EVALUATION OF
AMERICAN INDIAN SCIENCE AND ENGINEERING SOCIETY
INTERTRIBAL MIDDLE SCHOOL SCIENCE AND MATH BOWL PROJECT

Grant

No: DE-SC0004058

The American Indian Science and Engineering Society

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Background

The American Indian Science and Engineering Society (AISES) has been funded under a U.S. Department of Energy (DOE) grant (Grant Award No. DE-SC0004058) to host an Intertribal Middle-School Science and Math Bowl (IMSSMB) comprised of teams made up of a majority of American Indian students from Bureau of Indian Education-funded schools and public schools. The intent of the AISES middle school science and math bowl is to increase participation of American Indian students at the DOE-sponsored National Science Bowl. Although national in its recruitment scope, the AISES Intertribal Science and Math Bowl is considered a "regional" science bowl, equivalent to the other 50 regional science bowls which are geographically limited to states. Most regional bowls do not have American Indian student teams competing, hence the AISES bowl is meant to encourage American Indian student teams to increase their science knowledge in order to participate at the national level. The AISES competition brings together teams from various American Indian communities across the nation. Each team is provided with funds for travel to and from the event, as well as for lodging and meals. In 2011 and 2012, there were 10 teams participating; in 2013, the number of teams participating doubled to 20.

Each Science and Math Bowl team is comprised of four middle school — grades 6 through 8 — students, one alternate, and a teacher who serves as advisor and coach — although in at least two cases, the coach was not a teacher, but was the Indian Education Coordinator. Each team member must have at least a 3.0 GPA. Furthermore, the majority of students in each team must be comprised of American Indian, Alaska Native or Native Hawaiian students.

Under the current DOE grant, AISES sponsored three annual middle school science bowl competitions over the years 2011, 2012 and 2013. The science and math bowls have been held in late March concurrently with the National American Indian Science and Engineering Fair (NAISEF) and EXPO at the Albuquerque, NM Convention Center. Albuquerque is also the home of the AISES national office. The AISES staff also recruits volunteers to assist with implementation of the science and math bowl event. In 2011, there were 7 volunteers; in 2012, 15 volunteers, and in 2013, 19 volunteers. Volunteers are recruited from a variety of local sources, including Sandia Laboratories, Southwest Indian Polytechnic Institute students, Department of Defense, as well as family members of AISES staff.

For AISES, the goals of the Intertribal Middle School Science and Math Bowl project are to have more Native students learn science, for them to gain confidence in competing, and to reward their effort in order to motivate them to pursue studies in the sciences and engineering. For DOE, the goals of the project are to get more Native students to compete at the National Science Bowl, held in Washington, DC.

The format of the National, as well as AISES, Science Bowl is one in which teams are quizzed in a fast-paced question and answer session similar to the television show Jeopardy, testing students' knowledge in all areas of science. Thus, the focus is on team knowledge or competition and engagement of student team members in a competitive environment. This format is quite different from the focus of AISES' National American Indian Science and Engineering Fair, which emphasizes individual knowledge of competing students as demonstrated through individual research projects. In this respect, AISES staff have noted that

their student teams don't seem to be as competitive at the national level which may be a result of cultural values and/or differences in the quality of science education provided by their schools. The competing schools for each year of the AISES Intertribal Middle-School Science and Math Bowl were:

2011:

- Aneth Community School, Aneth, UT
- Communities in Schools Academy, Pembroke, NC
- Cruikshank School, Beaver, AK
- Hannaville Indian School, Wilson, MI
- Lac Courte Oreilles Ojibwe School, Hayward, WI
- Native American Community Academy, Albuquerque, NM
- Madison Metropolitan School District, Madison, WI
- Tiospa Zina Tribal School, Sisseton, SD
- Tse'Bit'Ai Middle School, Shiprock, NM
- Wells Middle School, Catoosa, OK

2012:

- Arapaho School, Riverton, WY
- Communities in Schools Academy, Pembroke, NC
- Gila Crossing Community School, Laveen, AZ
- Madison Metropolitan School District, Madison, WI
- Menominee Tribal School, Kashena, WI
- Native American Community Academy, Albuquerque, NM
- Newcomb Middle School, Newcomb, NM
- Norman Public Schools, Norman, OK
- Sacaton Middle School, Sacaton, AZ
- Westville Junior High School, Westville, OK

