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Informal Science Engagement via Extension Exhibits: A Pilot Evaluation of Adult State Fairgoers' Experiences, Attitudes, and Learning at Raising Nebraska

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Informal Science Engagement via Extension Exhibits: A Pilot Evaluation of Adult State Fairgoers' Experiences, Attitudes, and Learning at Raising Nebraska

Abstract

Science communication and informal science education collide in the context of Extension state fair exhibits for engaging public audiences in critical agricultural and natural resource issues impacting people's daily lives. A need exists to employ systematic communication and education theory and techniques to effectively deliver scientific information in informal learning spaces. In an effort to apply and expand systematic instructional design thinking and research in informal science learning, this study piloted a touchscreen iPad survey evaluation (n= 93; ages 19-66) of adult state fairgoers' demographics, experiences, attitudes, and learning during their visit to a 25,000 square-foot facility featuring an Extension museum-quality exhibit at the Nebraska State Fair in 2016. The exhibit included content such as farmers' and ranchers' stories, food security, soil quality, and water flow via natural landscapes and irrigation. Survey results included fairgoers' demographics and backgrounds, as well as insights into favorite exhibit features, attitudes toward agricultural and environmental issues, and exhibit experience and attitude differences between visitors with agricultural backgrounds versus non-agricultural backgrounds. Results showed respondents were predominantly Caucasian with ties to agriculture, preferred physical and electronic engagement pieces of the exhibit compared to static text panels, and expressed slight changes in attitudes about agriculture with larger shifts in attitudes about the role of science in agriculture. Recommendations include systematically developing Extension informal learning efforts and exhibits such as the one in this study by conducting needs assessments and evaluations, as well as expanding exhibit locations, access, and topics to reach more diverse demographics.

Keywords

Extension, exhibits, engagement, state fair, informal learning, science, attitude change

Cover Page Footnote/Acknowledgements

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Introduction

The land grant university mission emphasizes the importance of researchers and educators sharing science-based information with a diversity of audiences using a variety of platforms for public learning, decision-making, engagement, behavior change, and overall lifestyle improvement (Colasanti, et al., 2009; Kellogg Commission, 2000; Spanier, 1999). While much attention is paid to online spaces such as websites, social media, and blogs in the current Information Age, an opportunity still exists to interface with public audiences in person via immersive and interactive informal learning experiences such as museum-quality exhibits at state fairs (Kirby, et al., 1995; Tucker et al., 2011; Rollins & Watson, 2017). Specifically, adult learners continue to engage in self-determined lifelong learning activities such as reading periodicals, visiting in-person learning environments, and participating in distance education via mobile devices to further their understanding of scientific topics to grow their knowledge and engage in their communities (Falk & Dierking, 2002; Merriam, 2001; Sharples, 2000). Extension services have an opportunity to engage adult learners in lifelong learning via state fairs and exhibits. However, there is a lack of published research in the areas of agricultural education, agricultural communication, and Extension about strategic efforts to employ systematic instructional design and assessment of these informal learning spaces. In an effort to add to the body of knowledge about science communication, informal science education, and Extension, this study assessed an elaborate museum-quality exhibit developed and operated year-round by Nebraska Extension on the state's fairgrounds. The authors surveyed adult state fairgoers about their experiences, content perceptions, and potential attitude change as a result of visiting the exhibit.

Literature Review

Informal Science Education and Communication

According to the National Research Council (NRC, 2009), many learners constantly pursue gaining scientific knowledge to improve their understanding of the world. The NRC categorized informal science learning as present primarily in three venues: 1) everyday activities such as reading newspapers, playing games, conversations, etc., 2) locations such as zoos, museums, national parks, and science centers, and 3) programs such as 4-H, after-school clubs, girl/boy scouts, etc. Informal science learning is often said to happen outside the classroom in planned programs and places (NRC, 2010). The National Academy of Sciences (NAS) pointed out that schools are often expected to teach science 'facts', while citizens often learn about the process of science through informal experiences (Fenichel & Schweingruber, 2010). NAS reported it is imperative that members of society work together, not solely through schools, to develop scientifically literate citizens. The Kellogg Commission on the Future and State of Land Grant Universities (1999) called for institutions to support a 'learning society' through programs and technologies targeted at lifelong learning for continued effective public education.

Falk and Dierking (2002) coined the term 'free-choice learning' to describe learning not mandated as part of a curriculum or specific set of standards. Rather, this learning occurs out of the public's free-will choice and genuine desire to learn about a new topic during free time in their busy lives. Falk, Storksdieck, and Dierking (2007) defined free-choice learning as "learning that individuals engage in throughout their lives when they have the opportunity to choose what, where, when and with whom to learn" (p. 456). Falk suggested free-choice learning is intrinsically motivated by each learner's interests and goals and impacts public understanding of science and citizens' identities and involvement within society. Falk, et al. conducted a random phone survey

of adult residents in California (n=1007) and found most participants had an interest in science and expressed a moderate 'knowledge of science and technology' (p. 459). The survey also showed that while adults attributed their science learning to school classes or courses, they also acknowledged life experiences, multimedia, books, museums, and family or friends informed much of their science understanding.

In the fields of agricultural education and communication, Extension has a rich history of implementing and researching informal science learning experiences with a variety of public groups. Some settings include agricultural and environmental field days (Ober, Giuliano, Sheftall, Byrne, & Dillard, 2012; Presternon, 1986), youth programs outside of typical PK-12 classrooms (Barker, Larson & Krehbiel, 2014; Hendrix & Williamson, 2017), and agricultural producer workshops (Falconer & Parker, 2001; Luck, Fulton & Rees, 2015). While there is a dearth of literature examining several Extension informal learning contexts, research is lacking when it comes to state fair and exhibit specific informal learning implementation and evaluation.

State Fair Contexts for Science Learning, Engagement, and Attitude Change

State fairs became popular across the Midwest in the nineteenth century and served as places for farmers and ranchers to gather and share ideas and advances in agriculture (Rasmussen, 2015). Fairs have also grown as places to display and exhibit yearly achievements from 4-H and other Extension programs, as well as share agricultural scientific findings and technological advances. Amusement is also a center point of most fairs with rides, games, and food as expected components. Rasmussen (2015) pointed out state fairs also highlight Midwestern cultural shifts and advancements and offer an opportunity for citizens, who may be removed from agriculture, to learn about livestock, crop production, and more via spaces such as livestock barns and exhibits.

While state fairs are often described as a time for fun, socializing, and 4-H exhibitions, a growing need and opportunity exist to reframe thinking about the potential of these large-scale annual events through the lens of informal, free-choice science education and learning. In a commentary, Nicholson (2011) called upon Extension to re-examine its role and research of youth learning experiences in state, county, and local fairs, and challenged Extension to develop long-term goals for fair programming purpose and evaluation. While many fairs are centered on 4-H youth experiences, some Extension services have identified fairs as opportunities to develop programming not only for youth participants, but also to engage broader public audiences in informal learning about critical agricultural and environmental issues.

