Positive Effects of Science and Technology Summer Camps on Confidence, Values, and Future Intentions

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ABSTRACT

The purpose of this study was to evaluate the effects of science and technology summer camps on the confidence, values, and future intentions of female and male campers. The week-long camps were administered by Actua, a national organization with a mandate to increase awareness of science and technology among Canadian youth. Campers completed a survey both pre- and post-camp. Camps were perceived to be a very positive experience by 83% of campers. Significant positive changes were reported in confidence, values, and future intentions. Results provide some of the first quantitative evidence, at a national level, for the effectiveness of science and technology summer camps that use a hands-on, interactive approach.

RÉSUMÉ

Le but de cette étude est d'évaluer les effets des camps d'été en sciences et en technologie sur la confiance, les valeurs et les ambitions futures des participant(e)s âgées entre 10 et 14 ans. Les camps, d'une durée d'une semaine, ont été administrés par Actua, une organisation nationale dont le mandat est d'augmenter les connaissances en sciences et en technologie parmi les jeunes Canadiens et Canadiennes. Les jeunes ont rempli des questionnaires d'enquête avant et après leur participation aux camps, et 83% des jeunes étudiés ont perçu ces camps comme une expérience très positive. Notamment, des changements positifs ont été notés par rapport à la confiance, les valeurs et les ambitions futures des participant(e)s. Ces résultats sont parmi les premières données quantitatives, à l'échelon national, appuyant l'efficacité des camps d'été en sciences et en technologie qui utilisent une approche interactive et pratique.

Employment within the science and technology sectors is expected to grow significantly in the next decade. Furthermore, positions in science and technology are rated within the top salary quartile (Braddock, 1999). Promoting awareness of the many career options available in these fields is important for today's

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youth, particularly for underrepresented groups such as women. The underrepresentation of women in careers in science is believed to be due partially to gender differences in attitudes and values regarding science (Eccles, 1994). Changing these attitudes and values is essential in attracting today's youth to tomorrow's science and technology-related careers.

Facilitating positive experiences for young people in science and technology is one of the best ways to increase interest in these careers. Positive experiences are thought to promote confidence with and positive attitudes towards science and technology. In their examination of the influence of fifteen different science promotion programs on career choice, Vickers, Ching, and Dean (1998) surveyed 1,570 undergraduate students enrolled in a first-year calculus course. From these retrospective data, the researchers concluded that summer science programs featuring hands-on science activities are a highly effective way to increase both interest in science and technology and the intention to pursue a career in these fields. The purpose of the present study is to investigate the effects of science and technology summer camps on the attitudes and future intentions of youth.

Out-of-school experiences with science have been shown to be an important supplement to formal science and technology education. Maarschalk (1988) has made a distinction between informal and nonformal education. Nonformal education is "that which proceeds in a planned but highly adaptable way in institutions, organizations, and situations outside the sphere of formal and informal education" (p. 137). Science camps may be considered to be nonformal education. In contrast, informal education occurs spontaneously in life situations, for example, students discussing a science topic among themselves outside of school (Maarschalk, 1988). Tamir (1991) investigated these two constructs by surveying 10th grade students regarding informal and nonformal science activities and attitudes toward science. He found that out-of-school, science-related experiences, especially when linked to school subjects, were associated with the intention to pursue a career in science, higher confidence with science, higher regard for science as important, and greater liking for science. It is likely that the potentially positive effects of summer science camps on attitudes and future intentions would be not only due to their function of providing nonformal education, but also due to their ability to stimulate informal educational experiences for campers.

In examining the effects of science camps, the differing attitudes and values of males and females regarding science and technology are important to address as they are thought to contribute to the underrepresentation of females in science careers. Eccles (1994), in her review of research on adolescent educational and occupational choices, reported that females are less likely to enroll in advanced level mathematics courses than are males, are less confident of success in science-related professions, and perceive math to be less important, less useful, and less enjoyable. In related research, Fisher, Margolis, and Miller (1997) interviewed students in an undergraduate computer science program to better understand gender differences in the factors affecting the academic choices of these students. Compared to their male peers, female computer science majors had less previous computer experience, underestimated their ability to succeed in their courses, and focused more on the usefulness of computer science and less on how much they liked working with computers. Providing females with opportunities to enjoy positive experiences with science and technology, from which they gain confidence in their abilities and learn to appreciate the usefulness of science, may be key to diminishing gender differences in future intentions in these fields.

