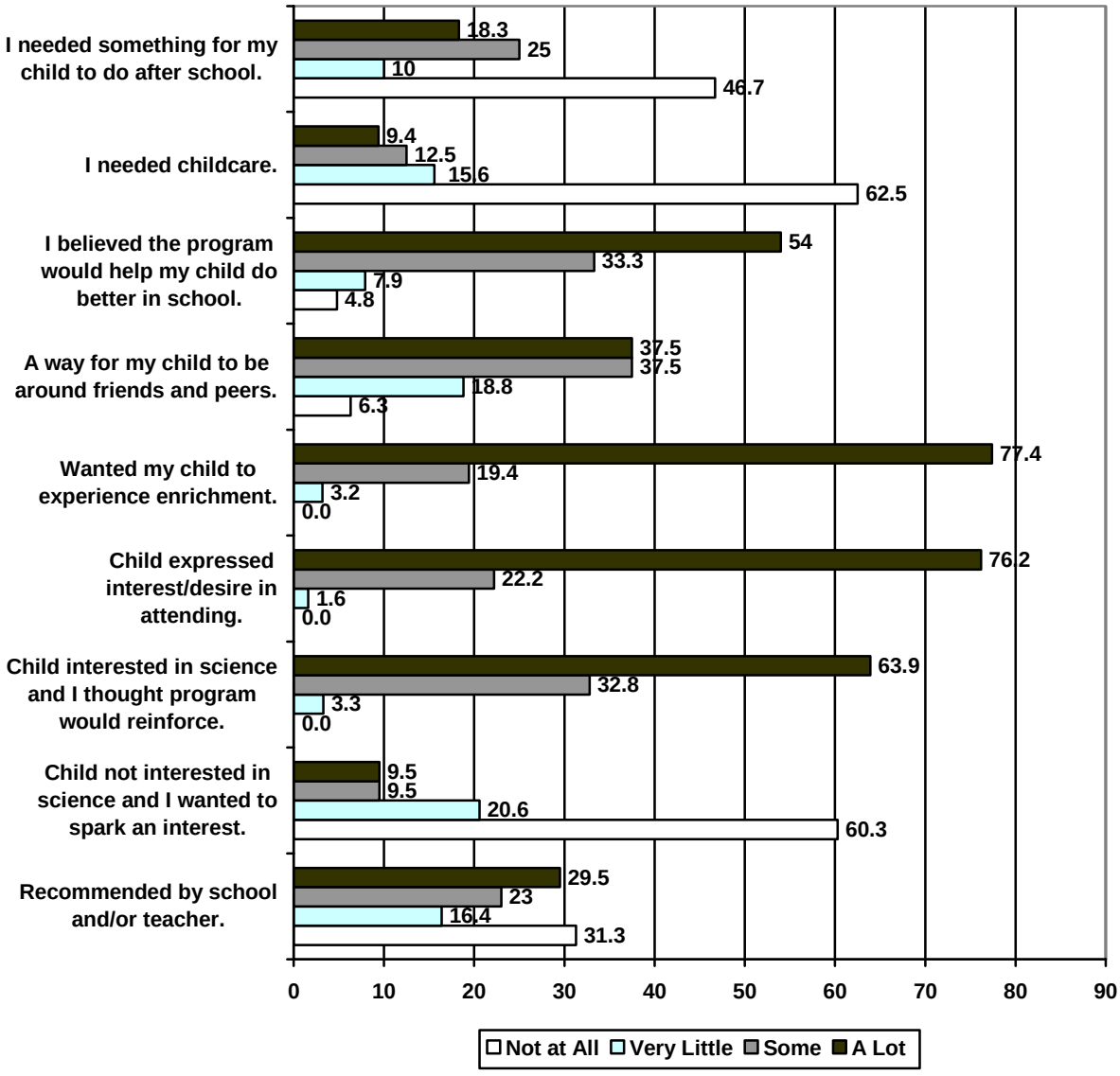
It can be seen that the two major reasons parents chose to send their children to Club Invention were because they wanted their children to experience enrichment and because their children had expressed an interest or desire in attending. Another major reason parents sent their children to Club Invention was because their children were interested in science and the parents thought that Club Invention would reinforce that interest. Conversely, not many parents sent their children to Club Invention hoping to spark an interest in science that was not already there.

Parents were also interested in sending their children to the program because they believed it would help them do better in school. Another moderately important reason was to enable their children to be around their friends and peers. Teacher and/or school recommendations was cited as a reason by some parents. Very few parents sent their children to the program because they needed something for their child to do after school or because they needed childcare.

Table 13. Parent Responses to the Extent to Which Each Reason Contributed to Why They Enrolled Their Child or Children in Club Invention

		PERCENTAGES			
ITEM	**N**	**A Lot**	**Some**	**Very Little**	**Not at All**
I needed something for my child to do after school.	60	18.3	25.0	10.0	46.7
I needed childcare.	64	9.4	12.5	15.6	62.5
I believed the program would help my child(ren) do better in school.	63	54.0	33.3	7.9	4.8
It was a way for my child(ren) to be around friends and peers.	64	37.5	37.5	18.8	6.3
I wanted my child(ren) to experience enrichment.	62	77.4	19.4	3.2	0.0
My child(ren) expressed an interest/desire in attending.	63	76.2	22.2	1.6	0.0
My child(ren) is interested in science and I thought this program would reinforce that interest.	61	63.9	32.8	3.3	0.0
My child(ren) was not interested in science and I wanted to spark an interest.	63	9.5	9.5	20.6	60.3
It was recommended by the school and/or teacher.	61	29.5	23.0	16.4	31.1

Figure 7. Illustration of Reasons Why Parents Enrolled Children in Club Invention