Much of the documented development and research of educational Extension exhibits at state fairs comes from the 1990s. Oklahoma State University developed and conducted research using an interactive exhibit called 'Caring for Planet Earth' where state fairgoers learned about "ozone depletion, water quality, pesticides, forestry practices, and wildlife management" (Kirby, Chambers, & Cuperus, 1995). An 'Active Learning Center' developed at the Iowa State Fair paired older 4-H participants with youth fair visitors to help them learn about a variety of topics such as animals, nutrition, and communications (Gamon & Primmer, 1995). More recently, Tucker, Bricker, and Huerta (2011) outlined their evaluation approach for an Extension state fair educational exhibit about nanotechnology, and highlighted that most exhibit research has been conducted by museums and science centers. A tremendous opportunity exists to grow museum-quality exhibit research in the agricultural education, science communication, and Extension disciplines.

The Purdue University Exhibit Design Center focuses on developing mobile science education exhibits for state fair, science museum, and school venues for informal public learning

(Rollins & Watson, 2017). Designers at the center used a systematic instructional design approach and created an interactive multimedia-rich exhibit about the hellbender salamander, investigating the exhibit's impact on fairgoers' (n= 409) attitudes about the salamander. The researchers found 81% reported enjoying the exhibit and 73% felt "more connected to the hellbenders and the environment as a result of this visit" (Rollins & Watson, 2017, p. 4). Rollins and Watson's study is foundational in that it connects informal science education via Extension-related exhibits with intentional instructional design and attitudinal change theory.

Attitudes help individuals organize their social worlds, shape perceptions, and influence judgments. According to Perloff (2014), attitudes are "learned, global evaluation[s] of an object (person, place or issue) that influence thought and action" that we acquire over a period in childhood where we begin to understand societal norms (p. 71). Sherif (1967) noted "when we talk about attitudes, we are talking about what a person has learned in the process of becoming a member of…a group, and of a society that makes him react to his social world in a consistent and characteristic way" (p. 2).

The National Research Council noted "a range of outcomes are used to characterize what participants learn about science in informal environments…usually described as particular types of knowledge, skills, attitudes, feelings, and behaviors" (NRC, 2009, p. 58). Consequently, learning about science in an informal context such as a state fair exhibit means attendees form attitudes about topics in the exhibit. Attitudes can include positive or negative evaluations and can be affected by stimuli such as persuasive messaging and imagery. Attitudinal learning and change are comprised of three components: affective (emotion), cognitive (knowledge), and behavioral (lifestyle choices/activities) (Kamradt & Kamradt, 1999; Simonson & Mushak, 2001). Museum and other informal science learning exhibits have the potential to impact visitors' emotions, knowledge, and lifestyle choices connected to their attitudinal evaluations of the material and their learning experiences related to the exhibits.

Instructional Design Approach

Instructional design (ID) is a "creative, active, and iterative" process for thoughtfully and systematically developing education following a series of steps such as identifying target learners, their prior knowledge, learning objectives, methods and tools for delivering content, and assessment of content learning, experiences, and attitudes (Gustafson & Branch, 2007, p. 11). Through ID processes, teams of educators, developers, and designers align learners' goals, learning objectives, content, and evaluations to implement and revise learning experiences from start to finish (Gustafson & Branch, 2007). ID models such as ADDIE (analysis, design, development, implementation, and evaluation) are utilized for creating, testing, and revising intentional learning efforts (Gustafson & Branch, 2007).

In the context of Extension, there is an opportunity to employ and research systematic instructional design to effectively create public informal science engagement for increasing science literacy about agricultural and environmental content. Falk, et al. (2007) recommended informal science education efforts should first focus on understanding the public's existing knowledge of science in order to better tailor content and educational experiences to support adults' science learning interests and goals. Extension services could heed Falk et al.'s suggestions to develop needs assessments and evaluations to successfully develop content based on adult learners' prior knowledge and motivation for engaging with various science disciplines and concepts impacting their lives.

Field days appear to be an informal Extension learning context with a depth of intentional instructional design related research. For instance, Comtio, Case Haub, and Stevenson (2017) identified a "field day success loop" with a systematic process for analyzing impacts on farmers' learning, confidence, and conservation adoption. Shepard (2001) described the need to design intentional questionnaires to assess field days and outlined best practices for evaluations such as allowing enough time in the field for survey completion, simplifying questions and appearance of the survey, avoiding bias, and providing incentives for survey completion.

Including the aforementioned field days, there is a need to expand and apply systematic ID approaches in multiple agricultural and environmental informal science education settings for developing effective learner-centered experiences with the potential to impact attitudes, learning, and behavior. For this reason, the ID field and processes served as a grounding for the following research. Researchers stepped into the evaluation phase of the ADDIE model to examine the impacts of an ongoing informal agricultural education state fair museum-quality exhibit on adult participants' perceptions of the exhibit and potential attitude change.

Methods

Research Objectives, Procedures, and Participants

The purpose of this project was to explore and document the experiences, learning, and attitude change of adult visitors at the *Raising Nebraska* exhibit, as well as inform future design changes of the exhibit. More specifically, the objectives were to:

1. Determine demographics of the visitors
2. Evaluate visitors' exhibit experiences and learning
3. Document and compare visitors' attitudes about key exhibit topics before and after visiting the exhibit
4. Determine differences in visitors' experiences and responses by their relationships to agriculture

Raising Nebraska Exhibit Context

The 25,000 square-foot *Raising Nebraska* exhibit opened at the state fairgrounds in 2014. The interactive exhibit showcases how farmers and ranchers in the state take steps to protect the environment while growing food, feed, fuel, and fiber products that are shipped around the globe. Its ultimate goal is to help visitors better understand and appreciate the advancements, impact, and global leadership role of Nebraska's agriculture. The exhibit contained several interactive experiences designed to educate visitors about conservation efforts, food production, land elevation, nutrition, uses of corn and soybeans, irrigation, satellites, aquifers, livestock production, and agricultural commodities. Exhibit features included a walkable map of Nebraska, the agri-house, build your meal table, control the flow pivot and game, beef production model, grain bin theater, presentation kitchen, corn harvest, biofuels exhibit, reading rails, "trusted voices" video kiosks, milking machine, interactive grocery coolers, and an outdoor planted landscape featuring the state's commodities. Major exhibit themes included: 1) making choices, 2) family farmers and ranchers, and 3) producing more with less.

Figure 1. *Raising Nebraska* exhibit context.

