

INTEGRATING NATIVE AMERICAN MDEWAKANTION SIOUX CULTURE
WITH ENVIRONMENTAL SCIENCE CURRICULUM

by

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ABSTRACT

Native American students struggle to form a connection to science education due to a lack of culturally relevant material. While many state teaching standards require educators to attend a cultural awareness course as part of the licensure process, there is a lack of culturally relevant materials available to educators. The need to develop culturally relevant resources that is engaging to Native American students has driven many educators to develop their own material. In this study, educators spent time researching and developing a cultural plant field guide to use within their environmental education and outreach program on the reservation. Participants were given questionnaires, content knowledge self-assessments, and structured interviews in order to determine their knowledge of cultural plants before and after the activity, what resources they relied on when identifying and researching cultural plants, as well as their perspective on developing their own resources. The results from the data collection methods showed that educators had minimal knowledge of cultural plants as well as minimal knowledge on where to locate resources on this subject. Their frustration in finding appropriate resources to utilize was notable and brought awareness as to a void that needed to be filled. While the educators expressed their desire to utilize existing resources to teach with they did note that the process of developing their own material provided them with a better background knowledge and confidence of the material as well as a the likelihood that they would utilize the material they created in the future.

INTRODUCTION AND BACKGROUND

As stated by Smith, Stumpff, and Cole (2012) and Ward (2011), Native American students struggle to form a connection to their public education due to a lack of culturally inclusive curriculum. While many state standards require educators to attend a cultural awareness course as part of the licensure process, there is an overwhelming lack of curriculum materials available to educators once in the classroom. This creates a challenge for educators trying to learn about regionally specific cultures as well as incorporate relevant cultural pieces into the curriculum.

There has been a recognized need to develop culturally related curriculum that is engaging to Native American students (Gilbert, Reyhner, & Lockard, 2011). It falls upon the educator to develop these resources and to utilize them in a way that is engaging and culturally meaningful to the students' identity. Yet it requires a lot of time and effort to understand specific cultures in order to create appropriate educational resources (Yong, 2013).

In a standard science curriculum there is little material that is culturally relevant to the student's heritage, specifically when students live within or near the Mdewankanton Sioux Nation. Infusing culturally significant material that connects science to the student's cultural identity may provide an avenue that would pique the student's interest and encourage further inquiry and learning. The focus of this paper will be to specifically emphasize the limited knowledge of the cultural and medicinal plants significant to educators to local tribes of Southeast Minnesota. There are resources that contain this information but it is in the form of scientific reports which are not easily understood or accessible by educators.

In order to address these concerns and the lack of culturally based educational material, a cultural and medicinal plant guide was created specific to the tribes of the Dakota Sioux. This plant field guide was created by environmental interns and professionals of the Tribe to be utilized as an environmental education tool within the Tribal community as well as by the Tribe's educational department to infuse into their curriculum. It includes the common name, scientific name, and the Dakota name of plants, as well as color pictures of the plants and its specific cultural and medicinal uses. This field guide will be made to educators in order to provide a contemporary educational tool.

The idea for this action research project was developed through my time spent as an environmental educator while working for a Dakota Sioux tribe in Minnesota. It was my constant involvement with the Native American students that provided me with the awareness of Native American students' lack of interest in science. Yet, during the outdoor environmental activities I would conduct on the Reservation the students' interest and excitement was notable. It is the focus of this project to help find a way to inspire this type of excitement and curiosity while focusing on environmental science curriculum.

My primary research questions is: Does having access to modern culturally relevant resources help educators of Native American students feel better prepared to instruct to cultural sensitivities? Secondary research questions I investigated are: What is the extent of environmental educator's knowledge of Native American cultural and medicinal plants? And, what resources do environmental educators utilize most when researching culturally significant plants?

CONCEPTUAL FRAMEWORK

The incorporation of a culturally-based science curriculum has largely been nonexistent from current pedagogies. Current research demonstrates that “culturally based education may be successfully integrated into the classroom in a manner that would provide Native students with instruction in the core subject areas based upon their cultural values and knowledge” (Gilbert, Reyhner, & Lockard, 2011, p. 44). Native American students may then become intrigued in, and connect with the science curriculum as it relates to their culture.

Incorporating traditional cultural characteristics into the science curriculum would provide a contemporary way of learning. Providing a culturally based science curriculum in a way for Native American students is a holistic approach that influences how the students view themselves and how they are interconnected to the world of science around them.

The biggest obstacle is integrating cultural values with core science curriculum. It is ultimately up to the teacher to create this content. A tool such as this would provide educators of Native American students a way to teach plant biology and environmental science in a way which Native American students could identify with.

As stated by Smith, Stumpff and Cole (2012), “Native Americans are among the most underrepresented populations in America’s colleges and universities.” (p. 60) The author refers to a 2010 study by Faircloth and Tippeconnic which statistically describes how, on a national comparison, Native American students high school graduation rates averaged 46.6% compared with 71.4% for other students (as cited in Ward, 2011). This clearly indicates an alarming disconnect between Native American students and interest

in school. Ward also discusses the limited access Native American students have to cultural related curriculum and how there is a demand that continues to grow for this type of information.

Smith, Stumpff and Cole (2012) describe whose responsibility it is to build bridges between the culture of a community and the culture of a school. They provide background of ethnographic studies involving native youth showing that the students frequently report feeling bored or that schooling has no relevance to their everyday lives outside of school. Coladarci (1983) and Hoisch (1992) (as cited in Smith, Stumpff, & Cole, 2012) also state that infusing culturally relevant content is one aspect of curriculum content that is particularly relevant for engaging Native American learners. Starns (2006) reinforces this concept that there is a positive relationship between native student academic learning and their strong sense of cultural identity.