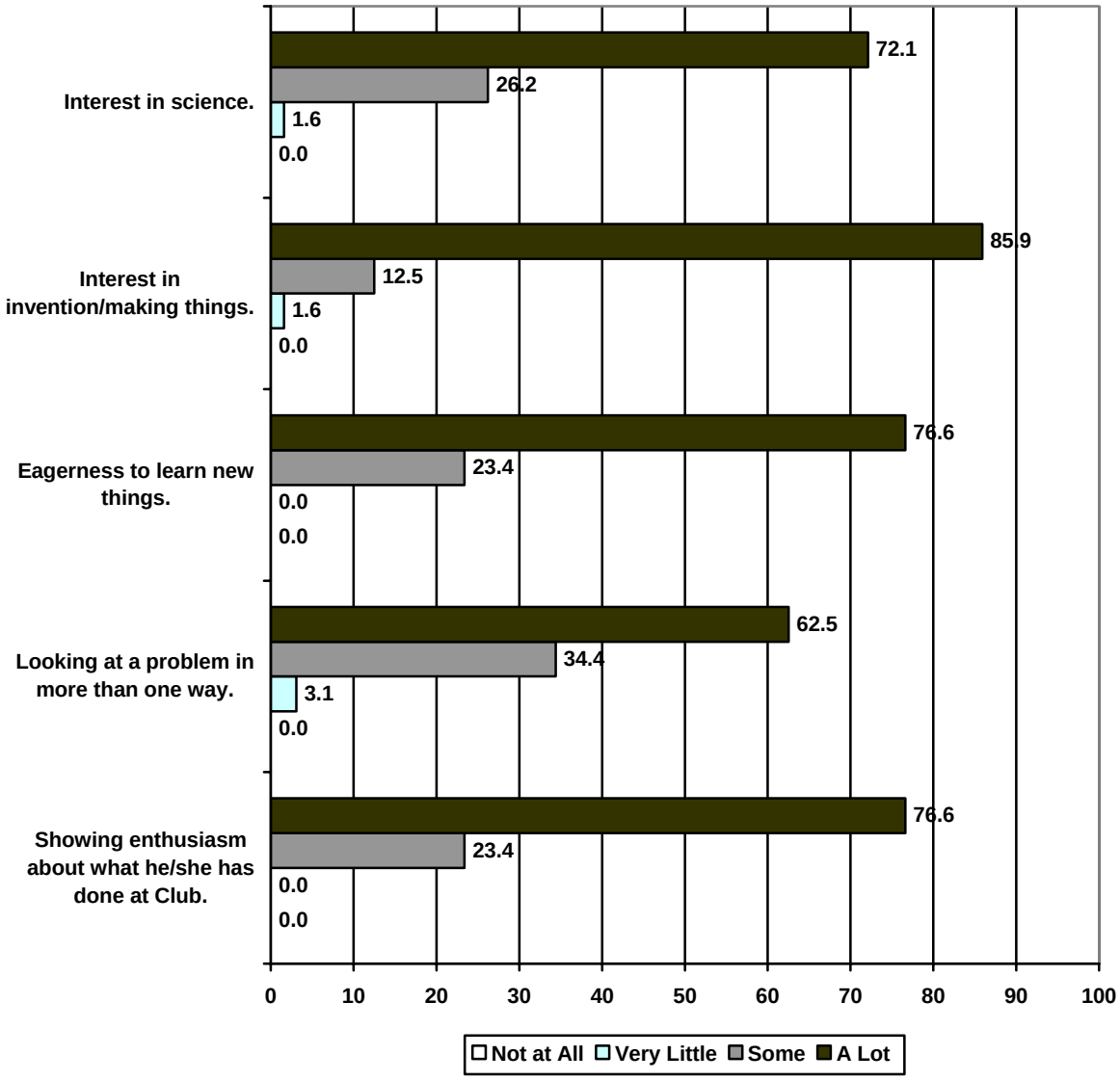
The final section of the parent survey asked the parents how much they thought their child had benefited from participating in Club Invention in five ways. One of the items addressed immersion ("Showing enthusiasm about what he/she has done at camp."), and the remaining four items pertained to the child's interest in science, invention, and creativity. These items were additional ways to assess the change in students' perceptions toward science and creativity, as seen through their parents' eyes. Response categories included, "A Lot," "Some," "Very Little," and "Not at All."

Table 14 presents the percentage of parents' responses in each category for each item. Figure 8 illustrates these percentages. It can be seen that, according to parents, the objectives of Club Invention regarding a change in students' perceptions and knowledge regarding creativity, problem solving, and science were wholeheartedly met. Regarding perceptions of science, almost 100% of parents felt that their children had benefited some or a lot in their interest in science and invention. One hundred percent of parents felt their children had benefited in terms of their eagerness to learn new things. Pertaining to a specific creative problem solving skill, i.e., looking a problem in more than one way, nearly 97% felt that their children had benefited. Most parents, nearly three-quarters, felt that their children had benefited a lot in each of the areas.

Table 14. Parents Responses to How Much They Thought Their Child Had Benefited from Participating in Club Invention

		PERCENTAGES			
ITEM	**N**	**A Lot**	**Some**	**Very Little**	**Not at All**
Interest in science.	61	72.1	26.2	1.6	0.0
Interest in invention/making things.	64	85.9	12.5	1.6	0.0
Eagerness to learn new things.	64	76.6	23.4	0.0	0.0
Looking at a problem or challenge in more than one way.	64	62.5	34.4	3.1	0.0
Showing enthusiasm about what he/she has done at Club.	64	76.6	23.4	0.0	0.0

Figure 8. Illustration of How Much Parents Thought Children Benefited from Club Invention



DISCUSSION

As stated earlier in this report, the evaluation was completed to address four specific questions regarding program outcomes. This section will review each of the questions by reformulating them into outcome statements and then discussing the results of the data analysis to determine outcome achievement. The research questions are restated here for ease of reference:

1. *Has a change in student participant perceptions regarding creativity and science occurred as a result of their involvement with Club Invention?*
2. *Has a change in student participant knowledge regarding creative problem solving occurred as a result of their involvement with Club Invention?*
3. *Has a change in teacher participant knowledge regarding creative problem solving techniques occurred as a result of their involvement with Club Invention?*
4. *Has a change in teacher participant instructional techniques in their school-based classes occurred (or is there an intent to change) as a result of their involvement with Club Invention?*

Outcomes

Several techniques were employed by the evaluation team to assess both student and instructor outcomes. Site visits were conducted, and observers evaluated the Club Invention sessions according to indicators of creative problem solving, such as brainstorming techniques, create/recreate, and immersion. When possible, the evaluation team assessed changes in those indicators from one session to another several weeks later. Evidence of brainstorming, create/recreate, and immersion were indicated and described on the site visit observation forms.

In addition to observations, both primary and intermediate students were surveyed in an attempt to ascertain the impact of Club Invention on their perceptions of creativity and science, as well as their knowledge of creative problem solving. Instructors were also asked to complete surveys to gain their insights on outcome achievement. Some items on the instructor survey addressed student outcomes, as perceived by the instructors, and others addressed instructor outcomes. The instructor student-related items attempted to assess growth in students in their perceptions and knowledge of creativity, science, and creative problem solving. The instructor self-perception items attempted to assess instructor growth in those same areas, as well as any changes they had made or intended to make in their classroom teaching based on their experiences with Club Invention. Finally, parent surveys were administered to not only assess parent satisfaction with the program, but to also assess parents' perceptions of the impact of Club Invention on their children.

Thus, student outcomes were assessed through observations, student surveys, selected items on the instructor surveys, and selected items on the parent surveys.

Instructor outcomes were assessed through observations and selected items on the instructor survey.

Student Outcomes

Outcome 1. To increase student participant perceptions regarding creativity and science as a result of their involvement with Club Invention.

The responses that primary students gave on their survey that pertained to the impact of Club Invention on their perceptions of creativity and science indicated that the student objectives for Club Invention – a change in perceptions regarding creativity and science – were met for primary students. Most primary students indicated that, since coming to Club Invention, they felt more curious about things.

Intermediate students also responded to their survey in a manner strongly suggesting the impact of Club Invention on their perceptions of creativity and science. For example, over 80% of intermediate students felt they were more interested in science than they were before they came to Club Invention, with half of the students indicating they were a lot more interested. In addition, intermediate students indicated that Club Invention had impacted their perceptions toward creativity and science in that most of them felt they were better at coming up with new ideas and at solving problems, they found solving problems to be more of an interesting challenge, and they were more curious about things.

As far as parents' perceptions of benefits to their children, almost 100% agreed that their children felt more confident in their science abilities and that their interest in science and invention had increased since attending Club Invention, and that they had benefited "*a lot*." This is another measure of attainment of the goals of Club Invention, namely that the student's perceptions toward science would change. Their parents overwhelmingly agreed that this is true. Furthermore, 100% of parents felt their children had benefited in terms of their eagerness to learn new things.

