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Abstract
In an effort to prepare youth for the 21st century workplace, 4-H has placed an emphasis in science and technology program areas. The purpose of the exploratory study reported here was to gather input via a mail survey from 4-H families concerning the development of new science and technology programs. The results of the survey were themed into six main areas: technology, agriculture, science, implementation ideas, self-efficacy, and miscellaneous. Moreover, the results of the survey indicated that new programs should be connected to traditional program areas especially agriculture.

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Introduction

The Internet, digitalization, and high-speed data networks have spawned the 3rd wave of globalization, the so-called globally integrated knowledge economy (Engardio, Bernstein, & Kripalani, 2003). The integrated knowledge economy permits high technology jobs like computer programming, engineering, and even corporate accounting to be outsourced to professionals in other countries for a fraction of the costs.

The new global integrated knowledge economy is a boom for developing nations as high technology jobs are being shifted from the United States and Europe to countries like China and India. The outsourcing of these jobs has been a wake-up call to the educational system in the United States.

Our youth need more than domain knowledge in subject areas; they need job skills that will allow them to compete in the integrated knowledge economy. To compete, youth need skills such as information and communication skills, thinking and problem-solving skills, and interpersonal and self-directed skills, such as the ability to retrain and lifelong learning. Combined, these skills are referred to as the "21st century job skills" (Partnership for 21st Century Skills, 2003). Nationally, 4-H has emphasized curriculum development in the areas of science and technology as a way to prepare youth for the 21st century workplace (The National 4-H Strategic Directions Team, 2001).

While 4-H develops projects to help youth develop 21st century workplace skills, it is important to receive input from stakeholders. The determination of priorities within the science and technology program areas by stakeholders, in this case, 4-H families, is important because it ties the program priorities back to what is needed by the community (Kelsey & Mariger, 2003).

Purpose

The purpose of the exploratory study reported here was to collect input from 4-H families pertaining to science and technology programs areas. As a follow-up to self-reported questions concerning the importance of science and technology development areas, a narrative type open-ended question was used at the end of a mail survey to elicit ideas and reactions from respondents.

Procedure

Population

A random sample of 1,414 families out of a total population of 13,516 Nebraska 4-H families with club members was selected from the 2004 4-H Plus database. Randomly selected families were sent the paper-based survey via US mail with a pre-paid return envelope. To inform selected families of the survey, a postcard was mailed approximately 2 weeks before the survey was mailed. Follow-up postcards were sent after 2, 4, and six weeks to participants who had not returned the survey. There were 498 surveys returned for a response rate of 35.2%. Of the 498 surveys, 56 respondents provided qualitative data.

Instrument

A survey was developed based on the U.S. Census Bureau's Computer and Internet Use in the United States: 2003 survey instrument. The survey consisted of 19 questions concerning technology 4-H families have in their home and how they utilize the technology. Questions 1 through 14 of the survey examined technology 4-H families currently have in their homes. Results for questions 1 through 14 will be reported in a subsequent article.

Questions 15 through 18 examined possible development areas in science and technology, while question 19 was an open-ended question asking respondents for specific program ideas. Using a Likert-type scale where 1 = not a priority and a 4 = high priority, questions 15 and 17 asked respondents to rank the priority of possible science and technology program areas. The possible science and technology program areas listed were meant to represent the broadest array of science and technology disciplines. For example, question 15 asked respondents about possible technology areas such as basic computing, Web site development and robotics (Table 1).

Table 1.
Survey question 15, Possible Technology Development Areas

Area Number	**Possible Development Area**	**How much priority, if any, should each development area have? (Please circle your answer.)**			
1	Basic computer knowledge	NOT	LOW	MEDIUM	HIGH
2	Developing Web sites for the Internet	NOT	LOW	MEDIUM	HIGH
3	Office application (word processing, spreadsheets, databases)	NOT	LOW	MEDIUM	HIGH
4	Graphic arts	NOT	LOW	MEDIUM	HIGH
5	Digital movie creation	NOT	LOW	MEDIUM	HIGH
6	Computer programming	NOT	LOW	MEDIUM	HIGH
7	Computer Networking	NOT	LOW	MEDIUM	HIGH
8	GIS/GPS	NOT	LOW	MEDIUM	HIGH
9	Robotics	NOT	LOW	MEDIUM	HIGH
	Are there any others? (Please list)				
10		NOT	LOW	MEDIUM	HIGH
11		NOT	LOW	MEDIUM	HIGH

Question 16 asked respondents to rank the three most important areas by entering the area number found in the first column of question 15 next to the following three statements: most important, second most important and third most important (Table 2).