A number of articles go more in depth on how to address this problem. Gilbert, Reyhner, and Lockard (2011) state that it is the responsibility of the teachers to provide resources, materials, and skills to engage students in meaningful activities which would deepen science and cultural knowledge. To build on this point, Yong (2013) mentions that “It requires substantial effort to understand the tribal cultures and to develop innovative teaching styles that suit the local community. Still, if educators can overcome these challenges, the relationships they can form with the students will make all the sacrifices worthwhile (p. 25).” Smith et al. (2012) discuss the need to “Promote Native American student success by creating a culturally relevant curriculum with engaging pedagogies (p. 60).” And another article by Bequette, Hrenko, and Ness (n.d.) describes

to do this by enhancing interest, understanding, enthusiasm, and performance in standards-based subjects among American Indian students.

Taking this one step further, a study by Fox (2006) discusses that ideally, lessons should be focused on the local tribal groups of that region. Incorporating the names of local tribes helps students get a deeper understanding of their tribal identity. Fox also mentions instances where she “often heard Indian students wonder why they always learn about Aztecs and Incas and never about their own tribal communities (p. iii).” She goes on to state that “The content needs to have a meaningful connection to the curriculum. In an effort to provide multicultural content, teachers often find themselves having to search for materials (p. iii).” Fox also reinforces this goal by discussing the importance of enhancing interest, understanding, enthusiasm, and performance in standards-based subjects among American Indian and non-American Indian students promote Native American student success by creating a culturally relevant curriculum with engaging pedagogies.

There is additional research that focuses on incorporating cultural background with science. Smith (1982) discusses how teaching science is an approach of process development. When teaching Native American students it is important to be aware of teaching the process as well as cultural background. This author discusses processes and then applies it to content in a cultural framework. Going into more detail Staley and Staley (1988) discuss in their article a framework for using the outdoors as a vehicle for providing meaningful language arts experiences as well as how outdoor education provides motivation, inspiration, as well as activities on human connection to the environment such as plants.

Some potential assessment techniques discussed by Sutherland and Swayze (2012) include ways to evaluate the effectiveness of attempts to make programs more culturally responsive. In her 2006 study, Fox states that teachers need to consider the students' prior knowledge as well as plan a lesson in identifying the continuum of that knowledge. This includes analyzing students' attitudes and perceptions about the content. She also states that teachers may assess learning through a variety of means such as informal observations, learning journals, student drawn diagrams or charts, student created videos, PowerPoints, etc. The author also mentions that assessment should have the purpose of instructing us as teachers how well we did in providing the learning opportunity. On another note the Nebraska Department of Education (2004) outlines educational standards when it comes to designing curriculum to connect Native American students to science. For example: "Standard 3: Contextualization/Making Meaning Connecting School to Students' Lives" (p. xi).

There are also a number of supporting success articles such as Cagete (1988) discussing how "American Indian languages and culture make use of descriptive examples of practical experience and knowledge which personify an intimate understanding of natural phenomena. It is possible to use this cultural understanding of nature to enhance American Indian student motivation in science and math courses." Similarly Van Lopik (2012) discusses how traditional ecological knowledge in the classroom is embraced by students and how they relate to the time they have spent in the forest and their interactions with the land.

A study by Zwick and Miller (1996) identified this lack of culturally based curriculum and provided an article full of science curriculum specifically for teachers of

Native American students of all ages. Included were hands on activities in science, math, language arts, and social studies. Along these same lines, the Nebraska Department of Education (2004) contains curriculum units for grades K-12 that incorporated Native American literature and activities into the academic areas order to make instruction more culturally relevant. Completion of this field guide and the goal of sharing and creating a communication bridge through this tool is only one small step toward achieving that lofty goal.

An example on a much more personal note is described in Sottile (2012) when a student found the Institute of American Indian Arts (IAIA) in Santa Fe, New Mexico on a serendipitous weekend visit. "The Institute is really special," said Tarpalechee. "They honor our traditions and where we come from and the communities that we represent."

I discovered through the literature review that an effort has begun to develop and make available some culturally relevant science activities and emphasized the further need in continuing this effort. Additionally, I have identified some possible assessment techniques that would be useful in determining if the hands on educational process of having educators create a cultural plant field guide will increase their background knowledge in plant science and their comfort ability in instructing others on cultural plant science. Creating educational tools like this would provide teachers of Native Americans with curriculum that would incite student's curiosity and help them connect science lessons more specifically to their lives.

METHODOLOGY

The primary problem statement in this study is the lack of availability of culturally relevant science curriculum to educators who instructing Native American students.

Creating culturally specific educational tools to fill this gap will hopefully better prepare educators with proper tools that will spark student inquiry into science topics as well as keep the students interest and act as a way for them to further engage in the science learning process. Creating a cultural plant field guide will provide educators with a tool they need to connect science curriculum that Native American students identify which can create a more interesting topic for the students.

Participants

The participants in this study included three environmental outreach educators from a Dakota Sioux Indian Reservation in Minnesota. The educators work for the Tribe's Environmental Department and are actively involved in public outreach and education within the Tribal Community. One of the participants was an intern who is a senior in college, another participant was a newly appointed technician who has recently graduated from college, and the final participant was an established technician with multiple years of experience. This is the first position all participants have had working with an Indian Reservation. All participants have interest in Tribal culture but have had no previous experience working with the culture. This selection of participants is representative of the staff typically involved with the Tribes environmental education/outreach activities.

The research methodology for this project received an exemption by Montana State University's Institutional Review Board and compliance for working with human subjects was maintained.