Observations revealed that students were immersed in their activities and enjoyed being creative. To the extent that change could be ascertained – in those sites whereby two observations were made with several weeks intervening – students appeared to demonstrate more confidence in their creative and problem solving abilities.

In conclusion, survey and observation evidence support that Outcome 1 was attained for students.

Outcome 2. To increase student participant knowledge regarding creative problem solving in science and technology as a result of their participation with Club Invention.

Primary students indicated that Club Invention had an impact on their knowledge of creative problem solving, supporting that this student objective was met for primary students. Most primary students indicated that, since coming to Club Invention, they

knew how to solve problems better, felt more comfortable coming up with new ideas, could stick with a hard problem better, and could think about how to use everyday items in new and different ways.

Intermediate students also indicated positive change in knowledge of creative problem solving in their survey answers. One aspect of knowledge of creative problem solving pertains to perseverance with difficult problems. Knowing that one should persevere with his/her efforts with trying to solve a difficult problem indicates that one knows at least one aspect of creative problem solving as a process. Most students felt they were better at sticking with a hard problem than before they attended Club Invention. Another aspect of knowledge of creative problem solving deals with knowing that one needs to try more than one way to solve a problem. Again, most students felt that Club Invention had taught them to try more than one way to solve a problem. Knowing to use everyday items in new and different ways is another indicator of knowledge of creative problem solving. Most students felt that Club Invention had taught them to use everyday items in new and different ways, with a very high percentage indicating they had changed a lot in this regard. These findings strongly suggest that Club Invention impacted knowledge of creative problem solving.

These findings were corroborated by the responses that instructors gave regarding their perceptions of the impact that Club Invention on their students' knowledge of creative problem solving. Teachers believed that most students (75%) had demonstrated at least a medium amount of growth in brainstorming activities, including building upon ideas of other, and in exploring solutions through trial and error. They also believed that most students showed growth on focusing on ideas to develop a plan of action.

It can be seen that, according to parents, the objectives of Club Invention regarding a change in students' knowledge regarding creative problem solving were wholeheartedly met. Pertaining to a specific creative problem solving skill, i.e., looking a problem in more than one way, nearly 97% felt that their children had benefited. Most parents, nearly three-quarters, felt that their children had benefited a lot in each of the areas.

Observations support partial attainment of this objective. It was clear from the observations that students were very good in their brainstorming techniques, developing to the point of being able to carry on brainstorming with each other without being led by the teacher. They even became adept at building upon each other's ideas. They were free and creative with producing ideas

Students were somewhat impatient when it came to recreating projects that needed adjustments, but when they were encouraged to do so by their teachers and when time allowed, they did so. There were many instances in which the students realized that they needed to make adjustments, and they proceeded to attempt other solutions.

Teacher Outcomes

Outcome 3. To increase teacher participant knowledge regarding creative problem solving techniques as a result of their participation in Club Invention.

Survey data gathered from the instructors indicated that they strongly felt that Club Invention had prepared them to use more inquiry-based teaching their classrooms, which is the epitome of creative problem solving resulting in knowledge gained. Teachers also agreed that Club Invention had given them new ways to encourage a high level of student engagement in their classrooms, had shown them new ways to integrate content areas, and had given them new techniques to use in their classrooms. Thus, teachers believed that Club Invention had increased their knowledge regarding creative problem solving techniques.

Observations revealed excellent teacher techniques toward fostering brainstorming activities, but only mediocre abilities in facilitating the create/recreate process. Teachers utilized strong question-answer techniques, and they were highly supportive of students' responses, providing much positive feedback. They allowed all ideas, and they encouraged students to build upon each other's ideas. They were also almost always fully immersed in the activities, making sure that the students were having fun.

However, they became too directive during the activities in which the students were creating something. They seemed too eager to help the students "fix" the problem, concentrating more on the finished product than on the process. They did not allow the trial-and-error process as a means for children to make their own discoveries and form their own principles. This was partially due to time constraints, but it was also due to their techniques. As discussed earlier in this report, teachers appeared more comfortable with "explaining" rather than facilitating discovery learning, which is the crux of the creative problem solving process. This is evident with the type of instruction they provided students during a potential "recreate" situation. For example, they might direct a student to "try using glue instead of masking tape," instead of asking them, "What idea do you have about what might stick better?"

There were several examples in which the teacher did facilitate the recreate process, and those produced positive results. There was also some evidence to suggest that teachers became better at this over the course of a few weeks in Club Invention. However, it is safe to say that there is still to be work done in this area.

Outcome 4. Teacher participants will apply to their school-based classrooms the knowledge regarding instructional techniques they gained as a result of their participation in Club Invention.

Without directly observing classrooms both prior to and following a teacher's involvement with Club Invention, it is difficult to ascertain the actual extent to which this objective was actually met. However, several items on the instructor survey asked

teachers for their own input as to the extent to which their classroom practices had changed, or will change, because of Club Invention. Survey results must be interpreted with caution, as only seven instructors responded to the survey.

Extent of change in eighteen areas pertaining to the teaching of creative problem solving and discovery learning was assessed. The results indicated that at least 70% of the instructors felt that their classroom teaching practices had changed this year (or would change) at least to a medium extent in every area. Half or more than half the instructors indicated their classroom teaching practices had changed to a great extent in ten of the areas.

The areas in which instructors felt they had changed the most in their classrooms seemed to pertain to brainstorming methods of creative problem solving, such as using interactive questioning, helping students piggyback on each other's ideas, and encouraging students to look at information and challenges from a variety of angles. They also felt they had changed in their classroom teaching in using trial and error. Areas of less change included the higher levels of inquiry teaching. There was some change in these areas, which is a positive finding. So, while the evaluators believed that teachers did not facilitate the trial and error process as well as they might, teachers believed that they had incorporated those aspects into their classroom teaching. Perhaps they truly did change in these areas throughout their involvement with Club Invention even though it was not observed consistently during the brief observation period.

RECOMMENDATIONS

Both student and teacher objectives were largely met. The program provided a very positive experience for students, teachers, and parents, in terms of both skills learned and perceptions changed. In addition, both students and teachers expressed the fact that they enjoyed themselves very much, and had a lot of fun. Parents concurred. However, the evaluation team has some recommendations for improvement in order to better achieve the learning outcomes, which are presented below.

1. Emphasis needs to be placed on following the curriculum. In those cases in which the teachers deviated from the curriculum, objectives were not met as clearly.

2. It is difficult to accomplish all the activities given for a particular session in the curriculum guide within a single day. Many sites expanded the curriculum over extra weeks, and the activities proceeded very smoothly. The disadvantage of having to rush through the activities is that not enough time is permitted for the recreation of projects.

3. Teachers need better training in facilitating the create/recreate process, and they need to be fully instructed as to the purpose of it. Perhaps a training video can show more fully developed examples of ways to direct trial-and-

error activities to encourage discovery learning. The same situation could be illustrated with instructors utilizing brainstorming and create/recreate methods contrasted with instructors utilizing more directive approaches. Good ways and poorer ways of doing this could be illustrated. If it is unfeasible to produce a training video, then perhaps a lively script could be written with two different types of teachers handling the same situation two different ways. Both of these instructional tools could illustrate methods to respond to student questions and problems that will better foster creative problem solving, especially in the area of the create/recreate process.