Since the 1980s, a wide variety of out-of-school science programs have been implemented to promote interest in and confidence with science and technology among elementary and high school students (Brown, 1999; Gilbride, Kennedy, Waalen, & Zywno, 1999; Margle & VanLeuvan, 1999; Morrow, 1999). Many of these programs receive sponsorship from both government organizations and private industry and are able to reach a large number of young people. Thus, it is important that these programs be evaluated objectively and quantitatively to establish the extent and nature of their effectiveness and how they can be further improved. In addition, evaluation legitimizes the work of these programs, lending further support for increased funding and development. Informal and anecdotal support for the effectiveness of summer science camps has accumulated, however, and the need for both short- and long-term formal evaluations has been recognized as being of crucial importance (Gilbride et al., 1999; Heller, Martin, & Thomas, 1997; National Science Foundation, 1999). In fact, some researchers (Heller et al., 1997) have stated that follow-up evaluations are fundamental to any well constructed program.

The evaluations of science camps conducted to date have tended to be either anecdotal or limited to the analysis of a single camp program. In evaluating the effectiveness of science camps, it is advantageous to examine a general approach that is then implemented by a number of different camps, by different instructors, in different locations, and offered to a broad range of campers. This would increase the generalizability of the results. In the present study, we examined week-long summer science camps delivered by the different member organizations of Actua.

Actua is a national not-for-profit organization that supports the development and delivery of hands-on science, engineering, and technology programs for youth. As one of Canada's larger science promotion organizations, Actua represents a network of 28 member organizations. Each year, Actua member organizations work with over 225,000 youth, aged 6 to 17, through hands-on summer day camps, in-school workshops, community outreach activities, and year-round clubs. The Actua programs represent a commitment to reach underrepresented audiences through specialized activities for girls, Aboriginal communities, and underprivileged and rural youth. The goal of these programs is to increase the scientific and technical literacy of youth and to help them develop the confidence, attitudes, and skills necessary for success in today's knowledge-based economy (Actua, 2003).

ACTUA'S SUMMER CAMP PROGRAM

The present study was conducted on the camp portion of Actua's member organizations. Although Actua's 28 members across Canada deliver programs that are unique and customized to the needs of their local audiences, they share common goals and approaches in the design and delivery of the summer camp program. Summer camps are one week in duration and are offered for youth in Grades 4 to 9. The camps run the full day, on university or college campuses, with recreational activities included. At each camp a broad range of curriculum is covered focusing on different areas of science, engineering, and technology and complimenting what is delivered at school. Participants are provided with hands-on, interactive experiences in a fun and supportive environment. The camp programs are designed to: (a) provide positive learning experiences, (b) strengthen the intrinsic value that youth place on science, (c) increase awareness of the diverse opportunities available in science, engineering, and technology, (d) encourage youth to pursue science and math courses in high school, and (e) allow youth to interact with positive role-models and mentors.

To achieve these goals, the mission of Actua includes the following values: (a) For youth, by youth: Instructors are undergraduate students studying in the fields of science, engineering, and technology. The instructors provide positive role models; (b) Child centred: Members use a hands-on, discovery-based approach to learning and create positive environments that encourage risk-taking and creativity; and, (c) Connecting science to the lives of youth: By connecting science and technology to what is important in the lives of young people, science is made more relevant, thereby increasing interest in science and the likelihood that they will pursue science as a career option.

This collection of values, approaches, and goals are core components of these summer science camps. The activity schedule for the summer camps is different at each location. Each day, however, is some combination of the following: hands-on building projects (e.g., building robots, building catapults, egg drop); tours of university science and engineering laboratories (e.g., biology lab, electronics lab, biomedical lab); mentor presentations (e.g., presentations by men and women engineers and scientists on their education, work, and career); recreational activities (e.g., soccer, swimming, capture the flag); brain bumpers (e.g., science puzzles, mysteries, math challenges); technology activities (e.g., building websites, learning Flash, video conferencing); and week-long projects. An example of a week-long project is the building of Goldberg machines. For this activity, campers design and build a machine that will perform a specified task. The participants must work together to develop a plan, which they then build using commonly found materials. On Monday, the campers participate in opening activities (e.g., name games, making slime, fire drills) and on Friday, family and friends are invited to an end-of-week celebration at which campers demonstrate their projects.

