SCIENCE FAIR SUCCESS: HELPING STUDENTS PRESENT THEIR PROJECT

by

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In presenting this professional paper in partial fulfillment of the requirements for a master's degree at Montana State University, I agree that the MSSE Program shall make it available to borrowers under the rules of the program.

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ABSTRACT

The intent of this action research was to determine which presentation method of science fair project would benefit eighth grade students. Students are allowed to choose between a 10 minute oral presentation or a traditional tri-fold display board. Students were surveyed to determine their skills and beliefs and then provided with a recommendation as to which type of presentation would make them most successful. The results show no difference in success based on the type of presentation. The most important factor in science fair success was determined to be effort invested by the student not the type of project chosen by the student.

INTRODUCTION AND BACKGROUND

Project Background

All GHP (gifted high potential) science students at Orefield Middle School are required to complete a Science fair project and present their results it to a team of judges. The students are presented with the choice of either a 10 minute oral presentation aligned to a PowerPoint that they present via transparency slides or a tri-fold display board with visual documents affixed to it. I teach eighth grade Physical Science in Orefield, Pennsylvania, which is a northern, rather affluent suburban area close to Allentown, Pennsylvania. Orefield Middle School is one of two middle schools in the Parkland School District. The district has a total student population of 9280 students, with 85% White, 6% Asian, 5% Hispanic and 3% African American. A total of 8% of students in Parkland School District receive free or reduced lunch. Of these students I teach 125 total eighth graders, and I have two periods of GHP (gifted/ high potential) students for a total of 45 students included in this study. My students are grouped by their choice of science level. To enter into GHP science each student and their parents are presented with a teacher recommendation of Physical Science or Gifted/High Potential Physical Science for eighth grade. The students and their parents are presented with a recommendation from their seventh grade science teacher for consideration and allowed to choose the course that best fits their student.

Each GHP student must choose a topic for science fair during October of their seventh and eighth grade year and design an experiment that follows the scientific method and have it approved by their science teacher. The content and area of science

focus are entirely up to the student. The choice of presentation method is made by the student with little input from the teacher. The choice of presentation stylye was presented to students at a Science Fair introductory meeting in early October. Dianne Haberstroh, Science fair Coordinator, gathered all GHP Science students in the school auditorium to overview both types of presentation and the entire science fair process. The students viewed this presentation about science fair and are then were presented with a binder that outlines the process.

Students filled out all associated paperwork and submitted completed paperwork to their science teacher along with a definitive research plan regarding their chosen topic, and then are entrusted with experimentation between November and mid-January of the school year. As January comes, science teachers help students analyze their data, draw conclusions and prepare their presentation for judges. The students are judged by a team of current and/or retired science teachers that are not their science teacher, and this helps to eliminate any bias. All students are graded using a standard rubric that is used by our school and all outside competitions. The judging of projects takes place during the third week of February. Grades are returned before the end of February, and students are finished with the school sponsored portion of science fair.

At this point, students who have presented orally at the school science fair can opt to compete in the Pennsylvania Junior Academy of Science (PJAS) Region 2 competition. The students who compete at the regional level and receive a first place award are invited to compete in the PJAS state level competition at Penn State University during May. The goal of many students is to make it to the state competition and visit Penn State for the three day trip.

The processes of science fair topic selection and presentation method choice have traditionally not been well developed. Students are presented with a binder containing all required information for the project and presentation and given a timeline of due dates. They are charged with working independently. This requires a very driven student. The GHP curriculum is the same in scope and sequence as the regular Physical Science course, but the addition of science fair into the curriculum does not include any extra instructional time. The majority of science fair instruction is given in lieu of the prescribed science curriculum and thus is limited. This presents the students with a very independent project. The lack of teacher involvement can be detrimental to the success of students. The choice of presentation method typically falls onto the student to choose what they like better or what someone else advises. The draw of PJAS at Penn State is also a significant reason students choose their presentation method. The school population of students are split between presentation methods with approximately 50% presenting an oral presentation and 50% choosing the traditional display board method. Students choose the oral presentation predominantly to participate in PJAS, but are typically fearful of the oral presentation component. If the PJAS competition was not existent, my conversations with students show most (85%) would choose the display board method of presenting their project.

I feel that a more informed choice by the student of the presentation method will lead to a better science fair experience and allow the student to be more successful in the process. I designed attitude and learning style strength inventories to align students with a presentation style that is suited for them individually. After completing the surveys each student was given a recommendation and reasons why they were better suited for an oral

or visual presentation style. This prescribed choice should make the experience easier and less time consuming.