4. The current study should be expanded to increase the generalizability of the findings. An increased number of observation sites, with observations made the first and last weeks, would not only provide more data and increase the generalizability of findings, but would allow for a better assessment of change which occurs throughout the Club Invention program.

5. Utilize more survey data, even from the sites that could not be observed. Perhaps electronic surveys could be implemented, at least for instructors, to expedite that process. This would assure a more representative sample from across the United States.

APPENDIX A: KEY PROJECT PERSONNEL

KEY PROJECT PERSONNEL

Sandra Ortega, Ph.D., Director
Dr. Ortega is a senior level evaluator with over 20 years of experience in conducting evaluation in various educational and social service settings. She earned her Ph.D. at The Ohio State University, College of Education in Quantitative Research, Evaluation and Measurement in Education (QREME) in the School of Educational Policy and Leadership.

Deborah Shama-Davis, Ph.D., Lead Evaluator
Dr. Shama-Davis is currently serving as a Lead Evaluator in the Bureau of Research Training and Services, College and Graduate School of Education, Health, and Human Services, at Kent State University. Dr. Shama-Davis has over 25 years experience in mixed methodology program evaluation and research, survey development, report and professional writing, teaching, and extensive statistical analysis and interpretation. She is also extensively involved in assisting various schools in Northeast Ohio with utilizing assessment data. Dr. Shama-Davis has consulted with hundreds of faculty and graduate students on their research and statistical projects. She has taught graduate and undergraduate classes and workshops in statistics, the use of educational assessment, data analysis and presentation, evaluation, child development, computer applications of statistics, and various special education classes at Kent State University. Before coming to Kent State in 1979, Dr. Shama-Davis taught special education for Akron Public Schools. Dr. Shama-Davis was responsible for the overall leadership and monitoring of the Club Invention evaluation.

Amanda Thomas, Data Lab Director
Amanda Thomas currently works as the Data Lab Director. She serves as a support for the Director. Amanda manages the Bureau budget and hiring, assists with planning, and oversees the successful operation of the Data Lab. Amanda has experience in instrument design and layout as well as qualitative and quantitative data collection and compilation. Amanda received a Bachelor Degree in Business Management and is currently enrolled in graduate classes in Higher Education Administration and Student Personnel. She began working with the Bureau in September of 2000.

Graduate Assistants
The graduate assistants have experience with writing literature reviews and developing evaluations instruments. They also have knowledge of data entry and analysis procedures. They participated in the site visits, data entry, review, analysis, and report development.

Data Lab Assistants
The Bureau of Research Training and Services employs ten undergraduate students. Their primary responsibility is to facilitate the transition of hardcopy data into electronic files. Data lab assistants are trained in survey layout, printing, scanning, data entry, data verification, and cassette and digital transcription.

APPENDIX B: SURVEYS

CLUB INVENTION® STUDENT SURVEY GRADES 1-3
2007-2008

Draw a circle around your answer for each question.

1. Club Invention® has helped me learn how to solve problems better.

A Lot  **A Little Bit**  **Not At All** 

2. Club Invention® has helped me feel more comfortable coming up with new ideas.

A Lot  **A Little Bit**  **Not At All** 

3. Club Invention® has helped me think about how to use everyday items in new and different ways.

A Lot  **A Little Bit**  **Not At All** 

4. Since I've been at Club Invention®, I feel more curious about things.

A Lot  **A Little Bit**  **Not At All** 

5. Since I've been at Club Invention®, I stick with a problem even if it's hard.

A Lot  **A Little Bit**  **Not At All** 

I am in grade:	I am a:	I would like to come back to Club Invention® again:
1 2 3	BOY GIRL	YES NO

CLUB INVENTION®
CUESTIONARIO PARA ALUMNOS GRADOS 1-3
2007-2008

Marca con un círculo la respuesta para cada pregunta.

1. Club Invention® me ha ayudado aprender como solucionar problemas mejor:

Mucho  **Poco**  **Nada** 

2. Club Invention® me ha ayudado sentir más cómodo/a en pensar en nuevas ideas:

Mucho  **Poco**  **Nada** 

3. Club Invention® me ha ayudado pensar en como usar artículos diarios en maneras nuevas y diferentes:

Mucho  **Poco**  **Nada** 

4. Desde que he asistido a Club Invention®, mi curiosidad ha aumentado:

Mucho  **Poco**  **Nada** 

5. Desde que he asistido a Club Invention®, no me rindo aun sea difícil un problema:

Mucho  **Poco**  **Nada** 

Estoy en el grado:	Soy:	Me gustaría volver a participar en Club Invention®:
1 2 3	Niño Niña	Sí No

CLUB INVENTION® PROGRAM - GRADES 4-6
2007-2008

Instructions:

"Please draw an 'X' over the answer you would like to choose after every question."

1. I can stick with a hard problem better than I could before I came to Club Invention®.

A lot Some Not at all

---

2. Club Invention® has taught me to try more than one way to solve a problem.

A lot Some Not at all

3. I feel I am better at coming up with new ideas than I was before I came to Club Invention®.

A lot Some Not at all

---

4. Club Invention® has shown me that solving problems is an interesting challenge.

A lot Some Not at all

5. I am more curious about things than I was before I came to Club Invention®.

A lot Some Not at all

---

6. Club Invention® has taught me how to use everyday items in new and different ways that I did not do before.

A lot Some Not at all

7. I am more interested in science than I was before I went to Club Invention®.

A Lot Some Not At All

---

8. I feel I am better at solving problems than I was before I came to Club Invention®.

A Lot Some Not At All

9. I am a... BOY GIRL

---

10. What grade are you in?

4th grade 5th grade 6th grade

11. What is the MAIN reason you came to Club Invention® this week?
*(Draw an **X** over only ONE answer.)*

a) I like science.

b) I thought it would be fun.

c) My mom or dad made me.

d) I like to invent things.

e) Because my friends were coming.

f) Because I needed somewhere to go after school.

---

12. Would you like to come back to Club Invention® next year? YES NO

13. What have you liked best about Club Invention®?

_____

_____

CLUB INVENTION®

CUESTIONARIO PARA ALUMNOS GRADOS 4-6

2007-2008

Instrucción:

"Marca con un círculo la respuesta para cada pregunta."

1. Desde que he asistido a Club Invention®, no me rindo aún sea difícil un problema**:**

Mucho Poco Nada

---

2. Club Invention® me ha ayudado encontrar varios modos de resolver un problema:

Mucho Poco Nada

3. Club Invention® me ha ayudado sentir más cómodo/a en pensar en nuevas ideas:

Mucho Poco Nada

---

4. Club Invention® me ha mostrado que interesante es resolver problemas:

Mucho Poco Nada

5. Desde que he asistido a Club Invention®, mi curiosidad ha aumentado:

Mucho Poco Nada

---

6. Club Invention® me ha ayudado pensar en como usar artículos diarios en maneras nuevas y diferentes:

Mucho Poco Nada

7. Desde que he asistido a Club Invention®, me interesa más la ciencia:

Mucho Poco Nada

8. Club Invention® me ha ayudado aprender como solucionar problemas mejor:

Mucho Poco Nada

9. Soy... Niño Niña

10. Estoy en el grado?

4 5 6

11. La razón principal por la cual elejí participar en Club Invention® es:
*(escriba un X sobre **una** respuesta.)*

a) me interesa la ciencia

b) pensé que sería divertido

c) mis padres decidieron

d) me gusta inventar

e) mis amigos pensaban asistir

f) porque había necesidad de tener donde ir después de las horas escolares

12. Me gustaría volver a participar en Club Invention®: Sí No

13. Lo que me gustó más de Club Invention® es:

_____

_____

PRIMARY STUDENT SURVEY SCRIPT

INTRODUCTION FOR EVERYONE: Hi, everyone. My name is _____, and this is _____. We are from Kent State University (in Ohio), close to where the National Inventor's Hall of Fame is. We are so excited to be here with you at Club Invention! It's been so much fun to see all the things you do here.