Data Collection and Analysis

Researchers in museum exhibit and informal science education have noted the traditional assessment procedures such as testing and other practices used commonly in schools and work environments often do not fit the complexity of informal settings, where learners often have their own motivations, goals, pre-conceived notions, and self-navigate their learning and engagement which is not defined by a set of standardized expectations or outcomes. That National Research Council (2009) pointed out it is "impractical, disruptive, and at times, impossible" to administer tests in informal learning settings, as it is unethical to isolate or control participants' learning experiences (p. 56). Additionally, informal learning opportunities often provide leisure experiences, requiring researchers to adapt learning measures to participants' expectations so the setting and events do not feel excessively controlling or critical (judgmental), which can stifle both participation in the event and learning (Shute, 2008; Steele, 1997).

Self-report studies based on questionnaires and structured interviews are appropriate to target attitudes among visitors to informal science exhibits (NRC, 2009). Another form of measuring exhibit effectiveness is the direct or indirect observation or reporting of visitors' time spent with specific exhibit features (Sanford, 2010). Visitors have been described as being engaged when they spend a range of 30 seconds to a minute with specific exhibit content, with those very interested engaged for two to three minutes (Falk, 1982). The "holding power" of an exhibit is then the amount of time a visitor spends at a feature divided by the true time it takes to read text or interact with the hands-on activities (Peart, 1984). Taking these potential exhibit measurement approaches into account, this study utilized self-reported visitor surveys to build upon efforts to examine connections among adult learners' experiences, learning, and attitudes and Extension informal science education efforts via exhibits focused on the state fair tradition of disseminating university-based research and content to public audiences.

Data were collected during the 2016 Nebraska State Fair, which began August 26, 2016 and ended on September 5, 2016. Survey items were developed in collaboration with the university's Bureau of Sociological Research (BOSR), and University of Nebraska-Lincoln

Institutional Review Board approval was obtained prior to data collection. All survey items were in English and administered via iPads, and participants spent an average of approximately 15-20 minutes completing the survey (Figure 2).

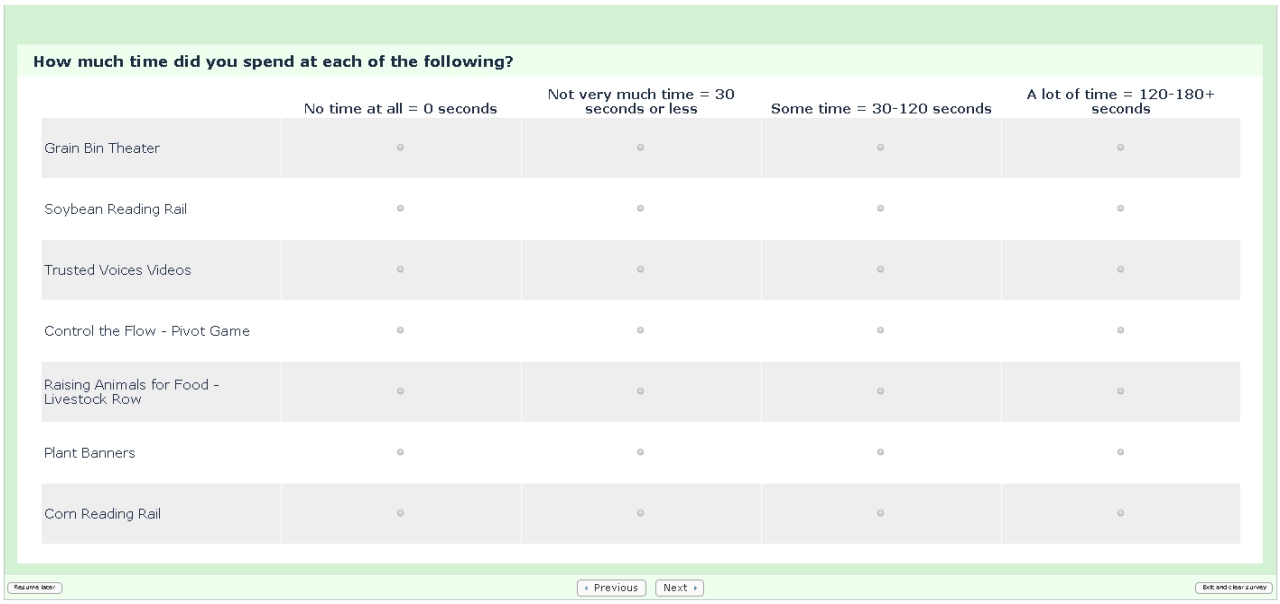

Figure 2. Screen capture of an iPad survey section.

Two researchers at a time spent four hours during five of the high traffic fair days to collect survey responses. Researchers approached every fifth visitor to *Raising Nebraska* to complete the survey. Participants were not incentivized. Data were analyzed in SPSS and frequencies, means, and cross tabulations were calculated. Significant differences by relationship to agriculture ('agricultural industry' and 'consumer only') were calculated using Chi-square testing. Results are considered significantly different if p value is less than .05 ($p<.05$).

Results

Objective 1: Respondent Demographics

During the two-week fair, a total of 93 adults completed the survey. Respondents were 35.4% male and 64.6% female, and tended to be a bit older with 30.4% 19-35 years-old, 16.5% 36-50 years old, 22.8% 51-65 years old and 30.4% 66 years and older. The vast majority lived in Nebraska (82.8%) and reported not being Hispanic or Latino/a (97.4%). All (100.0%) respondents listed their race as white. When asked about education, 48.1% reported having a Bachelor's Degree or higher. Half (50.0%) of respondents reported identifying as a farmer or rancher, while one-third (33.8%) reported being a member of the agricultural industry. Over one-third (39.7%) of respondents identified as consumers only (not involved in the agricultural industry).

Objective 2: Exhibit Experiences and Learning (Survey)

A majority of the survey items asked respondents about their experiences at the *Raising Nebraska* exhibit. Figure 3 shows roughly three out of four respondents reported enjoying the interactive map (74.4%) and outdoor living area activities (70.9%) very much. Videos were enjoyed very much (51.2%) or somewhat (45.1%) by almost all respondents. Similarly, the process of reading

text banners was liked very much by 44.0% and somewhat liked by 51.2% of respondents. Exhibit games were liked least among the learning activities, with almost 15% reporting not liking the games very much or at all.