Table 2.
Survey question 16, Respondents Were Asked to Rank the Top Three Important Technology Areas by Entering the Area Number from Table 1

___Most important	**___Second most important**	**___Third most important**

Questions 17 asked respondents to the rank the importance of possible science development areas

and was formatted in the same manner as question 15 (Table 1). Question 18 asked respondents to rank the three most important science development areas.

To gain insight toward responses to questions 15 and 17, the final question of the survey was a narrative type open-ended question formatted as follows: "In the space provided below, please list specific science and technology program ideas you have for Nebraska 4-H." Below the question was a blank text box about three-quarters the size of the page.

Content Validity and Reliability

Because a majority of survey was derived from the U.S. Census survey used in 2003, the questions have been pre-tested and reviewed by experts and therefore are deemed to be valid. The results of a Cronbach's alpha test for homogeneity revealed a very high standardized alpha coefficient (r=.96). The high reliability coefficient indicates that the test halves are highly correlated and the questionnaire has high internal consistency.

Results

Science and Technology Priority Areas

The science interest areas with the highest rankings were environmental sciences (M = 3.44), botany (M = 3.42), and zoology (M = 3.33). Physics (M = 2.77), biochemistry (M = 2.93) and engineering (M =3.06) received the lowest rankings.

Table 3.
Science Priority Areas

		Biochemistry[1]	Botany[2]	Chemistry[3]	Earth and Space Sciences[4]	Engineering[5]	Environmental Sciences	Physics[6]	Zoology[7]
Total	M	2.93	3.42	3.14	3.16	3.06	3.44	2.77	3.33
	n	442	449	448	447	450	448	447	447
	SD	.775	.629	.697	.690	.769	.683	.764	.696

[1] (Molecular biology, photosynthesis, food chemistry)
[2] (Agronomy, horticulture, forestry, plant taxonomy, plant physiology)
[3] (Physical chemistry, organic chemistry pesticides, soil chemistry)
[4] (Geology, meteorology, geography, topography, mineralogy, archaeology)
[5] (Civil, mechanical, aeronautical, electrical, bioengineering, lasers)
[6] (Solid state, optics, acoustics, fluid and gas dynamics)
[7] (Animal genetics, entomology, animal ecology, anatomy, paleontology)

Survey respondents indicated that basic computer knowledge (M = 3.47), office applications (M = 3.42) and graphic arts (M = 2.99) were the highest priority areas. Conversely, programs in robotics (M = 2.36), GIS/GPS (M = 2.56) and digital movie creation (M = 2.64) received the lowest priority rankings.

Table 4.
Technology Priority Areas

		Basic Computer Knowledge	Web Sites	Office Application	Graphic Arts	Digital Movie Creation	Computer programming	Network	GIS/GPS	Robots
Total	M	3.47	2.78	3.42	2.99	2.64	2.74	2.73	2.56	2.36
	n	465	468	467	465	466	464	460	416	434
	SD	.809	.800	.732	.731	.824	.856	.855	.865	.829

Cluster of Common Themes

The responses to the science and technology program ideas were broken down into clusters of common themes (Creswell, 1998). The six common themes that emerged from the data were: technology-related program ideas, ideas centered on agriculture, science ideas, implementation themes, issues dealing with self-perceived efficacy, and an "other" theme comprised of ideas that did not fit into the aforementioned themes.

Theme 1: Technology

The technology theme was further divided into sub-themes related to Web-based technologies, digital arts, and an "other" category. A majority of responses dealt with technology related programs. The Web-related responses included items like Web page design, Web publishing software training, and Internet safety. The digital arts area had responses centered on working with digital cameras and associated software. Finally, the other technology theme that emerged had items like global positioning systems (GPS) and global information systems (GIS), basic computer skills, robotics, and to have more computer-based forms. The list of technology related themes are as follows.

1. Web Related

a. Design family Web page.

b. Front Page/Web Design. Animal health care, Vet 101.

c. Publisher training, to design club brochure to recruit members.

d. Web page development knowledge is important. Maintaining a server would be a valuable skill.

e. Interactive 4-H Websites with games for learning.

f. Internet safety.

2. Digital Arts

a. Digital camera, computer programming, computer graphics, spreadsheets, a class dealing with pollution, engineering.

b. Power point presentations-"how to presentations."

c. Make a movie about anything pertaining to science!

d. Digital photography.

e. Power point programs on 4-H related topics.

f. I would like to see a graphic artist category. I would like to see money management, budgeting saving, and business establishment.

g. I would really like emphasis on digital photography/Photoshop etc.