First, we evaluated campers' perceptions of the camp experience to determine if it was perceived to be positive. Given that camp activities were selected to provide enjoyable, hands-on experiences, we predicted that the camp experience would be perceived as a positive experience by the majority of both female and male participants. Second, campers' confidence, values, and future intentions regarding science and technology were examined. We predicted that positive changes would be reported in confidence, values, and future intentions, as assessed both by pre- and post-camp scores and by campers' perceptions of change due to the camp experience. In addition, the effects of camp experience on future intentions were examined within a proximal-distal perspective. Mean scores for more proximal variables, such as, intention to do better in science next year, were expected to show greater positive change. In contrast, progressively less change was expected for more distal intentions, such as, intending to study science or technology in university and considering a career in the fields of science or technology.

METHOD

Participants

Participants were 876 campers who attended one of Actua's week-long summer science and technology day camps. Data analyzed in the present study are from camp sessions in the late summer of 2000 at 17 member sites across Canada. The sample consisted of 580 males and 296 females. Mean age for the participants was 11.56 for males and 11.29 for females, with ages ranging from 10 to 14 years.

Measures

The survey items were based on measures used in previous research on confidence, values (intrinsic, utility, and importance), and future intentions in the areas of math (Eccles & Wigfield, 1995) and computer science (Crombie, Abarbanel, & Trinneer, 2002). The items are from frequently used measures with well-established reliability and validity. The item wording in the present study was changed to refer to science and technology. A five-point Likert-type response format was used for all questions.

Camp experience. Camp experience was measured by one item in the post-camp survey asking campers to rate their camp experience on a five-point scale, with 1 = *Boring*, 2 = *A Little Boring*, 3 = *I Liked It*, 4 = *Very Good*, 5 = *Amazing.*

Perceptions of change due to camp. In the post-camp survey, campers' perceptions of change after a week at camp in confidence, importance, and five future intentions regarding science and technology were also assessed. Change in level of confidence was measured with the following item, "Has camp changed your confidence in your ability to do science and technology?" (1 = *Less Confident*; 3 = *Same as Before Camp*; 5 = *More Confident*). Change in importance of science and technology was measured with the following item, "Has camp changed your feelings toward the importance of science and technology in your everyday life?" (1 = *More Negative*; 3 = *Same as Before Camp*; 5 = *More Positive*). For the first future intentions item, subjects were asked to rate their perceptions of whether camp participation would help them to do better in science at school next year on a scale from 1 = *No Change* to 5 = *Much Better*. For the remaining four future intentions items, subjects were asked if, because of camp, they would be more or less likely to: (a) take optional science courses in high school, (b) take optional computer science courses in high school, (c) study science or technology at university, and (d) consider a job in science or technology. The response format for these four items was 1 = *Less Likely*; 2 = *Same as Before Camp*; 3 = *A Little More Likely*; 4 = *More Likely*; 5 = *A Lot More Likely*.

Pre- and post-camp measures. Items assessing confidence, importance, intrinsic and utility values, and future intentions regarding optional high school science and computer science courses were included in both the pre- and post-camp survey. Confidence and importance were each measured by one item; for example, "Is science and technology important to your every day life?" Intrinsic and utility values were each measured by one item; for example, "How much do you like/enjoy science and technology?" The response format for these four items ranged from 1 = *Not at All* to 5 = *Very Much*. The two future intentions were each measured by one item; for example, "In high school, will you choose to take optional science classes?" (1 = *Not at All* to 5 = *Very Definitely*).

Procedure

Pre- and post-camp surveys were administered on the first and last days of the week-long camps by the camp counsellors. All camp counsellors received an information sheet to help them standardize the administration of the surveys, answer questions about the surveys, and deal with any issues regarding data entry.

Approximately 91% of campers completed the survey online using the Actua website, whereas the remainder of the subjects completed a paper form of the survey. The paper surveys were later entered by the camp counsellors using the same website. The data for all paper surveys were double checked by one member of the research team. The treatment of the participants was in accordance with the ethical standards of the Canadian Psychological Association.

RESULTS

To assess whether the number of campers who responded positively concerning their camp experience was significantly different from what would be expected by chance, eight chi-square analyses were performed: one on the camp experience item and one on each of the seven perceptions of change due to camp items. Subjects responding with a three or higher on the five-point scales for camp experience and future intentions were categorized as responding positively. For the confidence and importance items, for which the response format differed, subjects with a four or five were categorized as positive. To assess gender differences, eight one-way ANOVAs were performed on camp experience and the seven perceptions of change items. For the pre-post data, six 2×2 ANOVAs with one within-subjects variable were performed to assess pre-post and gender differences on confidence, values, and future intentions. The main effect of Pre-Post Camp and the interaction between Pre-Post Camp and Gender were tested using the multivariate criterion of Wilks' lambda (χ). Results significant at the .01 level are reported.