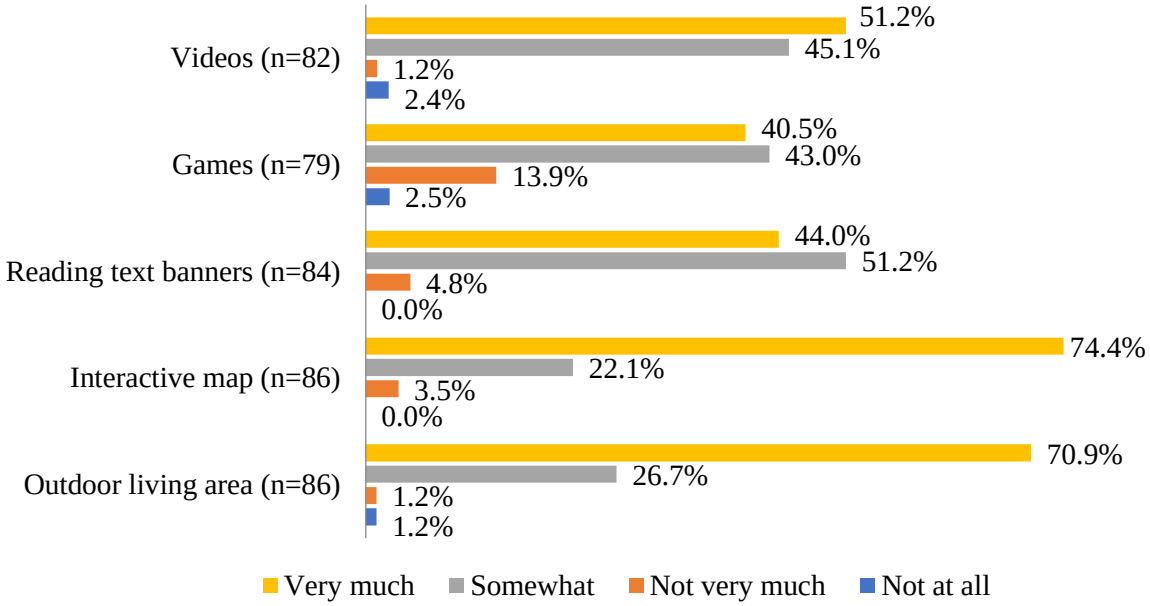

Figure 3. Percentage of how much respondents enjoyed each of the learning activities.

Figure 4. 74.4% of visitors very much enjoyed the interactive walkable map.

Respondents were asked how much time they spent at each area of the exhibit. The Raising Animals for Food-Livestock Row (34.9%), the Nebraska Walkable Map (46.0%) (Figure 4), and the outdoor living area (43.4%) are where a third or more of respondents reported spending a lot of time compared to the other areas asked about.

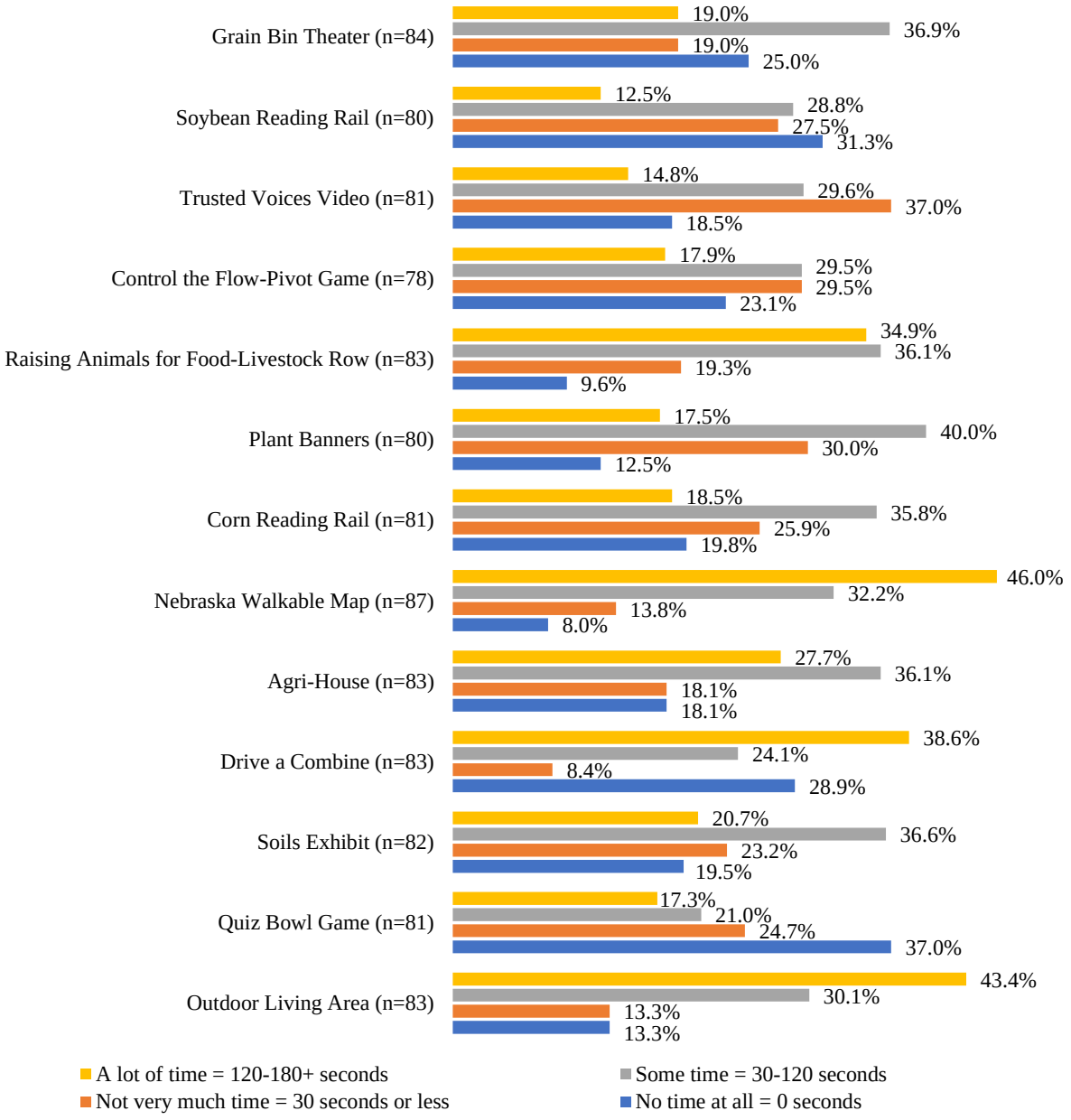

Figure 5. Percentage of time respondents spent in each area.

Most respondents reported learning some new information about Nebraska agriculture through the *Raising Nebraska* exhibit. A quarter (25.8%) reported learning a lot of new information while half (50.6%) reported learning some new information, and another quarter (22.5%) learning a little new information. When asked about the exhibit's credibility, 84.3% of respondents reported believing the exhibit very credible, 13.5% viewing it as somewhat credible, and 2.2% perceiving it a little credible.

Most respondents felt confident in expressing their opinions about Nebraska agriculture in (21.2% strongly agree, 55.8% agree) and outside (21.2% strongly agree, 51.8% agree) of the

exhibit (Figure 3). This question was intended to explore respondents' confidence in sharing, discussing, and/or stating their views on thoughts about the state's agriculture broadly. About half either strongly agreed (10.9%) or agreed (43.5%) with the statement "I considered different opinions related to Nebraska agriculture." The exhibit did change some opinions of Nebraska agriculture with 18.2% and 2.3% of respondents reporting they disagreed or strongly disagreed with the statement "The exhibit did not change my opinion of Nebraska agriculture."