Intervention

For this activity, the participants worked towards creating their own educational tool as a way to educate themselves on culturally specific science material and become

more comfortable with the material that they will be using during activities with the community. The focus was specifically on educating the Tribes environmental staff about cultural plants found on the Tribal reservation.

The final product of this project was the development of a cultural plants field guide for educators to use as part of their environmental science outreach. This resource can be used as a tool to incorporate plant science in a way that is relevant to the Native American community.

In order to create the field guide the participant's responsibilities included: 1. Conducting literature reviews of what plants are culturally significant to the Dakota Tribe. 2. Researching traditional cultural uses of the plants. 3. Researching Dakota, scientific, and common names of each plant. 4. Locating and collecting color pictures of each plant in its natural local setting. 5. Researching and summarizing the plants characteristics to aid in identification. 6. Organize the data and present it in a user friendly format in the form of a book and website.

Since this activity was conducted during the winter months a complete list of the cultural plants of focus were provided as well as color photos already taken of each plant. After all information was collected and summarized for each plant participants then worked together to prepare the information in a field guide format.

Data Collection Tools

In order to measure the participant's learning/attitude on this activity a number of data collection tools were utilized. All data collection tools were administered through an online format using Google forms. Inquiry data tools such as structured interviews (Appendix A) and pre and post activity questionnaires/attitude scales (Appendix B) were

utilized to gather information from participants about their knowledge, past experience, attitudes, and perceptions towards culturally responsive teaching. A pre activity questionnaire/attitude scale was given to participants before the intervention begins in order to create a baseline of current knowledge and perceptions such as asking the participant if they knew where to find culturally relevant educational material on plants. A post activity questionnaire/attitude scale was given to participants in order to determine if they felt better prepared to instruct others on culturally specific plants and what resources they found most useful. A structured interview was conducted after the intervention in order to determine effectiveness of the activity and included questions such as if the participant felt better prepared to instruct others on cultural plants from creating their own resources or by utilizing these resources if they were made available.

A content knowledge self-assessment (Appendix C) was utilized before and after the intervention to measure attainment of the subject studied during the intervention. This assessment required the participant to make a list of all of the cultural plants they know including names, uses, and identifying characteristics.

Finally, an observational data collection strategy (Appendix D) of using field notes and observational records was utilized in order to document participant behavior during the intervention. This data collection tool was most beneficial in determining which resources educators used most during the intervention.

Refer to Table 1 Data Triangulation Matrix for a summary of tools to be utilized in this study.

Table 1
Data Triangulation Matrix

Research Question	Data Source	Data Source	Data Source
Focus Question: Does having access to culturally relevant resources help educators of Native American students feel better prepared to instruct to cultural sensitivities?	Pre activity Questionnaire	Structured Interview	Post activity Questionnaire
Sub questions 1: What is the extent of educator's knowledge on Native American cultural plants?	Pre and post activity Questionnaires	Pre/post Participant content knowledge self-assessment	Field notes and observational records
Sub questions 2: What resources do educators utilize most when researching culturally significant plant information/resources?	Pre and post activity Questionnaires	Structured Interview	Field notes and observational records

DATA ANALYSIS

The instruments outlined in the data triangulation matrix supported all of the research questions posed in this study. Each data collection instrument provided helpful data in regards to the focus question as well as sub-questions one and two. Since this study included only three participants the results will be summarized for each one individually. Furthermore, information collected from each data collection instrument will be organized by the questions identified in the data triangulation matrix. Pseudonyms have been assigned to participants in order to keep their participation anonymous. Please refer to the appendix for copies of data collection forms in their entirety.

The focus question “Does having access to culturally relevant resources help educators of Native American students feel better prepared to instruct to cultural sensitivities?” relied on three data collection instruments: Pre-Activity Questionnaire,

Post-Activity Questionnaire, and a Structured Interview. Sub question one “What is the extent of educator’s knowledge on cultural plants?” relied on three data collection instruments: Pre/Post-Activity Questionnaires, Pre/Post-Activity Participant Content Knowledge Self-Assessment, and Field Notes and Observational Records. Sub question two “What resources do educators utilize most when researching culturally significant plant information/resources?” relied on three data collection instruments: Pre/Post Activity Questionnaires, Structured Interview, and Field Notes and Observational Records.

Ann’s Experience Creating a Cultural Plant Field Guide.

Ann is an Environmental Intern who has worked for the Tribe for a few months. She is a senior in college pursuing a B.S. in Environmental Science. She has a strong background in plant science from her college courses as well as previous jobs. This is her first time working with cultural plants and a Native American Tribe.

In order to determine whether Ann felt better prepared to instruct others after creating a culturally relevant resource she completed a Pre and Post Activity Questionnaire and participated in a structured interview. Although Ann selected on the Pre-Activity Questionnaire that she had a strong knowledge of plant science in general, the questionnaire showed that her knowledge of cultural plants was limited. Ann also marked on the Pre-Activity Questionnaire that she was comfortable teaching general plant science to others while responding that she was not comfortable teaching others about cultural plants. Specifically, she marked “Strongly Disagree” when asked if she was comfortable teaching others about cultural plants. She also marked “Strongly Disagree” to indicate that she was unsure of where to find culturally relevant resources to

educate others on cultural plants of Native Americans as well as where to find resources to culturally relevant educational materials on plants. After spending a significant amount of time on the activity, Ann marked on the Post-Activity Questionnaire a four (Agree) showing that she now is comfortable educating others on cultural plants. On a scale of one to five this was a three point positive shift. Ann's knowledge of cultural plants pre-activity to post-activity made the biggest increase on the scale of one to five. Pre-activity Ann marked a one on her cultural plant knowledge. In contrast, after the activity Ann marked a four. Furthermore, both the Pre and Post-Activity Questionnaires Ann marked at the very high end of the scale "Strongly Agree", that having access to culturally relevant educational resources would help her to better educate others on cultural plants. She also marked "Strongly Agree" on both questionnaires that having access to modern educational resources would be more beneficial to her when conducting environmental outreach and educational activities.

