

ACADEMIC COMPETITIONS: PERCEPTIONS OF LEARNING BENEFITS FROM A SCIENCE BOWL COMPETITION

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Abstract

The National Science Bowl® emphasizes a broad range of general and specific content knowledge in all areas of math and science. The achievements made through the science bowl experience are independent of the classroom environment and generally occur because the student has volunteered on his/her own to enter the competition and be part of the team. An important question to ask in light of the effort it takes to run regional or national science competitions is whether or not the event makes a difference to the student. And if it makes a difference, does it improve student learning or student attitudes about science. The data indicates that a statistically significant portion of the students competing in the Northern New England Regional Science Bowl Competition report that the event has a positive impact on the participants and fosters learning in science and mathematics. These data support findings that have been reported for other forms of academic competitions that are involved with science and mathematics.

Keywords: National Science Bowl®, Academic competition, learning

Introduction

Since 1991, the Department of Energy's (DOE) National Science Bowl® has been sponsoring annual regional and national competitions for high school students across the United States, Puerto Rico, and the U.S. Virgin Islands. This program was started to encourage students to increase their participation in math and science and to consider careers in those fields. In 2002, the competition expanded to include middle schools. These competitions feature teams of four to five students answering multiple choice and short answer questions in the areas of Science, Math and Technology. There are currently 67 regional high school competitions and 36 middle school regionals. The high school competitions involve more than 15,000 students and the middle school more than 6,000. The winning team from each regional event is invited to Washington D.C. to compete against the winners of the other regional events.

The National Science Bowl® emphasizes a broad range of general and specific content knowledge in all areas of math and science. The achievements made through the science bowl experience are independent of the classroom environment and generally occur because the student has volunteered on his/her own to enter the competition and be part of the team. However, each team must have a coach, which can be a parent or other interested person, but is usually a high school science teacher.

An important question to ask in light of the effort it takes to run regional or national science competitions is whether or not the event makes a difference to the student. And if it

makes a difference, does it improve student learning or student attitudes about science. Abernathy and Vineyard completed a study of students competing in the Science Olympiad published in 2001 asking students why they participated in the event. The number one reason for participation in the Olympiad was because they felt it was fun. The number two reason for participation was because they enjoyed learning new things. These findings were true for both male and female participants (Abernathy & Vineyard, 2001). In this case the participants seem to be saying that they think learning science and math is fun! Abernathy & Vineyard suggest that competitive events “may be tapping into students’ natural curiosity and providing a new context for them to learn in, without rigid curriculum or grading constraints” (2001, 274).

It has been suggested that the competitive events, such as the National Science Bowl®, may provide the “initial motivation” that is the spark for getting students to discover the joy of learning (Ozturk & Debelak, 2008). Academic competitions can provide motivation for students to study and learn new information or strengthen previous learned material so that they will be ready to compete with their peers from other schools both regionally and nationally. This type of motivation is difficult to provide for students in a normal classroom environment. While it can be argued that this is solely extrinsic motivation and not the best thing for students to be dependent on, it can however, provide a starting point for the student to progress into an intrinsic discovery of the joy of learning science and math.

One of the more important affective benefits of students participating in competitions such as the National Science Bowl®, is that the participants who may be the elite members academically within their home school (big fish in a little pond) get to test their knowledge and skills against the students from other schools who will be their peers once they get to college and then into the world of work. Ozturk and Debelak put it this way; the students “learn to respect the quality of work by other children and to accurately assess their own performance in light of the performance of their intellectual peers. They achieve an accurate assessment of where their level of performance stands in the world of their intellectual capacity and, in turn, develop a more wholesome self-concept” (2008, 51). Developing a more accurate self-concept is an important step for a child to go through on their way to becoming a healthy and mature adult. In the case of elite students who have never faced stiff competition or challenges to their academic abilities, this is often a difficult trait for educators to help students develop in their home school situation.

According to Ozturk and Debelak, “Academic competitions can teach children how to succeed and also how to fail, that is, how to face their failure, learn from their failure, and, subsequently, grow as a person and improve in performance” (2008, 52). This again may be one of the most important aspects of intramural academic competitions that cannot be easily provided to students in a normal classroom environment, learning to fail and being able to cope with the self-esteem and emotional aftermath. Being thrust into a situation where the participant must cope with failure (even after they prepared and did their best), promotes the development of a student’s self awareness. Academic competitions such as the National Science Bowl® and its many regional competitions may provide the type of environment that causes students to reflect on their knowledge and abilities and self-evaluate their image, promoting improved personal growth and development for the participants.