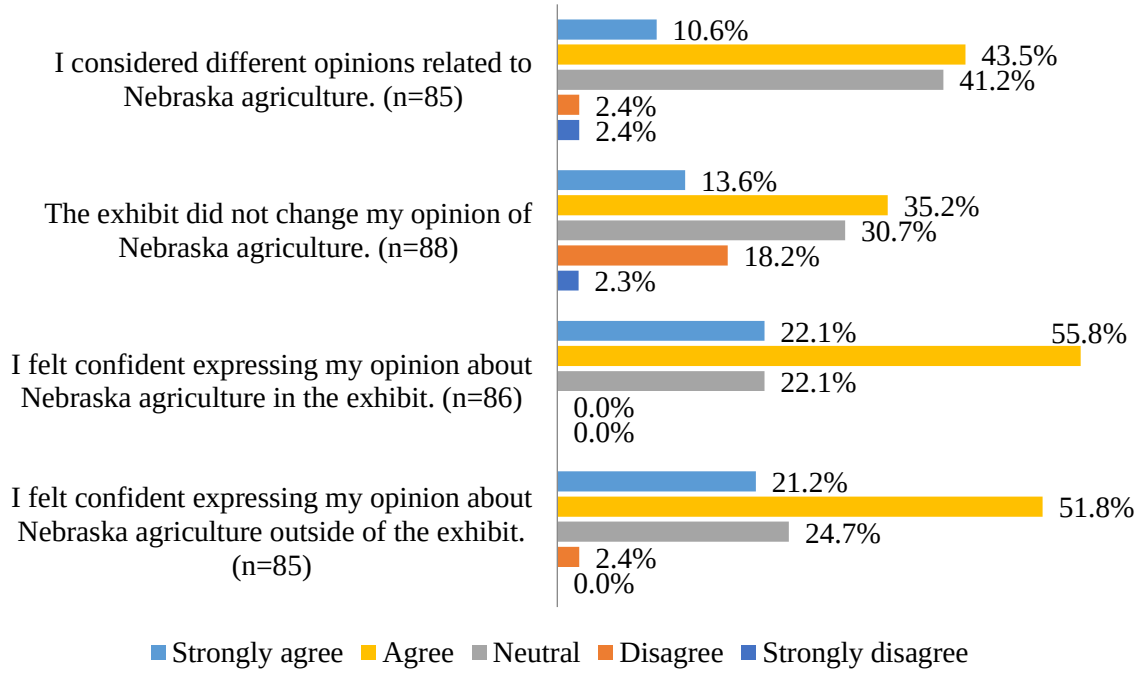

Figure 6. Percentage of respondent agreement with opinion statements.

The vast majority (75.9%) reported enjoying the exhibit very much with the remaining quarter (24.1%) reporting that they enjoyed it somewhat. Over three in four (79.3%) of visitors surveyed said they had enough time to do everything they wanted in the exhibit. Almost all respondents reported that they were very likely (44.3%) or somewhat likely (54.5%) to tell others about what they learned at the exhibit.

Objective 3: Exhibit Attitudes

The survey asked respondents to consider their attitudes before visiting the exhibit, and then after their visit and to then respond to a series of questions. Figures 7 and 8 illustrate the slight difference in attitudes before and after visiting the exhibit. Two-thirds of respondents reported strongly agreeing that agriculture is important to them (66.3% before, 66.3% after), family farms and ranches feed their family (68.7% before, 72.0% after), and Nebraska grows and raises safe food (63.9% before, 63.0% after) both before and after visiting the exhibit.

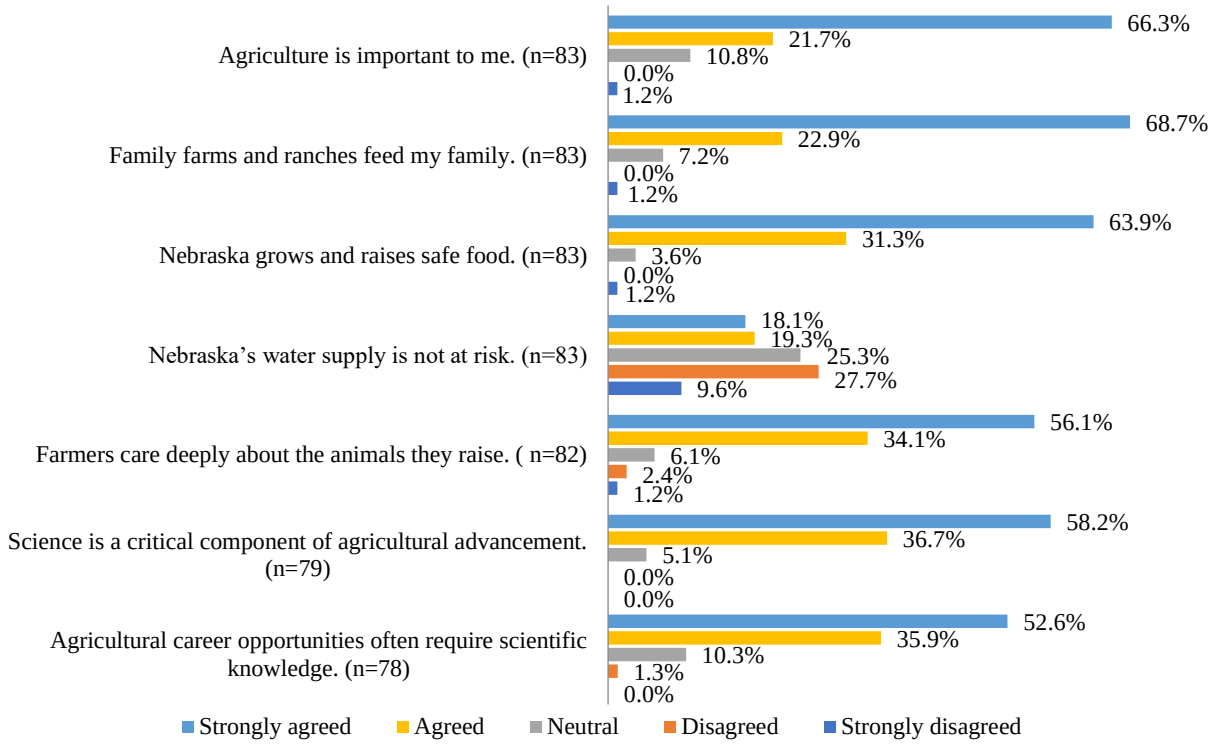

Figure 7. Percentage of respondent agreement to statements considering perceptions prior to visiting *Raising Nebraska*.