Right now I'd like to give you a survey with some sentences on it. In the survey, I want you to think about each sentence and decide how you feel about it. Your answers are going to help us know more about your experiences here at Club Invention.

First, I want to tell you that there are no right or wrong answers. We just want to know your thoughts. Also, your answers are totally private. No one will know what your personal answers are. We would really like for you to answer the sentences on this survey, but you don't have to. Also, you will not be penalized in any way if you decide to stop the survey at any time. We hope you do decide to take the survey because your answers will help us make Club Invention better for next time.

PRIMARY: Here are some pictures of faces. This one is smiling. This one is frowning. And this one is just neutral. The one that is smiling stands for "A LOT." That means if you think the sentence is true for you A LOT, you would draw a circle around this face. The one that is neutral means "A Little Bit." That means if the sentence is true for you A LITTLE BIT (but not a lot), then you would draw a circle around this face. This last one – the one with the frown – means "Not at All." This means if the sentence is NOT true for you, then you would draw a circle around this face.

Let's try an example. Here is a sentence: "I think spiders are scary." Who thinks spiders are scary a lot? Raise your hands. Okay, then you guys would draw a circle around the face with the smile. Okay, who thinks spiders are a little bit scary? You would draw a circle around the neutral face. Okay, who thinks spiders are not scary at all? You would draw a circle around the frowning face.

Okay, do you have the idea? We will help you read these sentences. If you have any questions, raise your hand and we'll help you.

INTERMEDIATE STUDENT SURVEY SCRIPT

INTRODUCTION FOR EVERYONE: Hi, everyone. My name is _____, and this is _____. We are from Kent State University (in Ohio), close to where the National Inventor's Hall of Fame is. We are so excited to be here with you at Club Invention! It's been so much fun to see all the things you do here.

Right now I'd like to give you a survey with some sentences on it. In the survey, I want you to think about each sentence and decide how you feel about it. Your answers are going to help us know more about your experiences here at Club Invention.

First, I want to tell you that there are no right or wrong answers. We just want to know your thoughts. Also, your answers are totally private. No one will know what your personal answers are. We would really like for you to answer the sentences on this survey, but you don't have to. Also, you will not be penalized in any way if you decide to stop the survey at any time. We hope you do decide to take the survey because your answers will help us make Club Invention better for next time.

INTERMEDIATE: These sentences will ask you to think about something related to your experiences at Club Invention. Read each sentence and ask yourself, *"How true is this for me?"* If you think the sentence is true for you A LOT, you would draw an X over the words "A lot." If you think the sentence is true for you SOME (but not a lot), then you would draw an X over the word, "Some." If you think the sentence is NOT true for you at all, then you would draw an X over the words, "Not at all."

Here's the first question: "I can stick with a hard problem better than I could before I came to Club Invention." How many of you think that you can stick with a hard problem A LOT BETTER than you could before you came to Club Invention? Then you would put an X over the words, "A lot." How many of you think you can stick with a hard problem SOMEWHAT (but not a lot) better than you did before you came to Club Invention? Then you would put an X over the word, "Some." How many of you think that you can't stick with a hard problem any better at all than before you came to Club Invention? Then this sentence is not at all true for you, and you would put an X over the words, "Not at All."

Does everyone understand? Any questions? If you need any help, please raise your hand and we'll come around to help you.

PRIMARY STUDENT SURVEY SCRIPT

INTRODUCCIÓN:
Hola, yo soy_____, el/ella es _____. Somos de la Universidad de Kent State (en Ohio), cerca de donde se encuentra el National Inventors Hall of Fame. ¡Estamos tan emocionados estar aquí con ustedes en Club Invention®! Nos hemos divertido mucho en ver todas las cosas que ustedes hacen aquí.

Ahora me gustaría darles un cuestionario. Quiero que ustedes piensen en cada frase y decidan que es lo que sienten. Sus respuestas nos ayudaran saber más acerca de sus experiencias aquí en la Club Invention®.

Primeramente, quiero decirles que no hay ninguna respuesta incorrecta. Sólo queremos saber sus pensamientos. Además, sus respuestas son totalmente privadas. Nadie sabrá cuales respuestas son las suyas. Nos gustaría que ustedes contesten las preguntas, pero es totalmente voluntario. No serán castigados de ninguna manera si por alguna razón deciden no terminar el cuestionario a cualquier momento. Esperamos que ustedes quieran participar en este estudio porque sus respuestas nos ayudarán mejorar Club Invention® para su próxima experiencia.

PRIMÁRIA: Aquí hay tres dibujos de unas caritas. Ésta sonríe. Éste esta triste. Y ésta es neutra. La carita que sonríe significa "**Mucho**." Esto indica que tú piensas que la oración es verdadera o correcta. Solo hay que marcar la carita con un círculo alrededor de esta carita.

La carita neutra significa "**Poco**." Esto indica que la oración es un poco agradable (pero no mucho), entonces hay que marcar con un círculo esta carita. La última carita significa "**Nada**." Esto indica que la oración no es verdadera, entonces hay que marcar con un círculo esta carita triste.

Vamos a intentar un ejemplo. Aquí está una oración: "Pienso que las arañas son espantosas. ¿"Quién piensa que las arañas son muy espantosas? Levanten las manos. Bien, entonces ustedes marcarían con un círculo la carita con la sonrisa porque ustedes piensan que la frase verdaderamente indica lo que ustedes piensan (que las arañas son espantosas. ¿Bien, quién piensa que las arañas son un poco espantosas? Ustedes marcarían con un círculo la carita neutra. ¿Bien, y quién piensa que las arañas **no** son nada de espantosas? Ustedes marcarían con un círculo la carita triste porque ustedes no estan de acuerdo con esta frase.

¿Bien, si entienden? Nosotros les ayudaremos leer las oraciones. Si tienen alguna pregunta, levantan la mano y les ayudaremos.

INTERMEDIATE STUDENT SURVEY SCRIPT

Hola, yo soy_____, el/ella es _____. Somos de la Universidad de Kent State (en Ohio), cerca de donde se encuentra el National Inventors Hall of Fame. ¡Estamos tan emocionados estar aquí con ustedes en Club Invention®! Nos hemos divertido mucho en ver todas las cosas que ustedes hacen aquí.

Ahora nos gustaría darles un cuestionario. Quiero que ustedes piensen en cada frase y decidan que es lo que sienten. Sus respuestas nos ayudaran saber más acerca de sus experiencias aquí en la Club Invention®.

Primeramente, quiero decirles que no hay ninguna respuesta incorrecta. Sólo queremos saber sus pensamientos. Además, sus respuestas son totalmente privadas. Nadie sabrá cuales respuestas son las suyas. Nos gustaría que ustedes contesten las preguntas, pero es totalmente voluntario. No serán castigados de ninguna manera si por alguna razón deciden no terminar el cuestionario a cualquier momento. Esperamos que ustedes quieran participar en este estudio porque sus respuestas nos ayudarán mejorar Club Invention® para su próxima experiencia.