There are numerous reports of how over the top competitiveness can cause anxiety and undue stress (see for example Davis and Rimm, 2004). We all can remember our psych 101 course describing things such as test anxiety and how this can affect student performance and achievement and lead to low self-esteem. Davis and Rimm also report that competition can promote high levels of achievement and productivity. Some students seem to need to compete with others in order to push themselves to produce at a higher level. It would follow that well organized competitions such as the National Science Bowl® and its many regional

competitions, could help to promote high levels of achievement and productivity in the participating math and science students. Part of the increased levels of achievement and productivity may be due to an increase in teamwork and study skills promoted by the participation in this type of academic competition. Bishop and Walters (2007) report that the students involved in competition increased their abilities to be leaders and team players. They further report that academic competition teaches the participants “how to study, how to communicate, and how to effectively manage challenges” (2007).

What do the students get from this competition?

Methodology

A survey was developed to give to the students who compete in the Northern New England Regional Science Bowl Competition that was intended to gather information about what type of impact the students perceive the competition has on them and other students. The questions were developed by the regional science bowl coordinators and distributed to the students on the actual day of competition that takes place in late February or early March of each year. The students in the Northern New England Regional Science Bowl Competition come from the three northernmost New England States, Maine, Vermont and New Hampshire. The competition is an extra-curricular activity and so the students in grades 9 – 12, have self-selected to be part of a team to practice and compete during non-school hours. Due to the self-selection process, it would follow that the students making up the teams are the better academic students who have found previous success in Math and Science. These students tend to like math and science and are pre-disposed to participate in activities involving these subjects. The teams of students come to the University of Southern Maine on a Saturday to compete in a one day event that culminates with a single elimination tournament round with the winner being offered an all expenses paid trip to Washington D.C. to compete with other regional winners for the national championship. It is during this one-day event that the students are given the survey and asked to respond to the questions below. Completing and returning the survey is voluntary, although the students and coaches are encouraged to do so to make the competition a better experience.

The Instrument

The first part of the survey was constructed to get some general background information about the students and their role in the day’s competition.

This section was a simple checklist of:

This is my first experience

I’ve been at previous science bowls here

I was a volunteer today

I am a spectator/guest

I was one of the student competitors today

I am a coach of one of the teams

The next set of items was intended to gain insight into the students’ perceptions of how the regional competition affected the students taking part in the day’s activities and events.

The questions consisted of 3 Likert-type response choice items:

I think this competition had a positive impact on the students:

Quiz competitions foster student learning about science and mathematics:

Quiz competitions are stressful in a negative way:

Each of these questions had a five choice scale that ranged from strongly agree to neutral to strongly disagree.

There were also two open ended questions:

The thing I enjoyed most about today was:
 What I would recommend for next year:
 And finally a yes – no question of:
 I'd like to come back next year:
 (See appendix A for a copy of the actual survey used)

Findings and discussion

For the purpose of this study, we started collecting data during the 2004 Northern New England Regional Science Bowl competition and continued to collect data through the 2009 regional. This longitudinal approach has provided six years of data composed of a constant mix of new and returning students. Throughout the course of the study, there was an almost equal distribution of first time and returning students who responded to the survey. Although the survey was distributed to students, coaches, and other volunteers who took part in the events, only the results of the students were used as part of this report. The voluntary nature of conducting the study produced an average of 15% of the students per year completing and returning the survey.

In 2007, Bishop and Walters discussed the viability of using a similar survey with students that also used a Likert-type scale to self-report information about how the National Ocean Sciences Bowl (NOSB) influenced their choice of major and courses in college. Bishop and Walters further triangulated their data using follow-up interviews of the students, information of the colleges the students attended and lists of the college courses the students took following their participation in the NOSB. Their longitudinal study, which took place from 2000 – 2007, established the credibility of the students' self-reported data using this type of survey (Bishop and Walters 2007) and so we feel confident in the credibility of the data collected in the study reported here.

Of the students participating in the Northern New England Science Bowl who responded to the survey during the study period 93% either agreed or strongly agreed that the competition had a positive impact on them.

Year	2004	2006	2007	2008	2009
mean	4.1	4.7	4.8	4.3	4.7
SD	.60	.42	.40	1.1	.45

Table 1: Based on a 5 point Likert scale with 5 being the highest.

Campbell & Walberg (2011) suggest that this positive impact follows the students throughout their life. Willingness to participate in events on their own time, especially on the weekend, demonstrates a high level of positive engagement that would lead to feelings of positive impact. Akey (2006) reports that “student engagement and perceived academic competence had a significant positive influence” (p 16) on achievement. The significant data that was self-reported by the students seems to indicate that the students also perceive that they are academically competent in math and science, and that is why they participate. This mirrors the findings of Abernathy and Vineyard (2001) who reported that academic competitions tap into the natural curiosity of students and provide an arena for them to learn new things. The Science Bowl event could provide the platform for these students to excel and finally get the recognition they deserve and crave. Further, Ozturk & Debelak (2008) report that academic competitions may provide the motivation to find the joy in learning. Curiosity and motivation are important aspects of learning that would be considered as having a positive impact on the lives of the participants in academic competitions like the National Science Bowl®.