The questions to be answered in this project include:

- How does a more informed student choice of the presentation style of a science fair project improve the science fair experience?
- How can a presentation style aligned to the learning style of a student improve the retention of scientific content?
- Does a presentation style aligned to the learning style of a student affect the stress level of a student when presenting?
- How does a more informed student choice of presentation style impact the student's grades?

The significance of this research project will extend to a variety of groups. Students who take the provided advice and prepare a science fair project best suited for their personal strengths should learn more, perform better, and have less stress than other students who do not use the recommended style. The effect of the students' benefits should positively impact their parents in the same ways, and is also intended to improve the experience for judges and teachers. Judges should not see overly stressed students and should receive a student better prepared to present their research. Teachers should have less interruption and require less effort during the presentation preparation time period.

A team of teachers assisted me in my preparation of the project. These teachers included: Kelly Tedesco, eighth grade Language Arts teacher; Dianne Haberstroh, seventh grade science teacher and science fair coordinator; Lisa Brown, Montana State

Program Manager and former science fair chair and Walt Woolbaugh, Montana State Education Professor.

CONCEPTUAL FRAMEWORK

Literature Review

Studying relevant literature proved to be a daunting task. I began searching for science fair and presentation style research and was left without any relevant articles. I was able to loosen my search and find articles relating to the educational value of science fair projects. I did not find articles that combine my prescribed topic of using PowerPoint to present science fair project compared to a traditional display board, but feel that authors that have studied the value of science fair to education will help define my project. I was surprised a study like mine has not been found. Many students in Pennsylvania compete in a statewide competition funded by PJAS (Pennsylvania Junior Academy of Science) and assisted by scientists to earn a trip to Pennsylvania State University and be honored for their work. This competition requires students to orally present their project at the local, regional and state level and I assumed there would be studies done to affirm the value of these methods. Unfortunately, the relatively recent increase in technological presentation methods has not been well documented in research.

Findings that Provide Direction

The purpose of this action research is different than the literature found, but the background and foundations have been documented previously. Predictions of success in science fair have been studied by researchers rather recently. Czerniak (1996) studied students' success in a science fair competition and found predictors of success. Her study

focused on 142 secondary science students in Ohio who participated in the district science fair. She found grades could be aligned to three main coefficients. Parental help, parental pressure and science self-concept were found to directly correlate to science fair project grades.

In her exploratory study, Czerniak (1996) also identified demographic variables that predicted success in the science fair competition. These variables included gender, ethnicity and parents' level of education. Each of these variables were studied and determined to have a positive correlation to the success of the project. The success of the project is only one factor in my research and will not be as important as the choice of presentation style.

Another study that directly relates to the purpose of my project was carried out by Dr. Watson (2003) to determine if science fair projects are more content or process related. His intent was to recognize how different the science fair project is from typical classwork, and determine whether this project increases learning. He focused on ten middle school students in an urban Tennessee school. His research says simple recall is not a valid reason to have students participate in a science fair project, and the process of performing science may or may not be a valid reason to perform the project. These questions were analyzed and it was determined that "students gain confidence using the process, but remember little to no content about their own scientific inquiry" (Watson, 2003, p.7).

These studies show that the process of scientific inquiry involved with preparing a science fair project are well engrained in the American educational system. The project is designed to work generally the same in schools across the nation. The style of

presentation varies from place to place, but the process can be generalized as a study of the scientific method. Students research a topic, perform an experiment that follows the scientific method, and present their findings to be judged. Both articles by Czerniak and Watson identify the values of the project and lend value to the purpose of my project.

Theoretical Articles

Teachers face enormous challenges to effectively prepare all students for a technological and global society that includes an ever increasing diverse range of student abilities (Green, 1999). The dynamics of science fair as a learning experience can be used as a prime example of a project that has the ability to engage many types of learners. This long term, outside of class project allows students to use the learning styles that best fit their personality. Gardner's 1993 research into multiple intelligences defined the variety of learners and classified them according to their skills. Gardner's research leads us to the conclusion that all students must be given opportunities to express their varied talents and to apply complex problem solving that needs to follow learning. Like the brain, good teaching should orchestrate all dimensions of parallel processing, and it must be based on theories and methodologies that make such orchestration possible (Caine & Caine, 1990). Science fair allows the student to engage their brain and meet the needs of the mind to discover and analyze (Caine & Caine, 1990). The choice of an experiment is a personal one for the student, the teacher guides choice; but ultimately it is the student's choice. This individualism is not common in a normal science curriculum and allows the student to personalize the learning experience. Personalizing the experience will hopefully cause the student to connect emotionally to their project.