2013:

- Catoosa Middle School, Catoosa, OK
- Communities in Schools Academy, Pembroke, NC
- Cruikshank School, Beaver, AK
- Gila River Community School, Gila River, AZ
- Grand Coulee Dam Middle School (2 teams), Colville, WA
- Hannaville Indian School, Wilson, MI
- Lac Courte Oreilles Ojibwe School, Hayward, WI
- Menominee Tribal School, Kashena, WI
- Mescalero School, Mescalero, NC
- Native American Community Academy (2 teams), Albuquerque, NM
- Newcomb Middle School (2 teams), Newcomb, NM
- Norman Public Schools, Norman, OK
- Sacaton Middle School (2 teams), Sacaton, AZ
- Tse'Bit'Ai Middle School (2 teams), Shiprock, NM
- Westville Junior High School, Westville, OK

The national distribution of the participating schools was 10 states represented in 2011, six states in 2012, and 8 states in 2013. In 2011, there were 27 tribes represented in the competition; in 2012, 32 tribes; and, in 2013, 29 tribes were represented.

The gender distribution of the participating students was fairly equitable over the three years of the IMSSMB, as shown in Table 1 below, with males being slightly overrepresented, especially in 2011.

Table 1: Gender Distribution of IMSSMB Student Teams

Year	Females	Males
2011	19	27
2012	24	25
2013	52	46
Total	**95**	**98**

The distribution of students by grade in school was somewhat skewed toward the eighth grade; however, grade level data was not available for all years as shown in Table 2 below.

Table 2. Distribution of Students by Grade Level

Year	6th Grade	7th Grade	8th Grade
2011*	14 (30.4%)	13 (28.3%)	15 (32.6%)
2012**	0	10 (27.8%)	26 (72.2%)
2013***	15 (15.3%)	30 (30.6%)	37 (37.8%)

*the percentages reflects that there were actually 46 students; however, grade level information for 4 students was not available.

**information was not available for all 2012 students because 13 students completed the Adult Survey which did not include this item.

***survey information was available from only 82 of 98 students total.

Surveys of participating teams were not conducted in 2011 but were implemented in 2012 and 2013. In both of the latter years, the majority of students — 63.3% in 2012 and 80.5% in 2013 — indicated that this was their first experience attending an AISES event. For most students who had been to other AISES events, the majority of students indicated that they had also attended the National American Indian Science and Engineering Fair (NAISEF), although a few had also attended the National AISES Conference.[1] Only 10 of 42 students in 2012 and only 25 of 82 students in 2013 indicated that they had also submitted a project to NAISEF that year.

Methodology

[1] The results are somewhat skewed in that 83% of the 2013 students did not respond to this item.

This evaluation report is comprised of survey data from the 2012 and 2013 AISES Intertribal Science and Math Bowl, as well as interview data from the coach of the winning team.[2] The survey data was collected by AISES staff manually using paper evaluation forms and data entered into Survey Monkey for analysis. The analysis was limited to quantitative analysis. Qualitative data was not analyzed in Survey Monkey; however, the evaluator did a limited analysis of qualitative data on specific items which were seen as particularly insightful to the goals of AISES for the project. This qualitative analysis was done by manually coding responses by common words and phrases. Furthermore, limited data summarized in AISES reports to DOE was used if relevant to the purposes of the evaluation. Additionally, interviews were conducted with the coaches of the winning teams in 2011/12 and 2013. It should be noted that neither coach was a science teacher per se, but recruited science teachers to serve as tutors and mentors to their teams.

Evaluation Findings

As per the DOE goal of increasing Native student participation in the National Science and Bowl, the winning team from each year of the Intertribal Middle School Science and Math Bowl is sent to the National Bowl. Thus, in each year of the AISES project, there were five students who attended the national event. At the national level, AISES teams have not done well having been eliminated in the first round in 2011 and 2013. In 2012, the AISES team made it through two rounds before being eliminated. In 2011 and 2012, the winning team was from the Madison (WI) Metropolitan School District. Their exposure to the national event in 2011 no doubt assisted them in gaining confidence to do better in their second year of competition. In 2013, the winning team at the AISES Intertribal Science and Math Bowl was from the Norman (OK) Public School District.