In addition, 91% of the students responding reported either they agreed or strongly agreed that the Regional Science Bowl competition fosters student learning in Science and Mathematics.

Year	2004	2006	2007	2008	2009
Mean	3.9	4.6	4.8	3.8	4.6
SD	.98	.49	.40	.98	.49

Table 2: Based on a 5 point Likert scale with 5 being the highest.

Again this appears to support the research done by Abernathy and Vineyard (2001) that academic competitions provide a forum to stimulate the students' natural curiosity about learning new things and also the work of Ozturk and Debelak (2008) concluding that academic competitions may provide the motivation required to get students started on a path to discover the joy of learning.

In this case it seems to be learning in Science and Math.

The high positive response rate of these two questions appear to indicate that the student participants in the Regional Science Bowl Competition are developing a strong positive sense of self. These responses indicate that the participants are reflecting on their experiences to help develop a more complete self-image and perhaps an increased sense of their personal competence. Bishop and Walters (2007) report that an enhanced sense of personal competence or capability "translates as a very high factor influencing career choice." Continuing this further, it would follow that academic competitions such as the National Science Bowl® and its associated regional competitions which appear to promote an increased sense of personal capability in the participants would in turn be an experience that positively influences the students' career choice.

Interestingly, the same students who reported that the Science Bowl competition has such a positive effect on them in general and a positive effect on their learning did not necessarily think the competition was unstressful. Only 61% disagreed or strongly disagreed that the quiz competition was stressful in a negative way.

Year	2004	2006	2007	2008	2009
Mean	2.3	2.0	2.1	2.6	2.1
SD	.79	.69	1.17	1.02	1.1

Table 3: Based on a 5 point Likert scale with 5 being the highest.

Maybe it was the way we worded the question that they students equated quiz with test and thus tended to rate this question neutral to correct. It could also be that the students equate any kind of stress with being negative and so if they perceived that the competition created any level of stress no matter how small, that this was a negative situation.

In the open-ended question that asked what they enjoyed the most about the Science Bowl, the number one response was competition, the second highest response was meeting like-minded people, and the third was the hands-on activities. These students seem to be saying that they feel that testing their knowledge and skills in Science and Mathematics against other similar ability students is fun! Maybe this is because they are beginning to respect or realize the quality of their work as suggested by Ozturk and Debelak (2008). It has been suggested that academic competitions (such as the Science Bowl) give students the opportunity to compete mentally the way athletic competitions allow them to compete physically (Parker, 1998). Maybe this is because that these students get the same kind of "high" that athletes get during competition, and that the thrill of academic competition releases endorphins much the same way that athletic competition does.

Summary

The data indicates that a statistically significant portion of the students competing in the Northern New England Regional Science Bowl Competition report that the event has a positive impact on the participants and fosters learning in science and mathematics. These data support findings that have been reported for other forms of academic competitions that are involved with science and mathematics. (See Campbell and Walberg's 2011 studies of the Science Olympiad). Such self-reporting indicates that the students have a high level of perceived personal competence, a high level of engagement in math and science activities and

a high level of motivation toward these academic subjects. Competence, engagement and motivation are factors that have been reported to strongly promote academic achievement, personal growth and career choices in those areas. If the education community is seeking to increase student interest and participation in science and mathematics majors and in turn science and mathematics careers, then academic competitions such as the National Science Bowl® may be an important part of the overall stimulus package that makes this happen.

Recommendations

With the release of recent papers such as “Steady as She Goes? Three Generations of Students through the Science and Engineering Pipeline *” (Lowell, et al, 2009) we feel an ethical responsibility to continue the investigation of whether or not science competitions represent meaningful positive contributions to the experience of students. We recommend surveys for all the National Science Bowl® middle school and high school science bowl competitions. The surveys should be standardized, with optional regionally-based questions, and should be part of a designed study that can inform future science bowl decisions. The surveys should also be followed up by a focus group interview that could provide greater depth to our understanding of the findings.

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- Comment Card for Volunteers: Please be sure to fill out a comment card and turn it in at the registration desk, even if you are not here for the entire competition. This will help us do a better job
- Northern New England Science Bowl 2009
- Comment card. Please turn in at registration table before you leave today.
- This is my 1st experience I was a volunteer today
- I've been at previous science bowls I am a spectator/guest
- I am a coach of one of the teams
- I think this competition had a positive impact on the students
- Strongly Agree Agree Neutral disagree Strongly disagree
- Quiz competitions foster student learning about science and mathematics
- Strongly Agree Agree Neutral disagree Strongly disagree

Quiz competitions are stressful in a negative way

Strongly Agree Agree Neutral disagree Strongly disagree

The thing I enjoyed most about today was: _____

What I would recommend for next year is: _____

I'd like to come back next year: yes no