Camp Experience

The chi-square test performed on camp experience was significant, χ^2 (1, N = 871) = 714.72, $p < .001$, with 95% of campers rating the camp experience as positive. More specifically, 42% rated their experience as *Amazing* and 41% of campers rated it as *Very Good.* No gender differences were found.

Perceptions of Change Due to Camp

For all seven perceptions of change items, the chi-square analyses were significant. For confidence and importance, 66% of campers reported an increase in confidence following camp, χ^2 (1, N = 851) = 87.58, $p < .001$, and 64% of campers reported an increase in their perception of the importance of science, χ^2 (1, N = 863) = 69.55, $p < .001$. A high percentage of campers (80%) reported that camp would help them to do better in science next year, χ^2 (1, N = 864) = 312.96, $p < .001$. For the remaining future intentions items, 83% of campers reported being more likely to take optional high school science courses, χ^2 (1, N = 846) = 357.57, $p < .001$; 75% reported being more likely to take optional computer science courses in high school, χ^2 (1, N = 835) = 216.32, $p < .001$; 78% reported being more likely to consider taking science or technology in university, χ^2 (1, N = 842) = 271.36, $p < .001$; and 71% reported being more likely to consider a career in science or technology, χ^2 (1, N = 845) = 152.52, $p < .001$.

Significant gender differences on perceived change in intentions to take optional high school computer science were found, with male campers (M = 3.54) rating more change in their intentions than did female campers (M = 3.25), F (1, 833) = 11.42, $p < .01$. For the remaining six perceived change variables, no significant gender differences were found.

Pre- and Post-Camp Measures

Means and standard deviations for pre- and post-camp items are presented by gender in Table 1. Significant pre-post differences were found on confidence, χ = .95, F (1, 853) = 43.23, $p < .001$, χ^2 = .05; importance, χ = .96, F (1, 852) = 35.95, $p < .001$, χ^2 = .04; intrinsic value, χ = .99, F (1, 857) = 6.59, p = .01, χ^2 = .01; intention to take optional science courses in high school, χ = .99, F (1, 845) = 7.32, $p < .01$, χ^2 = .01; and intention to take optional computer science courses in high school, χ = .99, F (1, 848) = 10.78, p = .001, χ^2 = .01, with higher ratings for post-camp scores. No significant differences between pre- and post-camp scores were found for utility value. Significant gender differences were found on confidence, F (1, 853) = 31.86, $p < .001$, χ^2 = .04; intrinsic value, F (1, 857) = 27.19, $p < .001$, χ^2 = .03; and intention to take optional computer science courses in high school, F (1, 848) = 42.69, $p < .001$, χ^2 = .05, with male campers having higher scores than did female campers. No significant gender differences were found on importance, utility value, and intention to take optional high school science courses; no significant interactions were found.

TABLE 1
Means and Standard Deviations for Pre-Post Camp Confidence, Values, and Future Intentions by Gender

	Male		Female	
Variable	Pre	Post	Pre	Post
Confidence[ac]	3.86 (0.89)	4.02 (0.88)	3.50 (0.88)	3.75 (0.92)
Importance[a]	3.91 (1.01)	4.06 (0.96)	3.77 (1.01)	4.02 (0.99)
Intrinsic value[bc]	4.35 (0.81)	4.40 (0.81)	4.05 (0.89)	4.15 (0.89)
Utility value	4.46 (0.80)	4.45 (0.82)	4.38 (0.82)	4.41 (0.83)
Intention to take optional science courses[b]	3.87 (1.02)	3.96 (1.06)	3.70 (1.05)	3.81 (1.08)
Intention to take optional computer science courses[bc]	4.08 (0.99)	4.14 (1.03)	3.59 (1.11)	3.75 (1.12)

Note. *N*s range from 562 to 570 for males and 284 to 290 for females. Values in parentheses represent standard deviations.

[a] Variables with superscript have significant pre-post camp differences, $p < .001$.
[b] Variables with superscript have significant pre-post camp differences, $p = .01$.
[c] Variables with superscript have significant gender differences, $p < .001$.