Slightly more respondents reported strongly agreeing with the statements that farmers care deeply about the animals they raise (56.1% before, 60.3% after), science is a critical component of agricultural advancement (58.2% before, 63.2% after), and agricultural career opportunities often require scientific knowledge (52.6% before, 57.9% after) after visiting *Raising Nebraska* than before their visits. Respondents reported similar levels of agreement before and after visiting the exhibit with the statement "Nebraska's water supply is not at risk".

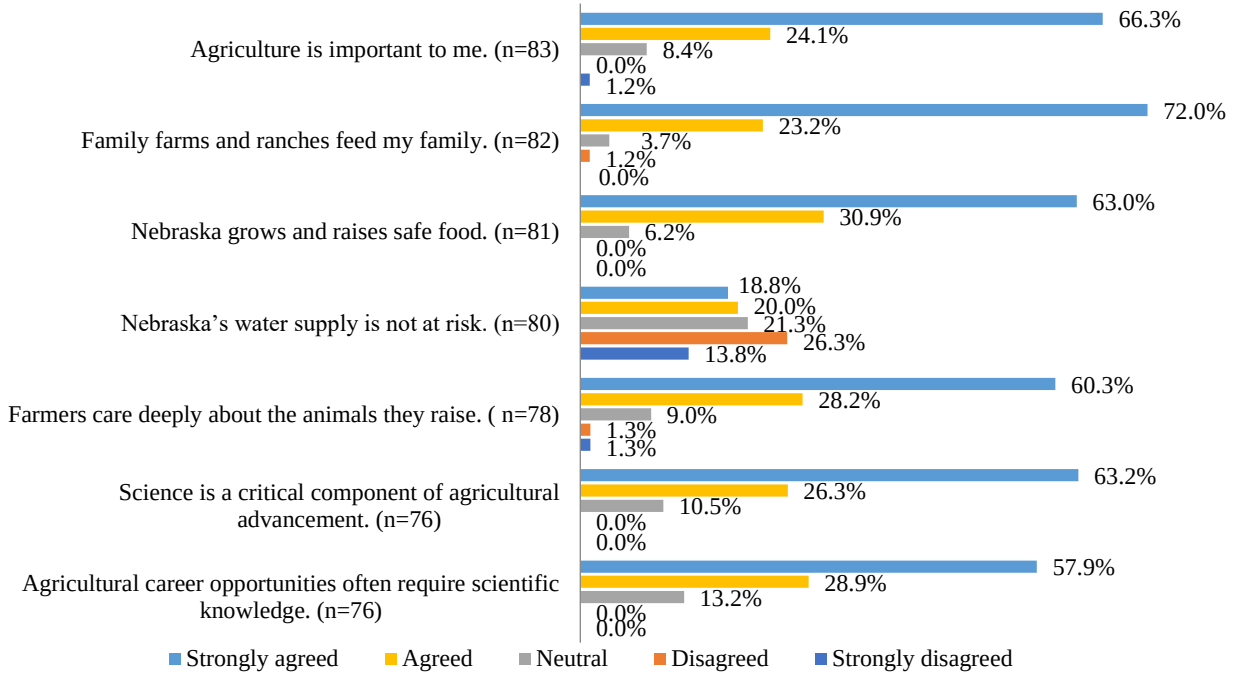

Figure 8. Percentage of respondent agreement to statement following *Raising Nebraska* visit.

Objective 4: Differences by Relationship to Agriculture

Data were also analyzed comparing farmers, ranchers, and self-identified agricultural industry members to consumer-only respondents. These analyses sought to determine if consumers not involved with agriculture had different experiences than those actively involved in agriculture. To conduct this analysis, respondents identifying themselves as consumers and not involved in the agricultural industry as a farmer, rancher or other industry member were coded as 'consumer only'. Cross tabulations were then conducted with the survey questions using this variable. Chi-square testing was used to indicate where a significant ($p<.05$) difference existed between consumer-only respondents and respondents involved in agriculture.

The most profound differences between consumer-only respondents and agriculture-related respondents were discovered in responses to attitude items inquiring about before and after visiting *Raising Nebraska*. Before visiting the exhibit, 41.9% of consumer-only visitors reported strongly agreeing agriculture is important to them, compared to 80.4% of farmers, ranchers, and industry members. Even after visiting *Raising Nebraska*, the difference between the two groups on this item was significantly ($p=.01$) different with 43.3% of consumers-only strongly agreeing and 78.7% of agriculture-related respondents strongly agreeing with this item.

Visiting the exhibit did appear to bring the two groups closer to the same opinion when each were asked if they considered science a critical component of agricultural advancement. When asked about their perceptions prior to visiting the exhibit, less than half (43.3%) of consumer-only respondents strongly agreed with this statement compared to almost three of four (71.1%) agricultural industry respondents. No significant difference existed, however, when the same question was asked about their perceptions after visiting *Raising Nebraska* with over half (58.1%) of consumer-only respondents strongly agreeing with the statement and two-thirds (67.4%) of farmer, rancher, and industry respondents strongly agreeing.

The opposite was true when respondents were asked about their level of agreement to the statement "Nebraska grows and raises safe food." When asked about their opinions before visiting *Raising Nebraska*, no significant differences existed between the two groups, with about half (54.8%) of consumer only respondents strongly agreeing with the statement compared to almost three-fourths (71.1%) of farmers, ranchers, and industry members strongly agreeing. When asked about their attitudes after visiting *Raising Nebraska*, this gap widened to be significantly (p=.02) different with fewer consumer-only respondents (50.0%) strongly agreeing and more agriculture-related respondents (73.3%) strongly agreeing.

Limitations

Limitations of this study included the small sample size, demographic homogeneity of respondents and potential response bias. Researchers collected data on five high traffic fair days and asked every fifth visitor 19 years or older to participate in the survey, which yielded 93 complete surveys from fairgoers 19-66 years old. All respondents were white and most reported a connection to agriculture. The lack of diversity in background of respondents may have contributed to the emergence of what seems to be a singular voice and perspective of positivity for Nebraska's agricultural industry. It is essential to conduct future research over a longer period of time and target a larger variety of visitors, including participants with different ethnic and racial backgrounds, to broaden the representation and contribute to a fuller picture of results.

Another potential limitation in this study is response bias, which has a few possible forms. First, it is possible participants responded to the survey items in a manner they believed was expected of them, as researchers were present during completion of the surveys. Standalone surveys at kiosks throughout the exhibit, without a researcher presence, might help participants feel more at ease to answer items. Additionally, an overwhelming number of respondents had connections to agriculture and Nebraska, potentially indicating a higher level of involvement with topics and issues discussed in the exhibit than expected. As *Raising Nebraska* is open to visitors year-round, visitors outside of state fair hours could also be surveyed. As state fair time typically has a high volume of visitors from agricultural backgrounds attending the fair for activities such as 4-H livestock judging, there is the possibility more visitors with non-agricultural backgrounds might visit during non-fair times.