Emotions are critical to memory because they facilitate the storage and recall of information (Caine and Caine, 1990). Students' emotional connections to their experiment trigger learning and development and may improve retention due to the personal connection. The learning that takes place during the experiment is enhanced by the challenge of the process. One of the goals of the process is to challenge students to use the project as a way to draw conclusions. This challenge is structured so that the brain will be optimally challenged to process learning. According to Caine and Caine (1990), the brain learns optimally when appropriately challenged. The overall purpose of this project is to challenge the brain to move from memorizing information and using the scientific method to create meaningful learning. The overall focus of learning should be teacher led and delve into appropriate subject matter that uses the senses to make observations and draw conclusions (Eiszler, 1983). Brain based learning and individual styles of learning are current hot topics in education and led me to psychological research that pushes to allow individuals to express themselves in their own ways. Science fair and the associated choices focus on this method of educating.

Findings that provide help with methodologies

The conceptual framework and associated purpose of my action research has been evident since inception, and it can now be backed up with appropriate literature. The data collection portion continues to prove to be more of an enigma. Research helped to lend ideas, but the search for methods to collect data continued to be a challenge in the process of formulating a valid plan. One article that helped related to teacher opinions concerning science fair. Although my project focused on student retention of content, this article

presented a survey and analysis that lent assistance. In it Michael Grote (1995) defined the science fair project as involving background research, a student defined experiment, and a report on the results. He continued to use this definition to determine teacher opinion whether teachers valued science fair or not. My research included questions like these, but I had to change the focus of the questions and the wording to adapt to middle school student's abilities and focus. Grote then collected all of the answers from the Likert Scale responses and calculated percentages for each. These results were then presented in tabular format that was easy to view and showed the important responses. Later in the analysis section certain responses were probed deeper and presented as graphs to visually show the importance of data. This helped me to formulate my plan.

Another article that helped with data collection was authored by Charles Eiszler (1995) and relates to adolescent preferences. In this article data was collected in a variety of manners, but two of the methods assisted in my data collection. Eiszler intended to determine learning styles and used a Learning Style Questionnaire that was adapted to a four point Likert Scale. Students were presented with specific statements that required responses. The statements were grouped in three different introductory categories: "If I have to learn something new, I like to learn it by…", "The things I remember best are the things…", "In my spare time I really like to…" (Eiszler, 1982, p. 235). Each of these options was then coded to students having visual preference, auditory preference, tactile preference, or kinesthetic preference. The type of preferred learning style was beneficial to help determine if one presentation style aligns with a specific type of learner and allows better retention of content. This information led to future recommendations that assisted students in choosing a presentation style that best suited their style of learning.

Eiszler (1983) also uses GPA (grade point average) as an indicator of preference. The student's past performance in science was calculated and used as an indicator of performance and success. This quantitative measure allowed an interesting way to determine if classroom success transferred to success in science fair. This comparison was not originally considered, but was easy enough to collect and organize that adding it was not detrimental to my project. The research led me in a direction of formulation of a plan to best assess students' skills and recommend to them the presentation method that guaranteed the most successful science fair experience.

METHODOLOGY

My treatment included two initial surveys that were presented to my 45 GHP students during the first week of November 2011to help determine which style of presentation was better for them. The first found in Appendix A was intended to give information about the individuals and their attitudes toward the presentation types and solicit any extraneous circumstances that may have influenced choice. It focused primarily on beliefs and attitudes about their perceived abilities to present information to others. The intended result was to begin aligning students to a presentation style (oral presentation or display board presentation). The assessment was also used to screen out any outliers and identify any individuals that may not make a presentation style choice that was best for them. Students can only compete to get to Penn State with an oral presentation. I do not intend to remove these individuals from the data collection, but

instead identify them appropriately. The students completed the first survey and then were presented with the second.