INTERMEDIO: Estas oraciones le pedirán pensar en algo relacionado a sus experiencias en Club Invention®.
¿Lea cada frase y pregúntese, “Qué tan agradable es esto para mí?” Si usted piensa que la oración es muy agradable para usted, solo marque una “X” sobre la palabra “**Mucho**.”
Si usted piensa que la oración es un poco agradable (pero no mucho), entonces usted marcaría una “X” sobre la palabra, "**Poco**". Si usted piensa que la oración no es nada de agradable para usted, entonces usted marcaría una “X” sobre la palabra, “**Nada**.”

Aquí les va la primer frase del cuestionario: “Desde que he asistido a Club Invention®, no me rindo aún sea difícil un problema.”

¿Cuántos de ustedes piensan que pueden cumplir con un problema difícil MUCHO mejor que antes de que participaran en Club Invention®? Entonces usted pondría una “X” sobre la palabra, “**Mucho**.”

¿Cuántos de ustedes piensan que pueden cumplir con un problema difícil un POCO mejor (pero no mucho) que antes de que participaran en Club Invention®? Entonces usted pondría una “X” sobre la palabra, “**Poco**.”

¿Cuántos de ustedes piensan que no hay cambio en poder cumplir con un problema difícil? Entonces esta oración no tiene un sentido verdadero para usted, y usted pondría un X sobre la palabra, “**Nada**.”

¿Bien, todos entienden? ¿Algunas preguntas? Si tienen alguna pregunta, levantan la mano y les ayudaremos.

The Club Invention Program® - Instructor Survey 2007-2008

MARKING INSTRUCTIONS

- **Use a No. 2 pencil or a blue or black ink pen only.**
- **Do not use pens with ink that soaks through the paper.**
- **Make solid marks that fill the response completely.**

CORRECT: ● **INCORRECT:** ⊘ ⊠ ◒ ◔

Thank you for taking the time to fill out this survey! This survey will provide valuable information about your child's experience at Club Invention®.

1. Club Invention® Module:

- ○ Bolder Builders
- ○ Passage to Planet ROG
- ○ E.Z. Science
- ○ Phys. Ed: Physics in Motion
- ○ SOS: Endangered Earth

2. Is this the first year you have taught Club Invention®?

- ○ Yes
- ○ No

A. If NO, how many sessions have you taught prior to this? _____

3. Consider your Club Invention® attendees from the first day of club until now. Please rate the following items according to how much, in your opinion, most of the students have demonstrated *growth* in the following areas:

	Not at all	A small extent	A medium extent	A great extent
a. Exploring solutions through trial and error.	○	○	○	○
b. Freely engaging in brainstorming activities	○	○	○	○
c. Building upon ideas of fellow students.	○	○	○	○
d. Focusing on ideas to develop a plan of action.	○	○	○	○

4. Are you a:

- ○ Teacher (If YES, please complete **entire survey**)
- ○ Preparing to be a teacher (If YES, please skip to **item 8**)
- ○ Not a teacher or Pre-service teacher (Please Specify): _____

(If YES, thank you, you have completed your portion of the survey. Please turn it in.)

---

5. During the school year what grade level(s) do you teach?

_____

6. Including this year, how many total years of experience do you have as a certified teacher (in any school)?

_____

7. Are you teaching science this school year?

- ○ Yes
- ○ No

TEACHERS AND PRESERVICE TEACHERS SHOULD COMPLETE THIS SECTION.

8. To what extent do you agree or disagree that your experiences with the Club Invention® Program have done each of the following:

	STRONGLY DISAGREE	DISAGREE	AGREE	STRONGLY AGREE
a. Prepared you to be a stronger teacher in the classroom.	○	○	○	○
b. Given you new ways to interact with students that you can apply in your classroom.	○	○	○	○
c. Prepared you to use more inquiry-based teaching in your classroom.	○	○	○	○
d. Given you new ways to encourage a high level of student engagement in your classroom.	○	○	○	○
e. Shown you new ways to integrate content areas.	○	○	○	○
f. Given you new techniques that you will use in your classroom.	○	○	○	○

9. To respond to items 9a-9r, please answer the specific question corresponding to the category that best describes you.

CATEGORY

CLASSROOM TEACHERS WITH PRIOR EXPERIENCE TEACHING CLUB INVENTION® : To what extent have your classroom teaching practices changed in each of the following areas since you *first* became involved in teaching either Club or Camp Invention?

CLASSROOM TEACHERS WHO ARE TEACHING CLUB INVENTION® FOR THE FIRST TIME: If this is your first year teaching Club Invention®, then to what extent do you think your classroom teaching practices *will change* this current school year (2007-2008) as a result of your experiences with Club Invention® ?

PRE-SERVICE TEACHERS: If you are a teacher-in-training, based on Club Invention® experiences, to what extent do you think you will incorporate each of the following areas in your future classroom teaching?

	Not at all	A small extent	A medium extent	A great extent
a. Using everyday materials to come up with something new.	○	○	○	○
b. Allowing "crazy" ideas as part of brainstorming.	○	○	○	○
c. Encouraging students to express ideas in a variety of ways, such as journals, drawings, reports, graphing, construction, etc.	○	○	○	○
d. Using trial and error.	○	○	○	○
e. Using interactive questioning to probe students for understanding, prediction, and explanations.	○	○	○	○
f. Encouraging multiple ideas and approaches to solving a problem/challenge.	○	○	○	○
g. Encouraging students to identity challenges.	○	○	○	○
h. Guiding students through their own independent observations and investigations.	○	○	○	○
i. Helping students identify the goal or direction in solving a problem.	○	○	○	○
j. Helping students generate multiple new and unusual ideas.	○	○	○	○
k. Structuring instruction to allow students to work in teams to solve problems.	○	○	○	○
l. Helping students find alternative ways to solve a problem.	○	○	○	○
m. Facilitating students in experiments for the purpose of their acquisition of knowledge of new principles.	○	○	○	○
n. Allowing students to devise their own procedures to investigate a problem.	○	○	○	○
o. Allowing productive noise in the classroom.	○	○	○	○
p. Helping students focus their ideas into their most promising ones.	○	○	○	○
q. Helping students "piggy-back" on each other's ideas.	○	○	○	○
r. Encouraging students to look at information and challenges from a variety of angles.	○	○	○	○

THANK YOU!

Club Invention® Parent Survey - 2007-2008

THANK YOU for taking the time to fill out this survey! This survey will provide valuable information about your child's experience at Club Invention®.