Finally, wording of the attitude change items may have confused respondents, as they may not have noticed the subtle but essential question stem differences asking about perceptions "before visiting the exhibit" and "after visiting the exhibit." It is possible respondents found these questions redundant or did not note the change in the question stem, which may have led to the minor shifts or lack of change in attitudes. Surveying visitors outside of the exhibit, with time elapsed in the exhibit between their before and after attitude responses, could potentially alleviate confusion about the before and after question stems.

Discussion, Implications, and Future Research

Large scale, museum-quality exhibits have been shown to be effective mechanisms for delivering scientific research to public audiences in an interactive format. By their nature, these types of exhibits fit the mission of Extension - to deliver research-based information from university experts to members of the public, including adult learners at county and state fairs. However, it is imperative these types of educational efforts utilize and implement systematic instructional design approaches to ensure the content and design meet the needs of the learners. An exhibit designed by communicators or museum staff often follows a design flow for reaching the goals of the

funders/stakeholders (Carliner, 1998), but it may not include an evaluation to determine what visitors are learning or observations to determine what interactives are effective. Museum designers do not necessarily conduct needs assessments and evaluations, which may result in the exhibit not reaching its goals. With intentional instructional design in mind, this study sought to gain insight into adult learners' exhibit experiences by evaluating their perceptions, and changes in attitudes at a pre-existing Extension state fair exhibit *Raising Nebraska*.

The exhibit's mission was to raise awareness of critical agricultural products, farmers and ranchers, and water and soil issues throughout the state. Results of the survey showed adult visitors were Caucasians who lived in the state, many of whom identified as connected to the agriculture industry. The most popular portion of the exhibit was a walkable map illustrating the state's elevation and watersheds, followed by an outdoor living space, videos, games, and text panels. These results were not surprising, as the exhibit was created to be highly engaging with multiple interaction points for visitors. The walkable map, outdoor space, and multimedia elements were vibrant and determined to hold interested visitors' attentions. It did appear the older fairgoers preferred the more text and video-oriented portions of the exhibit. The adult visitors were less likely to engage with the interactive video games. This finding is confirmed by much of the museum research literature that physical manipulatives and interactives are most appealing to exhibit visitors and have the greatest holding power, yet there remains a need to deliver content at multiple levels for younger visitors interested in games and adult learners interested in reading text and watching videos (Falk, Scott, Dierking, Rennie, & Jones, 2004). It is recommended future Extension informal science education efforts continue to keep in mind learners' multiple motivations, modalities, and learning preferences for developing and delivering content in a variety of interactive and text-based layouts to engage learners in their desired formats.

Respondents in this study had little change in their attitudes about the importance of agriculture, food production, animal welfare, food safety, and the water supply. One explanation for this could be that many of the respondents held existing ties to agriculture and the issues presented in the exhibit. Krosnick and Petty (1995) pointed out that attitudes can occur over time, can include multiple evaluations of the attitude object, and can also be connected to personal experiences, beliefs, and values. Attitudes can also become rooted, stronger, and less likely to change (Krosnick and Petty, 1995). Thus, the exhibit content most likely confirmed the attitudes of respondents connected to agriculture. However, results did show respondents had a slight attitude shift related to the need for science to advance agriculture. It is important to note that respondents' association of science with agriculture and the environment did increase. Perhaps additional materials could be added to the exhibit to help visitors contextualize their understanding of science and illustrate how they might identify how science from the exhibit impacts their everyday lives.

This study has implications for the design of future Extension exhibits for adult learners. The researchers recommend Extension administration, educators and specialists, and funders follow iterative design approaches and work with professional instructional and communications design teams to conduct needs assessments of target learners to inform learning objectives, content, interactives, and overall look of exhibits. While instructional design is not a new field, this systematic approach is often overlooked in the development of public education efforts. It is imperative to apply instructional design models such as ADDIE (analysis, design, development, implementation, and evaluation), and learning goals-driven/backwards design (Branch, 2009; Krajcik, McNeill, & Reiser, 2008). Pertaining to the exhibit examined in this study, it appeared the designers, Extension educators, and funders did intuitively follow some instructional design

and development processes, but a systematic learner needs assessment and evaluation were not necessarily direct steps in the planning.

Implications for informal agricultural education and communication also emerged from this research. Results showed all of the participants were Caucasian and most had ties to agriculture. This is in line with Nebraska's demographics, as the population is predominantly Caucasian and ethnic and racial groups make up less than approximately 20 percent of the population (U.S. Census Bureau, 2016). Efforts to reach ethnic and racial minority groups and people not connected to agriculture should be increased. Caucasian adults with connections to agriculture value and appreciate Extension programs, but how can programming be expanded to reach and obtain perspectives of more diverse audiences? It is imperative to include diverse learners in the creation, development, implementation, and evaluation of Extension exhibits. One suggestion is to create mobile exhibits that can travel to science centers and Extension offices in urban areas or electronic field trips to connect with permanently placed exhibits. Exploring ways to mobilize exhibits physically and virtually could make them more accessible to a broader audience. Also, include urban related content in the exhibit such as STEM (science, technology, engineering, and math) beyond traditional and typical 'farm to fork', and 'hardworking farmers/ranchers' storylines. A science communication research agenda from The National Academies of Sciences, Engineering, and Medicine pointed out the deficit model for communicating about science must move beyond the idea that people lack knowledge and do not understand science (NAESM, 2017). Within agriculture, it is often believed that 'consumers do not know where their food comes from'. Instead, it is essential to advance the societal conversation to focus on engagement with topics such as the science of food, climate change, pesticide use, biotechnology, and cultural and policy issues.

There is much room to grow informal science education, Extension, and communication research within the contexts of agriculture and the environment. Suggestions for future research from this study include: use of mobile eye-tracking to evaluate learners' exhibit experiences in replacement of self-reported surveys, case studies to track the development, implementation, and evaluation of Extension exhibits that intentionally follow a systematic instructional design and evaluation approach for developing best practices, develop agricultural exhibits with STEM focused content and evaluate impacts on attitudes and learning, examine impacts of mobile Extension exhibits on urban audiences, and evaluation of in-person and electronic field trips to permanent exhibits across adults and youth.

References

Barker, B. S., Larson, K., & Krehbiel, M. (2014). Bridging formal and informal learning environments. *Journal of Extension*, *52*(5).

Branch, R. M. (2009). Instructional design: *The ADDIE approach*. New York: Springer Science & Business Media. https://doi.org/10.1007/978-0-387-09506-6

Carliner, S. (1998). How designers make decisions: A descriptive model of instructional design for informal learning in museums. *Performance Improvement Quarterly*, *11*(2), 72-92. https://doi.org/10.1111/j.1937-8327.1998.tb00091.x

Comito, J., Case Haub, B., & Stevenson, N. (2017). Field day success loop. *Journal of Extension*, *55*(6).