3. Other

a. Wildlife handling and tracking using transmitters and GPS equipment. Mapping areas with GPS/GIS technology.

b. GPS, elementary chemistry, genetics, palm pilots, digital picture storage.

c. You could develop a science fair of some sort or computer project where kids could bring CD's or DVD's they've made.

d. I don't know if this idea fits, but as a parent I would like CD-ROMs or something like that to use as project guides, record keeping, etc., for the computer. Something user friendly.

e. Basic computer skills, power point presentations, databases and spreadsheets.

f. Design and create robotic projects on computer. Design blueprints on computer and create architectural models. Landscaping design for specific areas including construction and maintenance of water features.

g. 4-H just needs to be updated into the technology field. All youth need computer access at school, home, or extension office.

h. More computer based forms, manuals, etc.

i. Robot building technologies. Mechanical Engineering.

Theme 2: Agriculture

Another theme that emerged from the responses dealt with ideas related to agriculture. These responses recommended the development in areas closely related to farming and farm economics, traditional 4-H focused areas. Central to the agriculture themes were items like the economics of farming, conservation and environmental concerns, food production, and biotechnology. The list of

agriculture related themes are as follows.

1. Develop ways for agriculture to become more environmentally friendly: organic farming, seasonally friendly, cow calf operation, use of wind, solar power, and other renewable resources.

2. I think they should research better and more economical ways to grow food

3. How to make money composting. Value added agriculture products.

4. Chemical & effects they have on environment, possible other options for gardening. Use of computer to keep records of expenses and possible how to keep good records of loss and gain.

5. 4-H should foster the basic values that Agriculture has given to the programs in the past.

6. Biotechnology-related to agriculture--cloning and splicing.

7. Veterinary--increasing farm technology/efficiency (inventions for easier work).

8. My daughter is a Clover Kid. I think it would be fun to have a gardening project for that age group. I also think a project that studied the stars and constellations would be a fun learning experience.

9. Earth and animal sciences should rank at the top.

10. Some sort of agriculture related engineering program to develop new ideas for ag-related business.

11. Plant diseases-home owner's yard & houseplants, turf grass, crops, range land; animal health & genetics.

12. Study the aquifer and what we can do to preserve it. Groundwater Foundation is an excellent source and has excellent educational sites.

13. Forensic science, plant tissue culture.

14. Developing a food science project area that encourages students to get involved in food development and product quality.

Theme 3: Science

Science was another theme area that focused on areas such as renewable energy, archeology, paleontology, and the scientific methods. In addition, the science theme contains two responses that agreed with the concept of expanding 4-H programs into areas of science. The list of science related themes are as follows.

1. Home automation technologies. Alternative energy sources/fuels: ethanol, hydrogen, wind, solar. Basic genetics.

2. Alternative fuel sources.

3. Science project/experiment w/ back drop and report- scientific method 2. Machine project-project uses 3 or more simple machines to move a marble 4. Project display w/ written report and visuals 5. Energy alternatives -projects that use some wind.

4. Archeology, paleontology.

5. I think you've done a good job covering areas especially the science areas. I think it is wonderful that 4-H wants to expand the sciences.

6. I can't think of anything at this time, but I do believe you are doing a great job in introducing the newest technological advances as they become available to our youth through 4-H. Keep up the good work!

Theme 4: Implementation

The implementation theme emerged from participants who wanted to share ideas on how to implement science and technology programs. The list of implementation related themes are as follows.

1. Schools are most efficient way to teach basic computer and applications to youth. Consider including computer applications to current projects such as was done with the new quilt project.

2. I think that these programs would be wonderful for the older 4-H youth who are in the process of streamlining their choices of careers in the future. You would also have to train leaders in theses fields.

3. Exploration of careers in the sciences as listed on Q18. Why not start experience/knowledge in those areas during middle school/HS years?

4. We feel 4-H would be justified in computerizing on-line entries for 4-Hers, also holding more labs for children 8-12 to get them started.

5. If 4-H is going to have a computer/technology category in the presentations contest, make sure local or state 4-H can provide equipment for the contestants to use at state level contest.

Theme 5: Efficacy

Another common theme that emerged was that respondents held beliefs that they did not know much about technology and science. The list of efficacy related themes are as follows.

1. I'm not very computer literate. I think it is great for 4-H to be thinking about how to get more computer involvement in 4-H.

2. I'm really not well versed enough to understand all the applications and ramifications computers can have on own programs.

3. I'm sorry I have no ideas for you. The students are so far ahead of my experiences.

4. Wish I could help you. This is beyond my scope of ability.

5. I'm sure the areas listed would challenge many 4-H leaders; therefore, leader materials would need to be well written.