In the structured interview Ann was asked a number of questions to obtain her perspective on access to culturally relevant plant educational materials including what specific components of the resources she found most helpful, and if the time commitment of creating her own resource was worth it. When asked whether she preferred to create her own resource or use pre-existing ones, Ann indicated she preferred to use pre-existing resources. Yet, in the following interview questions she mentioned that creating her own culturally relevant plant educational resource was worth the time commitment, and that she learned more by creating her own resource. She further stated that she was most likely to use her own resource as well as feel better prepared to educate others on cultural plants and their uses. She said "The amount of learning that took place as a result of this

project was well worth it. I never would have learned this much without the incentive of this project.” When asked whether she felt better prepared to educate others on cultural plants after completing the activity she stated, “after doing some identification and research, as well as having better available resources such as the field guide that came out of this activity, I would feel very confident educating others on the cultural plant uses of Native Americans.”

In order to document Ann’s knowledge of cultural plants, questions in the Pre/Post-Activity Questionnaire were utilized. Additionally, a Pre and Post-Activity Content Knowledge Self-Assessment and observational records were used to identify actual knowledge of cultural plants. The Pre-Activity Questionnaire showed that Ann’s knowledge on cultural plants and their uses was limited, scoring both at the lowest possible score of one, out of a possible five. This was an interesting point to note as she was also able to list ten cultural plants on the Pre-Activity Content Knowledge Self-Assessment, which was the most listed out of all participants. After conducting the activity the same questionnaire was given again and Ann scored herself at a three for her knowledge on cultural plants and a five on cultural plant uses, a significant increase.

The Pre-Activity Content Knowledge Self-Assessment indicated that Ann was able to write down ten cultural plants and their uses. After conducting the activity, Ann was given the same Self-Assessment and the number of cultural plants that she knew increased from ten to thirty one, which was the largest number of cultural plants identified out of all three participants both pre and post activity. In the pre-activity assessment Ann only wrote down one use for each plant and after conducting the activity she was able to write down multiple uses for some of the plants.

Observational Notes indicated that Ann had minimal knowledge of cultural plants at the beginning of the activity which corresponded with her own self-perception on the Pre-Activity Questionnaire. At the beginning of the activity Ann was observed relying mainly on her “quick and dirty” resource that she had compiled in order to verify the correct plant and its use. Towards the end of the activity when Ann had spent considerable time researching cultural plants and their uses she had memorized approximately thirty out of the ninety cultural plants on the list and therefore spent significantly less time searching through the resources. The Post-Activity Content Knowledge Self-Assessment shows that Ann’s knowledge of cultural plants and their uses tripled, from ten plants pre-activity to thirty one plants post-activity. Another observation record noted was due to Ann’s frustration in relying on many separate resources to find information on cultural plants she created her own document to refer to during the activity. Her document was an electronic accumulation of all her resources condensed into one document for quick reference. She described it as an overabundance of data and messy to search through, but at least it was all in one place.

In the Pre-Activity Questionnaire, Ann noted that she had minimal knowledge of cultural plants, and used websites, Google, professors, and field biologists as her commonly used resources to find information. In the Post-Activity Questionnaire Ann had the same response with the addition of the field guide which she had helped to create. In the structured interview Ann stated that she preferred to use a field guide book with color pictures as her primary source as it was easy to take with her. She also liked to use websites but stated that she needed a computer in order to access them and a computer was not easy to take out into the field. She added that websites are convenient, especially

with their search capabilities, but they are not as convenient to use while identifying plants in a field setting. For convenience, Ann used a field guide book for identification of the plants and heavily relied on a number of website to research cultural plant uses. In the structured interview, she described her frustration that there was no ideal resource available, which prompted her to create a “quick and dirty” resource which was mentioned above.

The results from the Structured Interview provided a more detailed perspective of what key elements of all field guides, websites, and mobile apps Ann preferred. She said, “I prefer a field guide with color pictures when identifying all plants, as well as websites with color pictures. I think a mobile app is helpful for identifying plants in general, and if a mobile app was available for cultural plants that it would be just as helpful.”

Beth’s Experience Creating a Cultural Plant Field Guide.

Beth is an Environmental Technician who has worked for the Tribe for less than one year. She is a recent college graduate with a B.S. in Conservation Biology. She has a strong background in plant science from her college courses as well as previous jobs and has the most plant knowledge out of all three participants. This is her first time working with cultural plants of a Native American Tribe.

In order to determine whether Beth felt better prepared to instruct others after creating a culturally relevant resource, she completed a Pre and Post Activity Questionnaire and participated in a structured interview. Beth selected on the Pre-Activity Questionnaire that she had a strong knowledge of plant science in general and that she was comfortable teaching general plant science to others. She marked that she was not comfortable teaching others about cultural plants and that her overall knowledge

of cultural plants was limited. More specifically, in the Pre-Activity Questionnaire, she marked a two (disagree) on a five point scale when asked if she was comfortable teaching others about cultural plants or if she knew where to find culturally relevant resources to use while teaching. After spending a significant amount of time on the activity, on the Post-Activity Questionnaire, Beth marked a four (agree), indicating she now has more confidence educating others on cultural plants. This was a two point shift in a positive direction. In describing Beth's knowledge of cultural plants pre-activity versus post-activity, she had an unusual direction in marking. Pre-activity Beth marked a two on her cultural plant knowledge and after the activity Beth marked a one. This could be due to the fact that the activity brought awareness to the large number cultural plants that exist. In contrast, Beth was consistent in her scoring of five (strongly agree), both pre and post-activity, when asked if having access to culturally relevant educational resources would help her to better educate others. She also marked a five for "Strongly Agree", both pre and post questionnaires, that having access to modern educational resources would be more beneficial to her when conducting environmental outreach and education activities.