The overwhelming majority of students each year (98% in 2012 and 91.5% in 2013), for which survey data is available, indicated that participating in the Science and Math Bowl increased their awareness and interest in the science, technology, engineering and math (STEM) disciplines. Of those students responding negatively to the item — 1 student in 2012 and 7 in 2013 — most gave a vague response: “I don’t think it helped,” “I didn’t understand some of it,” “I don’t think it helped,” “No, because we lost,” etc. The vast majority of positive responses related to the experience being interesting, fun, challenging, helping him/her to set higher goals, increased awareness of more careers, increasing their sense of self-esteem (e.g., “feel smarter now”), as well as it being an opportunity to make new friends.

The majority of participating students — 41 (83.6% in 2012 and 70 (85.4%) in 2013 — felt that participating in the event increased their level of confidence in doing science and math. For both years, the vast majority (83.9%) also indicated that their parents and/or teachers encouraged them to take advanced courses in math or science. Furthermore, all but one student indicated that they planned to go to college. The top fields of study mentioned were math and/or science (19), engineering (13), medical (9), biology (8), and technology/computer programming,

[2] Survey data were not collected for the 2011 Science Bowl.

forestry, culinary arts (each mentioned four times).[3] Additionally, 86 students (72.9% of 118 total) of students combined for both years indicated that they saw themselves as becoming a scientist or engineer; only 28 students (23.7%) answered in the negative.

For both 2012 and 2013, of adult respondents, the majority (14 of 27 total or 51.9%) were teachers; the next largest categories of adult participants were parents (5 of 27 or 18.5%) and school administrators (4 of 27 or 14.8%). Twenty (74%) adult participants indicated they worked in STEM fields. When asked about the quality of preconference materials and instructions, adult respondents gave the highest (37%) or next highest rating (51.9%) rating; only 3 respondents gave a score in the middling range. The understandability of the materials was given the highest rating by 55.6% of adult respondents; the next highest rating was given by 33.3% of adult respondents. Sixty-three percent of adult respondents had attended other AISES events, with 37% citing NAISEF, 22% citing the AISES National Conference and 25.9% citing the Power Up Science Fair Workshop — it should be noted that 7 of 27 adults did not respond to the item. Regarding whether they thought Science Bowl participation increased their students' awareness and interests in STEM disciplines, 100% of adult participants responded in the affirmative for both years. 92% of adult respondents thought that they believed participation in the Science Bowl increased their students' confidence in doing STEM activities. Twenty-five of 27 (92.5%) adult respondents indicated they planned to apply for the Science Bowl in the following year. When asked what inhibits them from having students participate in STEM related programming, the most common factors cited were costs and funding (eight respondents) and commitment/time (3 respondents). All adult respondents thought that conducting science fairs and/or science bowls, both locally and through groups such as AISES generated students' interest in STEM fields.

Additionally, both the adult and student surveys asked respondents to provide additional comments. It should be noted that many respondents who chose to provide additional comments were generally positive. Below are noted some of those responses.

Students:

- liked the experience
- i liked meeting new people and different races
- the science bowl is fun and is a challenge
- you guys did a good job thank you
- was awesome
- the people were nice
- you didn't leave anything out
- The people were what made the experience wonderful.
- I believe that this was a very interesting, organized company and thank everyone who helped out THANK YOU SO MUCH!!!
- great experience! it is fun!
- (Did you like the Science Bowl?) YESS!
- Had a great time overall.

[3] Law, nursing, forensics, astronomy, geology, physics, psychology and sports science were also cited.

- I like the event.
- This was a great experience.
- The Science Bowl was a fun and good learning experience.
- We very much enjoy the event!
- I love being here, next year I'm thinking about doing both.
- Thank you for paying our way to and from
- Fun.
- Science rules.

Adult survey responses were generally as positive about the IMSSMB and complimentary of the AISES staff and volunteers.