Falconer, L. L. & Parker, J. L. (2001). Development and use of a stocker cattle market workshop in extension ranch management programming. *Journal of Extension*, *39*(3).

Falk, J. H., Storksdieck, M., & Dierking. L. D. (2007). Investigating public science interest and understanding: Evidence for the importance of free-choice learning. *Public Understanding of Science*, *16*(4), 455-469. https://doi.org/10.1177/0963662506064240

Falk, J. H., Scott, C., Dierking, L., Rennie, L., & Jones, M. C. (2004). Interactives and visitor learning. *Curator: The Museum Journal*, *47*(2), 171-198.

Falk J. H. & Dierking, L. D. (2002). *Lessons without limit: How free-choice learning is transforming education*. Walnut Creek, CA: Rowman Altamira.

Falk, J. (1982). The use of time as a measure of visitor behavior and exhibit effectiveness. *Roundtable Reports*, *7*(4), 10-13.

Fenichel, M. & Schweingruber, H.A. (2010). *Surrounded by science: Learning science in informal environments*. Board on Science Education, Center for Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

Gamon, J. & Primmer, J. (1995). The active learning center at state fair. *Journal of Extension*, *22*(1).

Gustafson, K. L. & Branch, R. M. (2007). What is instructional design? In Reiser, R. A. & Dempsey, J. V. (Eds). *Trends and issues in instructional design and technology* (10-16). Upper Saddle River, NJ: Pearson Education.

Hendrix, B. & Williamson, E. (2017). Tinkering with technology: A library workshop to support 4-H youth development. *Journal of Extension*, *55*(6).

Kamradt, T. F., & Kamradt, E. J. (1999). Structured design for attitudinal instruction. In C. M. Reigeluth (Ed.), *Instructional-design theories and models: A new paradigm of instructional theory* (Vol. 2), Mahwah, NJ: Lawrence Erlbaum Associates.

Kellogg Commission on the Future of State and Land-Grant Universities. (1999). *Returning to our roots: A learning society*. National Association of State Universities and Land-Grant Colleges.

Kellogg Commission on the Future of State and Land-Grant Universities. (2000). *Renewing the covenant: Learning, discovery, and engagement in a new age and different world*. National Association of State Universities and Land-Grant Colleges.

Kirby, S. D., Chambers, B. J., & Cuperus, G. W. (1995). Caring for Planet Earth interactive exhibit and school enrichment program. *Journal of Extension*, *33*(6).

Krajcik, J., McNeill, K. L., & Reiser, B. J. (2008). Learning goals driven design model: Developing curriculum materials that align with national standards and incorporate project-based pedagogy. *Science Education*, *92*(1), 1-32. https://doi.org/10.1002/sce.20240

Krosnick, J. A., & Petty, R. E. (1995). Attitude strength: An overview. In R. E. Petty & J. A. Krosnick (Eds.), *Attitude strength: Antecedents and consequences* (pp. 1-24). Hillsdale, NJ: Lawrence Erlbaum Associates.

Luck, J. D., Fulton, J. P., & Rees, J. (2015). Hands-on precision agriculture data management workshops for producers and industry professionals: Development and assessment. *Journal of Extension*, *53*(4).

Merriam, S. B. (2001). Andragogy and self-directed learning: Pillars of adult learning theory. *New Directions for Adult and Continuing Education*, *2001*(89), 3-14. https://doi.org/10.1002/ace.3

National Academies of Sciences, Engineering, and Medicine (NASEM). (2017). *Communicating science effectively: A research agenda*. Washington, DC: The National Academies Press. https://doi.org/10.17226/23674

National Research Council (NRC). (2009). *Learning science in informal environments: People, places, and pursuits*. Washington, D. C.: The National Academies Press. https://doi.org/10.17226/12190

Nicholson, D. J. (2011). Fairs and other exhibitions: Have we really thought this through? *Journal of Extension*, *49*(1).

Ober, H. K., Giuliano, W. M., Sheftall, W., Byrne, R., & Dillard, J. (2012). Leveraging partnerships to achieve high impact: Lessons from wildlife field days. *Journal of Extension*, *50*(1).

Peart, B. (1984). Impact of exhibit type on knowledge gain, attitudes, and behavior. *Curator: The Museum Journal*, *27*(3), 220-237. https://doi.org/10.1111/j.2151-6952.1984.tb01278.x

Perloff, R. M. (2014). *The dynamics of persuasion* (5th ed.). New York: Routledge.

Petty, R. E., & Brinol, P. (2010). Attitude change. In Baumeister, R. F. & Finkel, E. J. (Eds.), *Advanced social psychology: The state of the science*. (217-259). Oxford, New York: Oxford University Press.

Presternon, D. R. (1986). Forestry field days – an old idea that really works. *Journal of Extension*, *24*(1).

Rasmussen, C. (2015). *Carnival in the countryside: The history of the Iowa State Fair*. University of Iowa Press. https://doi.org/10.2307/j.ctt20p58cp

Rollins, J. & Watson, S. L. (2017). A salamander tale: Effective exhibits and attitude change. *Journal of Extension*, *55*(3).

Sharples, M. (2000). The design of personal mobile technologies for lifelong learning. *Computers & Education*, *34*(3), 177-193. https://doi.org/10.1016/S0360-1315(99)00044-5

Shepard, R. (2001). Questionnaires for evaluating on-farm field days. *Journal of Extension*, *39*(1).

Sherif, M. (1967). Introduction. In C. W. Herif & Msherif (Eds.) *Attitude, ego-involvement, and change* (pp. 1-5). New York: Wiley.

Shute, V. J. (2008). Focus on formative feedback. *Review of Educational Research, 78*(1), 153-189. https://doi.org/10.3102/0034654307313795

Simonson, M. R., & Maushak, N. (2001). Instructional technology and attitude change. In D. H. Jonassen (Ed.), *Handbook of research for educational communications and technology* (pp. 984–1016). Mayway, NJ: Lawrence Erlbaum Associates.

Spanier, G. B. (1999). Enhancing the quality of life: A model for the 21st-century land-grant university. *Applied Development Science*, *3*(4), 199-205. https://doi.org/10.1207/s1532480xads0304_3

Steele, C. M. (1997). A threat in the air: How stereotypes shape the intellectual identities and performance of women and African Americans. *American Psychologist, 52*(6), 613-629. https://doi.org/10.1037/0003-066X.52.6.613

Tucker, M., Bricker, J., & Huerta, A. (2011). An approach to measuring impact and effectiveness of educational science exhibits. *Journal of Applied Communications*, *2*(95). https://doi.org/10.4148/1051-0834.1172

United States Census Bureau (USCB). (2016, July 1). Nebraska Quick-facts. Retrieved from https://www.census.gov/quickfacts/NE.

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