In the structured interview, Beth was asked a number of questions to obtain her perspective on access to culturally relevant plant education materials including what specific components of the resources she found most helpful, as well as if the time commitment of creating her own resource was worth it. When asked whether she preferred to create her own resources versus using resources already available she mentioned that she always prefers to use existing resources, although she said that she learned quite a bit in making her own. During the interview questions she also stated that creating her own culturally relevant plant educational resource was well worth the time

commitment, stating “YES! Though it took a lengthy amount of time to collect pictures and information, the entire process made it a meaningful project that I remember more now than I would if it had been a shorter project.” She continued with “even though I already felt like I knew a fair amount about cultural plants I had no idea that they could be used for so many different cultural and medicinal uses.” She expressed that she was most likely to use her own resource in the future stating that she was “not really aware of other relevant field guides.” Finally, even though she felt better prepared to educate others on cultural plants, she felt that she would still need to refer to the cultural plant field guide in order to recall specific plant’s uses.

In order to document Beth’s knowledge of cultural plants, direct questions in the Pre/Post-Activity Questionnaire were utilized. Additionally, a Pre and Post-Activity Content Knowledge Self-Assessment and observational records were used to identify actual knowledge of cultural plants. The Pre-Activity Questionnaire showed that Beth’s knowledge on cultural plants was marked at a two and her knowledge on cultural plant uses was a three. After conducting the activity the same questionnaire was given again and Beth scored herself at a one for cultural plant knowledge and a four for knowledge on cultural plant uses. The decrease in her cultural plant knowledge was referred to in the focus question, possibly due to her realization on the vast number of cultural plants. Even though her knowledge on cultural plants decreased, her score on cultural plant uses increased by one point, most likely signifying that of the cultural plants she did know that she knew more of their cultural uses.

The Pre-Activity Content Knowledge Self-Assessment displayed that Beth was able to write down four cultural plants and their uses. After conducting the activity Beth

was given the same Self-Assessment and the number of cultural plants that she knew increased from four to twenty. In the pre-activity assessment Beth only wrote down one use for each plant and after conducting the activity she was able to write down multiple uses for some of the plants.

Observational Notes also indicated that Beth had minimal to moderate knowledge of cultural plants at the beginning of the activity. Even if Beth thought that she knew a cultural plant or its use, she was still observed relying mainly on field guides or websites to verify the correct plant and its use. Towards the end of the activity when Beth had spent considerable time researching cultural plants and their uses she had memorized approximately twenty out of the ninety cultural plants on the list and therefore spent significantly less time searching through the resources. The Post-Activity Content Knowledge Self-Assessment showed that Ann's knowledge of cultural plants and their uses quadrupled, from four plants pre-activity to twenty one plants post-activity.

In the Pre-Activity Questionnaire where Beth noted that she had minimal to moderate knowledge of cultural plants, she identified websites, library books, field guides, and professors as the resources she would use to find information. In the Post-Activity Questionnaire Beth had the same response but simplified her answer to books or online resources. While observed, Beth mainly utilized field guides while identifying plants. In the structured interview Beth stated that she preferred to use a field guide book with color pictures or diagrams as her primary source and if an online app was available she would definitely use that. She mentioned the mobile app and color pictures as being two very helpful tools in identifying plants as opposed to dichotomous keys or drawings. She repeated this statement when describing what would be most helpful resources to use

when educating others on cultural plants. This primary use of the field guide as well as an online app for plants in general was also noted in the observation record and coincided with the results of Beth's answers in the questionnaire and interview.

Claire's Experience Creating a Cultural Plant Field Guide.

Claire is an Environmental Technician who has worked for the Tribe for 4 years. She has a college education with a B.S. in Environmental Science. She has a moderate background in plant science from her college courses. Although this is her first time working with a Native American Tribe she has been working with the Tribe for four years and has been exposed to some cultural plants and their uses.

In order to determine whether Claire felt better prepared to instruct others after creating a culturally relevant resource she completed a Pre and Post Activity Questionnaire and participated in a structured interview. Claire selected on the Pre-Activity Questionnaire that she had a low to moderate knowledge of plant science in general, marking a two (disagree) on a scale of one to five. Her perceived understanding of plant science increased from one point to three on the Post-Activity Questionnaire. Claire also marked on the Pre-Activity Questionnaire that she was low to moderately comfortable teaching general plant science to others while responding that she was not comfortable teaching others about cultural plants. Specifically, she indicated her knowledge of cultural plants was limited by marking a two (disagree) on the scale "Strongly Agree / Strongly Disagree." She also marked a one (strongly disagree) that she knew where to find culturally relevant resources to educate others on cultural plants of Native Americans in addition to it being easy for her to find resources to culturally relevant educational materials on plants. After spending a significant amount of time on

the activity, Claire indicated that she was comfortable (four) educating others on cultural plants. This represented a three point shift. On the Pre-Activity Questionnaire Claire marked a one on her cultural plant knowledge and after the activity Claire marked a four, which was a three point increase in a positive direction. In both the pre and post-activity questionnaire, Claire marked a five out of five indicating that having access to culturally relevant educational resources would help her to better educate others on cultural plants. She also marked a five for “Strongly Agree” on both pre and post-questionnaires to indicate having access to modern educational resources would be more beneficial to her when conducting environmental outreach and education activities.