As was noted earlier, the evaluator conducted interviews with the coaches of the two school districts that won the AISES Regional Science and Math Bowls in each of the three years of the project. Their responses to the interview questions were insightful. The team that won in 2011 and 2012 spent approximately four to five hours per week (1 hr. x 2 weekdays and 2-3 hrs/Saturday) in preparing for the competition. During the first year, they did not start until January when they were selected; however, knowing that they needed more time, in the second year, they started in November in order to feel more prepared. In 2012, this school district had two teams, each with its own science teacher/tutor. The 2013 winning team spent 1 ½ hrs/week over 8-10 practice sessions starting in February. This group also worked closely with members of their local AISES collegiate chapter serving as tutors.

Both schools indicated that parental support and parents' high expectations for students' academic success were crucial to their success. The 2011/2012 winners had all sets of parents attend the AISES Science and Math Bowl, as well as the National Science Bowl, in the first year; in the second year, two sets of parents accompanied team members to the AISES competition. The 2013 winning team had three sets of parents attending the Albuquerque competition; furthermore, one parent serves as the coordinator of the school's Science Club and the liaison with its local collegiate AISES Chapter.

The biggest factor in their success, cited by the 2011/2012 winners' coach, was that there were two strong students on each team who went to good schools who assisted the other students who may not have been as strong in their abilities or competitive skills. The coach indicated that she kept track of who was strongest in math or science, and had them focus on those areas and were provided with additional "fact books" to help them, in addition to the AISES kits. The coach of the 2013 winning IMSSMB team cited the fact that they had two students who competed the previous year as being a helpful factor.

Both coaches indicated that their team members were somewhat intimidated by the caliber of competition at the National Science Bowl, but thought their students enjoyed the experience, as well as visiting Washington, DC sights. Both thought the level of competition at the AISES Science and Math Bowl was as rigorous as other regional competitions, but probably not as rigorous as the National event. One coach mentioned that since they were from an urban school district (as was the other AISES winning school), they were comfortable with the National Science Bowl experience, but thought other American Indian teams that came from smaller, rural or reservation schools might be somewhat at a disadvantage.

Recommendations

Both coaches felt that AISES needs to provide more guidance and information on the fact that winning teams have to build a car at the National Science Bowl as a critical event of the competition; this is known as the Hydrogen Fuel Cell Model Car Challenge. It was noted that while this was mentioned in the AISES application materials, more emphasis should be made in order that teams are aware and well prepared before coming to the Albuquerque event. It was suggested that a short presentation on this at the AISES Science and Math Bowl would drill this important point home so that they are thinking about getting the necessary support/help in advance of winning.

Another important factor cited was for AISES to consider having the application and selection process earlier, perhaps before Christmas break or even earlier so that teams can prepare over a longer period of time. It was also mentioned that a tour of the University of New Mexico campus, perhaps with members of the UNM AISES Chapter serving as guides would be motivational to Bowl participants. Both respondents thought the format of the Bowl is excellent and that the event was a great experience for their students.

Similar to the recommendation that AISES consider sponsoring a tour of UNM, several adult survey respondents also mentioned that AISES-sponsored tours of the Albuquerque Museum of Natural History and Science would have been appreciated. AISES staff may want to consider these ideas for future programming.

From an evaluator's perspective, I would recommend that the survey used in Survey Monkey be revised in terms of item 14 and 15. Item 14 asks as an additional comment, "If not, do you have any suggestions on sparking student interest [in STEM]?" This should be a separate item restated as "What other suggestions do you have for sparking student interest in STEM courses?" Item 15, presently stated as "Other comments:", would benefit from being more specific, i.e., "How might we improve the AISES Science and Math Bowl?". In that there may not be other IMSSMB's, these suggestions would apply to other questionnaires for other AISES projects.

Furthermore, only the 2013 list of student team members collected information on gender of the student (and it seems in relation to only making sure that T-shirt sizes were gender appropriate), AISES should make it a routine practice to collect gender information in light of the fact that gender is still an important factor in students going into STEM fields. Similarly, it is important to collect information on what grades student team member are in — the only place in the AISES materials reviewed by the evaluator where grade level was mentioned was in the surveys (which was anonymous) and in some of the student bio-statements in the IMSSMB programs. Such information would be useful to collect in terms of doing longitudinal analysis of team performance.