The second survey was a 15 question Likert Scale that allowed me to determine if students believed they learn better when information is presented visually or oral. The instrument in Appendix B, shows which questions are aligned to visual learning and which are aligned to oral or auditory learners. The inventory is based on an established scale that has been used at Penn State. Each question had the possibility of being answered as seldom, sometimes or often. Each answer was quantified as 1-positive, 0-sometimes and (-1) -negative. The sum of the oral questions compared to the sum of the visual questions was what allowed me to determine the style that was best for each individual and make a recommendation in late November 2011 to each student. Students then began the experimentation of their science fair project and worked towards completing a project in early 2012. The Likert scale inventory was given again in the same format prior to the end of December 2011 to help ensure validity and reliability. During the interim, students were charged with doing independent scientific study on their chosen topic. In early January, teachers evaluated progress and assisted students in organizing their data and drawing conclusions and assisted the group in creating a presentation. Select students were then interviewed relating to stress levels and task completion one week prior to the science fair due date of February 2012. Each of these assessments was designed to add to the validity of the treatment and help ensure that the research met its intended focus. Following the submission of the science fair project in late February 2012, all students were assessed to determine their success and their feelings about their dedication, commitment and effort that they put into the project. This

assessment used a variety of styles of questions to collect data about the experience and results. Students were questioned regarding their style of presentation, grade and satisfaction with their grade. They also answered questions about the amount of effort dedicated to their project, and how much they learned during the process. These qualitative questions about the experience were followed by quantitative questions that revealed whether they remembered the content from the project. The student's percentage grades were also collected to bolster the post science fair data and allow for conclusions to be drawn.

Table 1
Intended Focus of Data collection Methods

	DATA COLLECTION METHODOLOGIES							
DATA COLLECTION CHART	**PRE INTERVIEW**	**STUDENT SURVEY**	**JOURNAL**	**LEARNING STYLE ASSESSMENT**	**TEACHER SURVEY**	**GRADE ANALYSIS**	**FINAL INTERVIEW**	**PROCESS POST TEST**
RESEARCH QUESTIONS								
Main Topic How does the presentation style of a science fair project improve the science fair experience?	X	X	X		X	X	X	X
Sub-question #1 How can a presentation style aligned to the learning style of a student improve the retention of scientific content?			X	X	X	X	X	X
Sub-question #2 Does a presentation style aligned to the learning style of a student affect the stress level of a student when presenting?			X	X	X		X	X
Sub-question #3 How does a more informed student choice of presentation style affect the grades of students when compared to the mean score of all eighth grade students?	X	X	X	X	X		X	X

The instruments were designed to be easily understood by the science fair participants (45 eighth graders). All questions were designed to probe their commitment and effort and assess their individual talents and skills. Much of the information gathered related to their beliefs, and did not always have reinforcement in their true motives and effort. Interviews and journaling helped to lend credence to the observations and ensure that individuals were accounted for within the larger group.

The instruments were designed by the researcher to initially provide a clear picture of the individual students and their abilities. Pre-interviews allowed insight into the students' perceptions and were followed by quantitative instruments to collect data about the students' feelings, perceptions and beliefs. The pre-treatment instruments were designed as Likert Scale based surveys that required students to agree or disagree to questions about specific learning traits. The evaluation items were reviewed by a team of educators that included a middle school science teacher, middle school language arts teacher, science fair coordinator and Montana State University professors to help insure validity and reliability.

Journaling was a vital part of the process used to record comments and concerns of both the researcher and the participants. During the science fair process teachers of GHP students met regularly to discuss the process and provide feedback. When the school science fair was held in February grade data was collected to quantify results and determine successes. Thirty days after the completion of the school science fair students were surveyed to collect post treatment data using Likert Scale based questions relating

to satisfaction, effort and learning. These post treatment evaluations serve to relate results to research intentions.

The intended research and instruments were submitted to Institutional Review Board (IRB) and determined to be of minimal risk to participants and conducted in an educational setting and therefore designated as exempt by the IRB. The results of the instruments will be presented in the following section.

DATA AND ANALYSIS

Results

This section is intended to pull together the data collected through all of the instruments and present it to the reader in an unbiased way. The initial assessment was designed as a learning style inventory and allowed students to be defined as better suited for either a visual or oral presentation A question such as “I can remember more about a subject by someone telling me…” was coded as having a value of 1 for often, 0 for sometimes, or -1 for seldom. This example was one of fifteen questions relating to learning and the sum of each student’s responses for those questions was tabulated. The mean, median and standard deviation of all students’ responses was also calculated for each question to draw conclusions about the population *(N=45)* as a whole. Student open ended responses were included to elicit more information about what students felt and thought of themselves.