In the structured interview Claire was asked a number of questions to obtain her perspective on access to culturally relevant plant education materials including what specific components of the resources she found most helpful, as well as if the time commitment of creating her own resource was worth it. When asked whether she preferred to create her own resources versus using resources already available she mentioned that she preferred to use existing resources strictly based on time commitment. During the interview questions she did mention that creating her own culturally relevant plant educational resource was worth the time commitment because it exposed her to cultural plants and their uses a multiple times which helped her remember the plants and their characteristics. She mentioned that she was most likely to use her own resource since it was something that she knew and was proud of as well as being the only modern resource that she knew of.

In order to document Claire’s knowledge of cultural plants direct questions in the Pre/Post-Activity Questionnaire were utilized. Additionally, a Pre and Post-Activity

Content Knowledge Self-Assessment and observational records were used to identify actual knowledge of cultural plants. The Pre-Activity Questionnaire showed that Claire's knowledge of cultural plants was marked at a one and her knowledge of cultural plant uses was a two, both being scored on a scale of one to five, with five representing the greatest amount of knowledge. After conducting the activity the same questionnaire was given again and Claire scored herself at a four for both cultural plant knowledge and knowledge on cultural plant uses, a move in a positive direction with a four and three number increase, respectively.

The Pre-Activity Content Knowledge Self-Assessment displayed that Claire was able to write down five cultural plants and their uses. After conducting the activity Claire was given the same Self-Assessment and the number of cultural plants that she knew increased from five to twenty-five. In the pre-activity assessment Claire only wrote down one use for each plant while after conducting the activity she was able to write down multiple uses for most of the plants.

Observational Notes indicated that Claire had minimal knowledge of cultural plants at the beginning of the activity. Claire relied heavily on field guides, websites, and colleagues to identify the correct plant and its use. Towards the end of the activity when Claire had spent considerable time researching cultural plants and their uses, she had memorized approximately twenty-five out of the ninety cultural plants on the list. The Post-Activity Content Knowledge Self-Assessment shows that Ann's knowledge of cultural plants and their uses quintupled, from five plants pre-activity to twenty-five plants post-activity.

In the Pre-Activity Questionnaire where Claire noted that she had minimal knowledge of cultural plants, she identified websites, field guides, and colleagues as the resources she would use to find information. In the Post-Activity Questionnaire Claire had the same response but added colleagues and mobile apps for general plant identification. In the structured interview Claire stated that she preferred to use a field guide book or website, both with high definition color pictures as her primary source. When observed in the field, she actually utilized a variety of field guides and websites. She added that a field guide with large color pictures or an online app would be preferred when educating others on cultural plants.

INTERPRETATION AND CONCLUSION

The results of the data analysis of this study affirm that the activity conducted in this study successfully increased educators knowledge of cultural plant science and resources. All of the data collected through the data collection instruments provided conclusive results towards answering the focus question as well as the two sub questions.

The primary purpose of this study was to inform educators of Native American students of a way to incorporate culturally relevant environmental science activities into their environmental education and outreach plans in order to further engage Native American students. For this study the activity focused specifically on cultural plants of the Dakota Sioux since the participants all worked as environmental educators on a Dakota reservation.

The data collected for the focus question “Does having access to culturally relevant resources help educators of Native American students feel better prepared to instruct to cultural sensitivities?” gave insight into the perspective of the educators

confidence of their abilities to teach about cultural plants. All of the participants had diverse backgrounds in general plant science and were comfortable teaching others about that topic. All participants had some type of knowledge of cultural plants, some a little more than others, but all of them did not feel prepared to teach about cultural plants and did not know where to look to find resources on this subject. After conducting an intense activity of researching and creating a cultural plant field guide, all of the participants comfort levels in their knowledge of cultural plants and their uses and in the instruction of others on those subjects resulted in a shift to having a greater comfort level. All participants also indicated having access to culturally relevant resources would better prepare them to instruct to cultural sensitivities. Participants all independently agreed that they preferred to use existing resources due to the time commitment needed to make their own. The participants noted that by creating their own resource they were more aware of the resources available on the subject, were more knowledgeable of the material, were most likely to use it in the future, and felt better prepared to instruct others about the culturally relevant material. All participants acknowledged that even though the process to create a field guide was time intensive that it was worth it since it instilled the knowledge and confidence previously mentioned.

The focus question lead into sub-question one, “What is the extent of educator’s knowledge on cultural plants?” in order to determine the current knowledge of the participants. The Pre-Activity Participant Content Knowledge results were better than expected, two participants, Beth and Claire, had minimal knowledge of cultural plants although they were able to list four and five cultural plants respectively, which was more than expected. Ann, on the other hand, was able to list ten cultural plant and their uses

before the activity. After the activity the results of the participant's knowledge of cultural plants was significant for all three participants as they were able to list three to four times as many plants as well as their uses. The number rose from four to ten cultural plants pre-activity to twenty to thirty-one cultural plant post-activity (Figure 1). This is out of ninety cultural plants research for the activity.