MARKING INSTRUCTIONS

- **Use a No. 2 pencil or a blue or black ink pen only.**
- **Do not use pens with ink that soaks through the paper.**
- **Make solid marks that fill the response completely.**

CORRECT: ● **INCORRECT:** ⊘ ⊠ ◒ ◔

1. What is your relationship to the child/children who attended the Club Invention® Program?

- ○ Mother
- ○ Father
- ○ Grandmother
- ○ Grandfather
- ○ Other: _____

2. What is your child's ethnicity?

- ○ African-American
- ○ Asian
- ○ Caucasian
- ○ Hispanic
- ○ Mixed
- ○ Other: _____

3. How many sons do you have attending the Club Invention® program? _____ grades: _____

4. How many daughters do you have attending the Club Invention® program? _____ grades: _____

5. To what extent do you agree with each of the following statements about the Club Invention® program?

	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE
a. My child(ren) enjoyed attending Club Invention®.	○	○	○	○
b. My child(ren) feels more confident in their science abilities.	○	○	○	○
c. The interest my child(ren) feels in science has increased.	○	○	○	○
d. The Club Invention® staff was competent and professional.	○	○	○	○
e. I am satisfied with the Club Invention® curriculum.	○	○	○	○
f. Overall, I am satisfied with the Club Invention® program.	○	○	○	○
g. My child(ren) was excited about the daily activities at Club Invention®.	○	○	○	○
h. My child(ren) would like to attend the Club Invention® program again in the future.	○	○	○	○

6. To what extent did each of the following reasons contribute to your decision to enroll your child(ren) to the Club Invention® program?

	A Lot	Some	Very Little	Not at All
a. I needed something for my child to do after school.	○	○	○	○
b. I needed child care.	○	○	○	○
c. I believed the program would help my child(ren) do better in school.	○	○	○	○
d. It was a way for my child(ren) to be around friends and peers.	○	○	○	○
e. I wanted my child(ren) to experience enrichment.	○	○	○	○
f. My child(ren) expressed an interest/desire in attending.	○	○	○	○
g. My child(ren) is interested in science and I thought this program would reinforce that interest.	○	○	○	○
h. My child(ren) was **not** interested in science and I wanted to spark an interest in him/her.	○	○	○	○
i. It was recommended by the school and/or teacher.	○	○	○	○

7. Overall, how much do you think your child has benefited from participating in Club Invention® in each of the following ways?

	A Lot	Some	Very Little	Not at All
a. Interest in science	○	○	○	○
b. Interest in invention/making things	○	○	○	○
c. Eagerness to learn new things	○	○	○	○
d. Looking at a problem or challenge in more than one way	○	○	○	○
e. Showing enthusiasm about what he/she has done at Club	○	○	○	○

Club Invention® Encuesta de Padres - 2007-2008

¡Gracias por tomar el tiempo para llenar **esta encuesta!**
Esta iniciativa proporcionará información valiosa sobre la experiencia de su niño en la Club Invention ®.

INSTRUCCIONES

Favor de usar solo un lápiz No 2 o una pluma de tinta azul o negra.
Favor de no utilizar plumas con tinta que empape el papel.
Favor de indicar claramente la respuesta con marca firma y completa.

CORRECTO: ● **INCORRECTO:** ⊘ ⊠ ◒ ◔

1. Cual es su relación al niño/niña quien asistió al Programa de Club Invention®?

- ○ madre
- ○ padre
- ○ abuelo
- ○ abuela
- ○ otro _____

2. A qué grupo étnico pertenece su niño?

- ○ afroamericano
- ○ asiático
- ○ caucásico
- ○ hispano
- ○ étnica mezclada
- ○ otro _____

3. Cuántos hijos asisten al programa de Club Invention®? _____ grado escolar: _____

4. Cuántas hijas asisten al programa de Club Invention®? _____ grado escolar: _____

5. Hasta que punto está de acuerdo con cada una de las declaraciones siguientes sobre el programa de Club Invention®?

	Estoy completamente du acuerdo	Estoy de acuerdo	No estay de acuerdo	Estoy en complete desacuerdo
a. Mi niño disfrutó al participar en Club Invention®	○	○	○	○
b. Mi niño se siente más confidente en sus capacidades con la ciencia	○	○	○	○
c. El interés de mi niño en la ciencia ha aumentado.	○	○	○	○
d. El personal de Club Invention® son competente y profesional.	○	○	○	○
e. Estoy satisfecho con el plan de estudios de Club Invention®.	○	○	○	○
f. En general, estoy satisfecho con el programa de Club Invention®.	○	○	○	○
g. Mi niño estaba emocionado sobre las actividades diarias de Club Invention®.	○	○	○	○
h. A mi niño le gustaría asistir al programa de Club Invention® nuevamente en el futuro.	○	○	○	○

6. Hasta qué punto contribuye cada uno de los motivos siguientes a su decisión de registrar a su niño en el programa de Club Invention®?

	Mucho	Poco	Muy Poco	Nada
a. Necesidad de conseguir algo para mi niño después de las horas escolares	○	○	○	○
b. Necesidad de cuidado de niños.	○	○	○	○
c. Creí que el programa le ayudaría a mi niño mejorar sus estudios.	○	○	○	○
d. Era una manera en que mi niño podría estar con sus amigos y pares.	○	○	○	○
e. Quise que mi niño experimentara el enriquecimiento.	○	○	○	○
f. Mi niño expresó un interés/deseo en asistir.	○	○	○	○
g. Mi niño está interesado en la ciencia y pensé que este programa refuerce ese interés.	○	○	○	○
h. A mi niño no le llama la atención la ciencia y quise provocar un interés.	○	○	○	○
i. Fue recomendado por la escuela y/o profesor.	○	○	○	○

7. En general, cuánto piensa usted su niño se ha beneficiado en participar en Club Invention® en cada uno de los modos siguientes?

	Mucho	Poco	Muy Poco	Nada
a. Interés en la ciencia	○	○	○	○
b. Interés en la invención/fabricación	○	○	○	○
c. Entusiasmo para aprender cosas nuevas	○	○	○	○
d. Ver un problema o desafío en varios modos	○	○	○	○
e. Mostrar entusiasmo sobre lo que él/ella ha hecho en Club Invention®	○	○	○	○

APPENDIX C: OBSERVATION PROTOCOL

CLUB INVENTION OBSERVATION PROTOCOL
Introduction

PURPOSES OF OBSERVATION:

1. **To get a "real" flavor and rich description of the program and the program activities.**

2. **To determine the extent to which program fidelity is being maintained. Thus, when we talk about the outcomes, we can be assured that they are due to the program, which proceeded as intended.**

3. **To obtain qualitative data on the extent to which program objectives are being met. Since this is an "outcomes based evaluation," we need to observe and record the extent to which these outcomes are being met.**

OUTCOMES TO OBSERVE:

1. **<u>Student Outcomes</u>**

    - **The student will demonstrate behavior indicating that he/she is engaged in science as a creative problem-solving activity.**

    - **The student will demonstrate behavior indicating that he/she is enthusiastic about science and creativity.**

    - **The student will demonstrate behavior following the three key strategies: brainstorming, immersion, and create/recreate.**

2. **<u>Teacher Outcomes</u>**

    - **The teacher will demonstrate behavior indicating that he/she is engaged in inquiry-based teaching practices; i.e., the teacher is presenting science as a creative problem-solving activity. For example, the teacher is appropriately guiding brainstorming activities; the teacher is appropriately guiding independent work of the students. The teacher should be "facilitating" rather than "leading."**

    - **The teacher will demonstrate behavior following the three key strategies: brainstorming, immersion, and create/recreate.**

    - **The teacher will indicate that he/she will generalize some of these activities to his/her own classroom.**

HOW TO OBSERVE

- **Look for evidence that student and teacher outcomes are or are not being met.**
- **Circulate around the room; interact with students and teachers.**