DISCUSSION

Several important conclusions emerge from the present study. First, this science, engineering, and technology summer camp program with a hands-on, interactive approach was successful in providing a positive learning experience for both male and female campers. This result is similar to those reported in previous studies concerning science and engineering camps (Frize, 1998; Gilbride et al., 1999). Second, campers reported positive changes in their confidence, values, and future intentions regarding science and technology, as assessed both by perceptions of change data and by pre- and post-camp scores. Given that the summer camps were one week long, it is encouraging that significant changes were reported. We consider the positive quality of the camp experience to be the stimulus for these positive changes. The results provide empirical support at a national level for the effectiveness of science camps using a hands-on, interactive approach that directly relates science to young people's everyday lives. Our results also provide convergent validity for the relatively informal assessments and positive anecdotal evidence that have accumulated over the last two decades.

For the perceptions of change variables, high proportions of campers reported changes in confidence, importance, and future intentions, indicating that these summer science camps are meeting their mandate of promoting interest in and awareness of science. As hypothesized, there was a proximal-distal effect for future intentions, with higher proportions of campers reporting the perception of change for the more proximal intention of doing better in science next year (80%) and lower proportions of campers doing so for the more distal intention of considering a career in science and technology (71%). The results for the more distal career intentions indicate the need for further efforts to incorporate more occupational and career information directly into the camp experience.

For the stringent method of assessing change within a pre-post format, significant differences between pre- and post-camp scores were found on five of the six measures. In general, previous evaluations of summer science camps have relied either on campers' perceptions of change or on effects measured only at the end of camp. These types of data are susceptible to the possibility that the extent of reported change may be inflated. However, in the present study, the availability of pre-camp information allows us to assess whether there are actual quantitative differences between campers' pre- and post-camp scores. Stake and Mares (2001) have suggested that it is particularly difficult to obtain differences with pre-post measures. In their assessment of a high school science enrichment program, differences were not found with pre-post measures, whereas they were with perceptions of change measures. The fact that differences were found in the present study within a pre-post format provides strong support that the approach used in these summer science camps is making a difference.

Results concerning gender differences are consistent with the suggestion that females come to camp with somewhat less positive perceptions concerning science and technology than do males. Similar gender differences, favouring males, have been reported in related research in the areas of high school math (Eccles, Wigfield, & Schiefele, 1998) and computer science (Crombie et al., 2002). It is hypothesized that this occurs for many reasons, including a lack of female role models in science, engineering, and technology professions and a lesser tendency to engage in mechanically oriented hobbies (Zywno, Gilbride, Hiscocks, Waalen, & Kennedy, 1999). The hands-on, interactive approach used by the science camps may open-up new interests for female campers, whereas it may reaffirm prior positive experiences for male campers (Frize, 1998). Although females report the camp experience to be as positive as do males, and also report positive changes due to camp in several areas, females still leave camp with less positive perceptions in terms of confidence, intrinsic valuing of science, and intentions to take optional high school computer science. Furthermore, the fact that all interaction effects between gender and pre-post scores were not significant indicates that the relative position of male and female campers did not change due to the camp experience. These results indicate that continued efforts are needed to increase females' levels of confidence, values, and future intentions related to science and technology.

Limitations

Before discussing the implications of the current study, several limitations should be considered. First, the quality and quantity of the campers' prior experiences with science and technology before the start of camp were not assessed. It would be important to examine campers' prior experience, not only to ascertain if there are gender differences, but also to assess the representativeness of the males and females enrolling in science camps, which would increase confidence in the generalizability of results. Second, the use of measures without known reliability and validity is a limitation. However, the measures have been adapted from well-established measures concerning math and computer science for which there is strong evidence of reliability and validity (Crombie et al., 2002; Eccles & Wigfield, 1995). In addition, in the present study, for the four variables on which there are the two types of data, the results for perceptions of change measured at post-camp were similar to the significant differences found between pre- and post-camp scores. Thus, converging evidence for the validity of the perceptions of change and pre- post-camp measures is provided. Third, the lack of a follow-up evaluation leaves the question of the long term impact of the camp experience unanswered. Some of the positive results might be partially due to the immediacy of the positive experience of the camp and to the excitement and enthusiasm of other campers and instructors.

Directions for Future Research

Future research examining the long term impact of the camp experience on young people's enrollment choices in high school, college, and university will be important to determine if the summer camps have a lasting effect. In addition, researchers should investigate which types of campers are benefiting the most from the camp experience. For example, it is quite possible that youth who come to camp with high confidence and valuing of science will not report significant changes due to camp. The camp experience most likely results in a reaffirmation of their confidence and values (Frize, 1998). In contrast, campers who enter camp with low confidence and values are more likely to change due to a positive camp experience. It is important that we examine these group differences because a principal mandate of science camps is to encourage all young people, particularly those who traditionally have been underrepresented in the fields of science and technology, to enjoy and become involved in science.