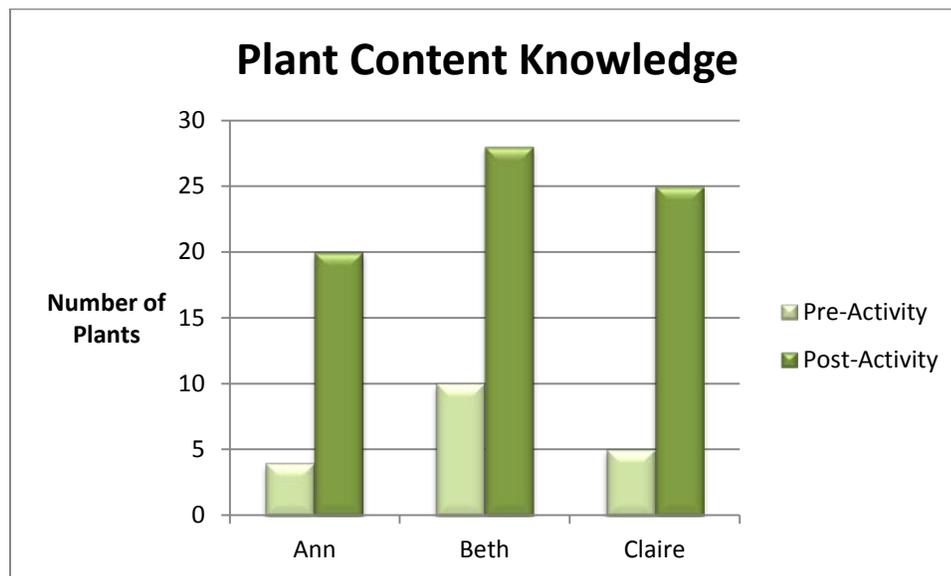


Figure 1. Participant Cultural Plant Content Knowledge.

One participant's perspective on her knowledge of cultural plants important to note was Beth's. On the Pre-Activity Questionnaire, Beth marked a two on her cultural plant knowledge yet after the activity Beth marked a one on the Post-Activity Questionnaire. The possible reason for this could be due to the fact that the activity brought Beth awareness as to the large number cultural plants that exist. Even though her knowledge on cultural plants decreased her score on cultural plant uses did increase one point, most likely due to the fact that of the cultural plants that she did know, she knew a larger variety of their cultural uses.

Sub question #2, “What resources do educators utilize most when researching culturally significant plant information/resources?”, also helped to identify what resources participants used most as well as finding out what key elements of each resource were most helpful. This also helped to guide the finished product of the cultural plant field guide in the activity. The participants relied on field guides, mobile apps, and web sites, as summarized in figure 2, in order to help in identifying the plants and relying on number of websites and old publications from the early 1900’s to gain knowledge of the plants cultural uses. The participant’s biggest frustration was the lack of resources available to gain information on cultural plants as they had to look at many different resources, some being very old, outdated, and hard to obtain. The participants identified the need and their preference of having one resource available to obtain information whether it was in the form of a field guide or a mobile application. Also, due to one participants use of a mobile application for general plant identification, as it provided a variety of detailed high definition photographs of the plants, all participants agreed that having a cultural plant mobile application as being very helpful to use as an educational tool. The key elements they identified in being the most helpful was having, whether it was in the form of a field guide book, website, or mobile application. Specifically they all identified the same key features from all the resources they used that were most helpful that they would like to incorporate into the guide that they were making. These items included large color photos of each plant as well as close up photos of key features helpful in identification such as the fruit of flower, information on the plants, bloom time or fruit time as it can be helpful when identifying the plant, as well as information on when to harvest the plant parts in order to use it for traditional cultural uses. It is also

important to point out here that the participants acknowledged in the results of the surveys that one of the frustrations was that there was no central resource available to utilize which reaffirms the void of culturally relevant material available to educators as identified in the problem statement.

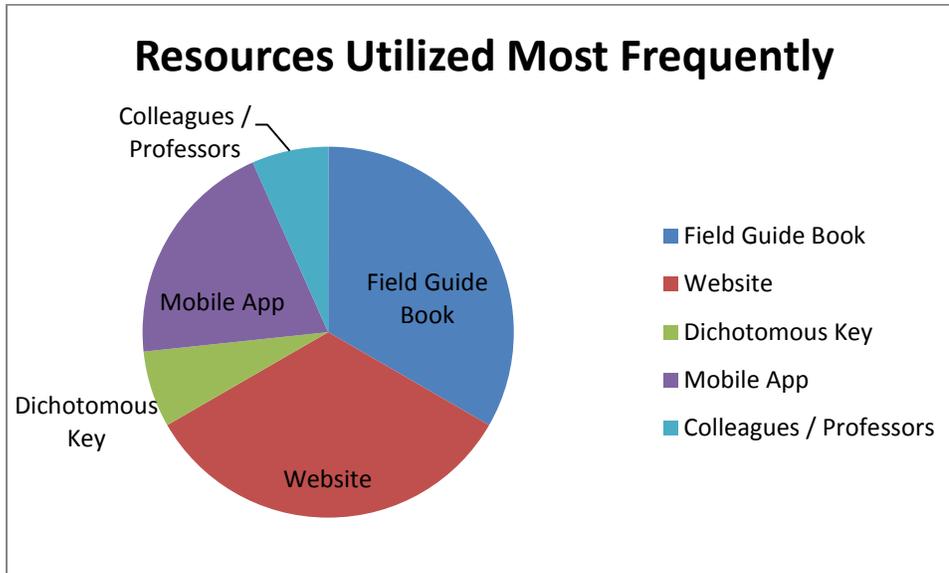


Figure 2. Cultural Plant Resources Utilized Most Frequently.

Some very helpful data collected from this study was the information collected in the structured interview. The participants were asked whether they preferred to create their own resource versus using ones that were already available. All participants answered with a uniform no, that they all preferred to use existing resources as they were readily available. While this may be true all participants were very clear in noting in a number of the questionnaire and interview questions that they learned a significant amount by creating their own resource, that they were more likely to use it in the future, and that they had more confidence using a resource that they created.