CLUB INVENTION OBSERVATION PROTOCOL
Page 1: Descriptive Information

NAME OF OBSERVER: _____

DATE OF OBSERVATION: _____ **TIME:** _____

SITE: _____

CLUB MODULE: ☐ ***Bolder Builders*** ☐ ***E.Z. Science*** ☐ ***Passage to Planet ROG***

☐ ***Phys. Ed: Physics in Motion*** ☐ ***SOS: Endangered Earth***

LESSON: _____

NUMBER OF CHILDREN IN ATTENDANCE: _____

AGE LEVEL(S) OF CHILDREN IN ATTENDANCE: _____

INTENTION OF ACTIVITY/ACTIVITIES OBSERVED:

_____

_____

_____

When describing the activity/activities you observe, please include the following elements:

1. **Provide a rich, detailed description of the activity/activities.**
2. **Describe the extent to which and the manner in which the children were engaged in the activity, paying particular attention to creative problem-solving activities/behavior (evidence of immersion, brainstorming, and create/recreate).**
3. **Describe strategies the instructor employed that demonstrated inquiry-based teaching (evidence of emersion, brainstorming, and create/recreate).**
4. **Describe efforts the instructor made to both motivate the entire class and to engage the off-task students in the activity, and describe what effect these had.**
5. **Describe strengths.**
6. **Describe shortcomings.**
7. **Provide suggestions.**

CLUB INVENTION OBSERVATION PROTOCOL
Page 2: OBSERVATION

APPENDIX D: CONSENT FORMS

Parental Consent Form

Dear Parent,

Your child has been chosen to participate in an evaluation of Club Invention®. The evaluation will be conducted by representatives from Kent State University's Bureau of Research Training and Services and seeks to identify ways to improve the program. The evaluation will be conducted by observing students in the classroom and asking students and parents to complete a survey related to their Club Invention® experience. This survey is *confidential* and *voluntary*. We thank you for allowing your child to participate in this important project. **If you want to know more about this project, please feel free to contact me. The project has been approved by Kent State University. If you have questions about Kent State University's rules for research, please call Dr. Peter Tandy, Acting Vice President of Research, Division of Research and Graduate Studies at (330) 672-2704.**

Sincerely,

Sandra de Ortega, Ph.D.
Director (330) 672-0746
sortega@kent.edu

By signing this form, I agree to the following statements:

- ✓ I understand my child's participation in this evaluation is voluntary and there are no negative consequences should my child choose not to participate in any part of the evaluation.
- ✓ I understand that the information provided will be kept confidential.
- ✓ By signing below, I allow my child to participate in the evaluation. The information gathered is to be used solely for evaluation purposes by the staff of the Bureau of Research Training and Services.

_____ _____

Parent Signature Date

_____

Please print child's name

Parental Consent Form

Estimado Padre,

Su niño ha sido elegido para participar en un estudio de Club Invention®. La encuesta será conducida por representantes de la Oficina de Formación y Servicios de la Universidad de Kent State y procura identificar modos de mejorar el programa de Club Invention®.

La evaluación será conducida por medio de observación de los alumnos en el aula y cuestionarios relacionados a sus experiencias con Club Invention® para los alumnos y sus padres. La encuesta es confidencial y voluntaria.

Le agradeceríamos mucho su participación en este proyecto importante. Si usted desea saber más sobre este proyecto de investigación, favor de llamarme al **(330)672-0746.** El proyecto ha sido aprobado por la Universidad de Kent State. Si usted tiene dudas acerca de cualquier aspecto de las reglas de investigación de la Universidad de Kent State, puede llamar al Dr. Peter Tandy, Vicepresidente Interino de la Investigación, División de Estudios de Graduado **(330) 672-2704**.

Atentamente,

Sandra de Ortega, Ph.D.
Director (330) 672-0746
sortega@kent.edu

Firmando este formulario indica que estoy de acuerdo con las declaraciones siguientes:

- Entiendo que la participación de mi niño en esta evaluación es voluntaria y no hay ningunas consecuencias negativas si mi niño decida no participar en cualquier aspecto de la evaluación.
- Entiendo que la información proporcionada será guardada de manera confidencial.
- Firmando este formulario, yo permito que mi niño participe en la evaluación. La información proporcionada sera utilizada únicamente para objetivos de evaluación por el personal de la Oficina de Formacion y Servicios Investigativos de la Universidad de Kent State y Club Invention®.

_____ _____

Parent Signature Date

_____

Please print child's name

Parent Survey

Dear Parent: November 1, 2007

The Club Invention® program at this school has been chosen to participate in an evaluation of Club Invention®. The evaluation will be conducted by representatives from Kent State University's Bureau of Research Training and Services and seeks to identify ways to improve the program. Club participants and parents are asked to take part in a survey of their Club Invention® experiences. This survey is *confidential* and *voluntary*. We thank you for your participation in this important project.

If you want to know more about this research project, please call me at (330) 672-0746. The project has been approved by Kent State University. If you have questions about Kent State University's rules for research, please call Dr. Peter Tandy, Acting Vice President of Research, Division of Research and Graduate Studies at (330) 672-2704.

If you would like to participate in the study, please complete the survey and mail it back in the enclosed self-addressed envelope. No postage is necessary. Thank you.

Sincerely,

Sandra de Ortega, Ph.D
Director
sortega@kent.edu
(330) 672-0746

Parent Survey

Estimado Padre:

El programa de Club Invention en esta escuela ha sido elegido para participar en una evaluación de este programa. La encuesta será conducida por representantes de la Oficina de Formacion y Servicios de la Universidad de Kent State y procura identificar modos de mejorar el programa.

Participantes de Club Invention® y sus padres son invitados a participar en una revisión de sus experiencias de este programa. La encuesta es confidencial y voluntaria. Le agradeceríamos mucho su participación en este proyecto importante.

Si usted desea saber más sobre este proyecto de investigación, favor de llamarme al **(330)672-0746.** El proyecto ha sido aprobado por la Universidad de Kent State. Si usted tiene dudas acerca de cualquier aspecto de las reglas de la Universidad de Kent State acerca de la investigación, puede llamar al Dr. Peter Tandy, Vicepresidente Interino de la Investigación, División de Estudios de Graduado al (330) 672-2704.

Si le interesa participar en este encuesto, favor de contestar las preguntas y regresar el cuestionario en el sobre incluido. Ningún franqueo es necesario.

Atentamente,

Sandra de Ortega, Ph.D
Directora
sortega@kent.edu
(330) 672-0746

Instructor Survey

Dear Instructor, November 1, 2007

The Club Invention® program at this school has been chosen to participate in an overall evaluation of Club Invention®. The evaluation will be conducted by representatives from Kent State University's Bureau of Research Training and Services and seeks to identify ways to improve the program. Club participants and parents are asked to participate in a survey of their Club Invention® experiences. This survey is *confidential* and *voluntary*. We thank you for your participation in this important project.

If you want to know more about this research project, please call me at (330) 672-0746. The project has been approved by Kent State University. If you have questions about Kent State University's rules for research, please call Dr. Peter Tandy, Acting Vice President of Research, Division of Research and Graduate Studies at (330) 672-2704.

If you would like to participate in the study, please complete the survey by the final day of Club Invention® and return it to us in the self-addressed envelope provided. No postage is necessary. Thank you.

Sincerely,

Sandra de Ortega, Ph.D.
Director
(330) 672-0746
sortega@kent.edu