Theme 6: Other

There were some responses in the survey that did not fit into the previous five common themes. These responses were put into a theme called "other." The list of "other" related themes are as follows:

1. A lot of things mentioned are exciting to learn about. The biggest thing is what the child is interested in.

2. No longer in 4-H.

3. Nutrition, physical activity, disease prevention I have no specific ideas for science.

4. Area is too in-depth for 4-H development.

5. Those listed seem fitting for a FFA program rather than 4-H.

Discussion

The exploratory study reported here examined Nebraska 4-H families' program ideas and reactions survey respondents shared concerning 4-H science and technology program areas. While the overall survey response rate was 35.2%, the response rate to the final open-ended question was 3.9%. The low response rate indicates that the results of the open-ended question may not be generalized to the population of 4-H families in Nebraska. However, the exploratory nature of the survey question permits the formulation of possible program ideas and barriers to science and technology programs in 4-H.

The results of the survey revealed six clusters of common themes among 4-H families' responses to an open-ended survey question. The questions asked respondents to provide specific science and technology programming ideas. The findings indicated that 4-H households in Nebraska are interested in technology programs. The technology themes emerged including Web-based projects; digital arts, including PowerPoint presentations; and an "other" theme. A majority of respondents had ideas about technology programs, including digital arts and GPS/GIS technology. Although the ideas varied, there was the consensus that 4-H should offer programs in this area.

However, the open-ended question also led to additional insights as respondents provided more than program ideas. Herein lies the usefulness of using an open-ended question. For example, many respondents wanted science and technology programming to be linked to agriculture. A central theme in this category was to support agriculture through scientific innovation. In addition, respondents indicated that the economics of farms operations can be improved by new crops, new farming methods, and the use of technology.

Moreover, the survey question revealed that not all respondents are enthusiastic about adding new science and technology programs areas into 4-H. For example, one respondent indicated that 4-H should "foster basic values that Agriculture has given to the programs in the past." Although somewhat vague, the statement could be interpreted to mean that respondent is worried that 4-H programs in science and technology emphasize different values.

Statements from the "other" theme indicated that 4-H may not be the place to teach about technology and science. One respondent felt that the program areas were too in-depth and were not suitable for 4-H involvement. Another respondent indicated that the areas were more suitable for FFA. One respondent from the implementation theme suggested that schools are an appropriate place to teach basic computer applications. Again the statement is vague but indicates that 4-H clubs may not be the most appropriate place to teach basic computer skills. As these responses indicate, stakeholder and program leaders should be cognizant of stakeholders who have reservations about new program areas or think 4-H is not a suitable dissemination platform for the subject areas.

In addition, many respondents reported low self-efficacy and indicated that they do not possess the ability to perform tasks with the technology or science domain. Interestingly enough, their efficacy was low enough that they felt they could not offer program ideas. Statements included: "I'm not very computer literate." "I think it is great for 4-H to be thinking about how to get more computer involvement in 4-H." "I'm really not well versed enough to understand all the applications and ramifications computers can have on own programs." "I'm sorry I have no ideas for you." "The students are so far ahead of my experiences." "Wish I could help you." "This is beyond my scope of ability."

At least one respondent with low self-efficacy indicated approval for programs centered on technology; ". . . it is great for 4-H to be thinking about how to get more computer involvement." Moreover, one respondent may have been projecting his or her low self-efficacy towards other 4-H leaders and volunteers with a statement indicating that the program areas would be challenging to leaders and thus recommending well-written materials.

Conclusion

The survey revealed six common themes among respondents (technology related, agricultural, science, implementation ideas, self-efficacy, and other). In addition, respondents indicated that agricultural economics as it related to science and technology is important to many respondents. Moreover, the survey revealed that some 4-H families were concerned about implementing science and technology programs within 4-H. Finally, some respondents remarked that they could not provide ideas because of their limited knowledge of the domains.

Although the response rate for the open-ended question was low and the results are localized to Nebraska 4-H families, the results of the survey identified potential barriers that should be addressed with the rollout of a national 4-H science and technology program emphasis. Primarily it would seem that new programs should tie in with traditional 4-H program areas and emphasize the economics of technology and technology adaptation and deployment. Furthermore, 4-H families

need to be reassured that they have or will receive adequate training to lead clubs in science and technology programming. Finally, because not all 4-H families are supportive of new science and technology areas, 4-H should explore ways to address this potential challenge.

Additional research is needed to identify other potential barriers and clarify the magnitude of issues revealed in the study reported here. The study could be replicated in other states using a similar format with a mix of Likert-type and open-ended questions.

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