In order to take the information in this study and further investigate the effectiveness of creating culturally relevant science material it would be beneficial to use the cultural plant field guide in an educational activity with Dakota Sioux students. This additional research would be helpful to determine the effects of this type of culturally relevant science curriculum on the students learning. Another capacity to focus the results of this research is in the development of additional platforms that could be utilized to convey this information. While the participants in this study focused on the development of a cultural plants field guide all of the participants mentioned how useful it would be to make this type of information available in the form of a mobile application. With the inclusion of technology both in the classroom and in the field, having some type of interactive resource available other than a typical book could potentially help gain student interest in the subject. There were a number of times during this study that the participants used a mobile application on their smart phones to look up color photographs of the plants. Since most students interact with their phones this could be another avenue to reach them.

VALUE

Culturally relevant science resources such as the plant field guide created in the activity is valuable as it provides a resource that fills a need I had identified through my work with a Native American community. The process of completing this study reaffirmed the lack of culturally relevant resources that are available to educators as the participants were frustrated with the limited resources available to complete the activity. The inspiration for the topic of this action research came from my experience of witnessing my coworkers not being well prepared to conduct environmental education

and outreach on the Native American reservation where they worked. This lack of preparedness was not a fault of their own but rather the lack of resources available. Seeing the participants knowledge on cultural plants science grow, their comfort level and preparedness in conducting culturally relevant environmental activities, as well as the pride they had in creating a field guide, provided me with a satisfaction that everyone took something out of this experience. This growth took many forms; by increasing the participants cultural plants content knowledge, an increase in their comfort level in educating others on the subject, learning where to look for the resource, or by having the means to better connect with the students on the reservations. A lot of students get excited at the chance to get outside a regular classroom and participate in environmental activities in the outdoors. As environmental educators on a reservation they are provided the opportunity to take it one step further and help the students learn about science in their environment while at the same time helping the students gain further interest in the topics by making it relevant to their culture and identity. The participants in this study who make up the environmental staff came to their positions with an immense background of knowledge and expertise of science in the environmental field. By helping them to utilize their knowledge and focus on making culturally relevant resources such as what was conducted in this study, they can then build a connection between environmental science, cultures, and personal identities.

As an environmental science educator, I am pleased with the results of this study. It has provided me with a controlled environment to test an intervention strategy and has shown me the benefits of practicing action research. It also reaffirms the attention needed

on this topic and inspired me to continue my research in the further development of culturally specific curriculum for Native American students.

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APPENDICES

APPENDIX A
STRUCTURED INTERVIEW

Structured Interview Questions

Interviewer _____ Date: _____

Participant _____

Time _____

Participation is voluntary, and you can choose to not answer any question that you do not want to answer, and you can stop at any time.

1. What resources do you prefer to use when conducting educational activities related to cultural plants?
2. What resource did you actually use the most?
3. What resource did you enjoy creating the most? Field guide book? Website?
4. Do you prefer to create your own resources or would you prefer to have access to already available resources?
5. Did you feel like you learned more by creating your own culturally relevant educational resources?
6. Do you feel like the time commitment is worth it?
7. After conducting this activity do you feel better prepared to educate others on cultural plant uses of the Native Americans?

APPENDIX B

PRE-POST ACTIVITY QUESTIONNAIRE/ATITUDE SCALE

Pre and Post Activity Questionnaire

Pre and Post Activity Questionnaire

Participation is voluntary, and you can choose to not answer any question that you do not want to answer, and you can stop at any time.

Please rate your beliefs on the following statements.

* Required

I have a good background knowledge on plant science *

1 2 3 4 5

Strongly disagree Strongly agree

I can identify the parts of a plant *

1 2 3 4 5

Strongly disagree Strongly agree

I am comfortable teaching plant science to others. *

1 2 3 4 5

Strongly disagree Strongly agree

I can describe cultural uses of some plants. *

1 2 3 4 5

Strongly disagree Strongly agree

I rely on traditional resources such as printed field guides when trying to identify a plant. *

1 2 3 4 5

Strongly disagree Strongly agree

I rely on modern resources such as online field guides or apps when identifying plants. *

1 2 3 4 5

Strongly disagree Strongly agree

I prefer to use these resources during activities when educating others about plants. *

Field guidebook

Website

Pre and Post Activity Questionnaire

- Online app
- Identification note cards
- Dichotomous key

I have a good background knowledge of cultural plants of Native Americans. *

1 2 3 4 5

Strongly disagree Strongly agree

I know where to find culturally relevant resources to educate others on cultural plants of Native Americans. *

1 2 3 4 5

Strongly disagree Strongly agree

It is easy for me to find the resources I need for culturally relevant educational material on plants. *

1 2 3 4 5

Strongly disagree Strongly agree

Having access to culturally relevant resources would help me to better educate other on cultural plants of Native Americans. *

1 2 3 4 5

Strongly disagree Strongly agree

I have taught others on cultural plants of Native Americans. *

- Yes
- No

I am comfortable on teaching others about cultural plants. *

1 2 3 4 5

Strongly disagree Strongly agree

Having access to modern educational tools such as websites and apps would be more beneficial to me in conducting cultural plant activities. *

- Yes
- No

Please list the resources you would use to find information on cultural plants. *

Pre and Post Activity Questionnaire

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APPENDIX C

PARTICIPANT CONTENT KNOWLEDGE SELF-ASSESSMENT

APPENDIX D

FIELD NOTES/OBSERVATIONAL RECORDS

Field Notes / Student Observational Records

Observer _____ Date _____

Activity _____ Time _____

Location _____

Participant #	1	2	3
Participant Name:			
<u>Resources Utilized</u> Field Guide-Paper copy Note/Index cards Online field guide Online "app"			
<u>How often does the student refer to a resource?</u> Frequently Moderately Minimally			
<u>What is the participants comfort level in using the resource?</u> 1. Very comfortable 2. Moderate 3. Very uncomfortable			
<u>Other Notes</u>			