Implications for Camp Instructors, Teachers, and Counsellors

The results of the present study have a number of implications for professionals. The results provide further indication that more emphasis should be placed on the distal future intention of considering a career in science, engineering, or technology. Actua instructors need to spend more time engaging campers in discussions about future career choices related to science, engineering, and technology. By extension, our results suggest that teachers and guidance counsellors should also pay particular attention to encouraging young people to consider a career in science, engineering, or technology. With respect to high school courses, our results indicate that the camp instructors were successful in encouraging campers to recognize the importance of taking optional science and computer science courses. These results suggest that this is an area in which encouragement by teachers and guidance counsellors would also be expected to have positive effects. This encouragement is critical in order to ensure students keep all doors open in their future post-secondary education.

Similar conclusions have been drawn by Zywno and colleagues (1999), who have suggested that a lack of knowledge and actual misperceptions about certain careers, such as engineering, are some of the key factors discouraging students from pursuing these careers. In particular, it is thought that these factors discourage females from pursuing engineering. Thus, an important goal for science camp instructors, as well as teachers, and guidance counsellors, is to provide young people with explicit and current information about the diversity of careers in science, technology, and engineering. This may require extra research by camp instructors, guidance counsellors, and teachers to increase their occupational knowledge base (Ciccocioppo et al., 2002), as well as the recruitment of guest speakers and mentors from industry to speak with students. The importance of incorporating career information directly into the classroom experience has also been noted for math (Meece, Wigfield, & Eccles, 1990) and computer science (Crombie, Long, Chetcuti, & Anderson, 1999). For example, in an observation of over 400 hours of classroom time, Eccles, Wigfield, Meece, Kaczala, and Jayarante (as cited in Meece et al., 1990) reported fewer than a dozen instances of teachers incorporating career information into math instruction. There is evidence from a number of sources that young people are not receiving enough information about careers in science and technology and therefore this area could be targeted by both in and out-of-school programs.

The results of the present study indicate that further efforts are needed to address the underrepresentation of females in science and technology. The lack of knowledge among most adults concerning careers in areas such as engineering is thought to be particularly detrimental for females because school is typically their primary source of information concerning careers in these fields (Zywno et al., 1999). A consistent finding in previous research (Clarke & Teague, 1996; Margolis, Fisher, & Miller, 1999) is that the perceived social relevance of an occupation is a critical factor in females' decisions to pursue careers in science and technology. Thus, science camp instructors, and by extension teachers and guidance counsellors, would benefit from understanding how females think about careers, as well as informing themselves about the social relevance of various careers in science and technology, and finding ways to emphasize the social relevance of these careers. Furthermore, although males and females change to a similar degree due to camp, the finding that females enter and leave camp with less positive perceptions suggests that existing training in gender sensitivity and a female-friendly approach (Ciccocioppo et al., 2002) needs to be continued with camp instructors.

One of the most important findings of the present study is the support for the approach that Actua instructors are currently using. Teachers and guidance counsellors may consider encouraging their students to participate in this type of summer science camp. Furthermore, this successful approach can be directly applied to the teaching of science and technology in schools. Presenting science in a hands-on, interactive way may be an important factor contributing to the increases in confidence and valuing of science and technology found in the present study. Science teachers may also consider making further efforts to relate explicitly the value of science to the lives of their students because using this approach appears to have been successful for camp instructors.

CONCLUSION

A strength of the present study is the relatively large sample size and the fact that campers represent a wide range of geographical locations across Canada and a variety of socioeconomic backgrounds due to the Actua policy of reaching out to underrepresented groups. The fact that pre-post differences were found under conditions in which campers were taught in different locations and by different instructors lends support to the generalizability of the results. Therefore, this study provides support for the conclusion that science camps, which use the general approach of engaging youth in hands-on, interactive activities in which science is connected to their everyday lives, may have an important influence on today's youth.

In summary, there is support for the conclusion that summer science and technology camps are meeting their mandate by providing important early positive experiences in science and by promoting positive changes in the confidence, values, and future intentions of campers. These positive changes for confidence and values on both the perceptions of change variables and on the pre-post camp scores represent an important step in encouraging students to keep their academic and career options open in the rapidly growing science and technology fields. Although positive changes were found for both males and females, continued efforts to interest females in science and technology are necessary in summer science camps because gender differences favouring males were maintained. Overall, the results of the present study provide some of the first quantitative evidence, on a national level, for the effectiveness of science and technology summer camps for today's youth and emphasize the value and importance of program evaluations.

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