Table 2
Average Scores per question from Student Likert Survey (N=45)

Question	Summary*	Mean	Median	STDEV	% Often
1-1	A-Remember by being told	0.2	0	0.48	31%
1-2	V-Prefer visual aids	0.64	1	0.48	64%
1-3	V-Like to take notes	0.18	0	0.68	31%
1-4	V-Prefer to make posters	0.4	1	0.72	53%
1-5	A-Require verbal explanation	0.02	0	0.75	29%
1-6	V-Working with hands	0.78	1	0.42	78%
1-7	V-Skilled at making graphs	0.09	0	0.73	31%
1-8	A-Can determine sounds	-0.2	0	0.61	9%
1-9	V-Remember by writing	-0.1	0	0.71	20%
1-10	A-Prefer listening to writing	0.11	0	0.71	31%
1-11	A-Spell better aloud	-0.4	0	0.68	11%
1-12	A-Understand reading news	0.16	0	0.71	33%
1-13	V-Remember by picturing	0.36	0	0.68	47%
1-14	V-Get information by reading	0.09	0	0.70	29%
1-15	A-Follow oral directions best	-0.1	0	0.70	20%

Note. *Summary Category notes: Question's intended focus A-Auditory, V-Visual
*Seldom = -1, Sometimes = 0, Often = 1.

The results of the Likert Scale responses show some interesting facts. Most students prefer working with their hands (78%) and also prefer visual aids (64%). This leads to the belief that most students would prefer making a trifold display and perform better if their choice matches their strength. One student responded that "it is fun to make poster boards and that they like to put together information and make it look nice." This response was generally true of students who chose the visual presentation, but did not accurately characterize all students. The results from the determination of standard deviations show a lean toward common answers. Most students answer the questions similarly, which leads to low standard deviations. Examples of the phenomenon can be seen in the initial assessment that places students in the auditory or visual classifications. It is most clear that students prefer visual aids over spoken information based on the low standard deviation (0.48) and the positive response median value of 1. This leads me to

believe that typical middle school students have not developed the confidence to speak publically and prefer to rely on visual representations to present their learning. A typical response by a student who chose a visual presentation shows the hesitation, “an oral presentation is not suited to me because I don’t like talking in front of people and I often forget information and stutter.”

Table 3 shows the results of the second portion of the pretreatment surveys. This instrument was designed to assess the attitudes of participants about the different styles of presenting.

Table 3
Average Scores per question from Student Attitude Survey (N=45)

Question	Summary	Mean	Median	STDEV	%Agree
2-6	Confident presenting to peers	0.80	1	0.89	87%
2-7	Nervous when presenting	0.16	1	1.3	62%
2-8	Ability to make neat poster	1.00	1	0.98	84%
2-9	Speaking to adults is stressful	0.00	-1	1.14	42%

The questions were designed as Likert Scale items and used to further identify participants as to which type of presentation was better suited for each individual. These questions were given following the option of an initial choice of presentation style and open ended questions to justify the choice of presentation style and provide further information. These questions were scaled differently to provide more information and help determine which style of question works better. Students were asked to choose between Strongly Agree, Agree, Disagree and Strongly Disagree; these responses being

coded as 2 strongly agree, 1 agree,-1 disagree, and -2 strongly disagree, respectively. An example of a question asked was: I feel confident when I stand in front of the class to present information. Students then chose one of the responses provided above. The last column shows the percentage of students who agree or strongly agree with the item.

The results show that students are generally confident when presenting to their peers (87%), but the large standard deviation reveals that the responses of students are spread across the continuum of possibilities (0.89 – 1.13) for the four questions that were answered. Students commonly provided the response “I don’t like talking in front of people,” as the reason they chose visual presentations. Students also felt they had the ability to make a neat and organized poster with a mean of 1.00 and 84% answering positively. This confidence in presentation should lead to a reduction in stress and better overall performance in science fair. This strong belief in ability comes from the student’s choice to be a part of GHP science and their previous knowledge that science fair would be a part of the course. The primary response by students that preferred the visual presentation style came from nervousness or “organized and creative.” One student who chose an oral presentation alluded to her being an auditory learner and felt she “would learn more from presenting orally.” She was in the minority, as most students (74%) who chose oral presentations cited the ability to present at PJAS for their choice.

The individual student scores can be seen in the Appendix C. The numerical value of each question was added together and a value for each category was calculated. This was done to triangulate data from multiple sources and give students a recommendation that best fits their individual profile. Questions 1,5,8,10,11,12 and 15 from the first assessment and questions 2-6, 2-7, 2-9 from the second assessment were added together

to determine a value for the auditory category and questions 2,3,4,6,7,9,13 and 14 from the first assessment with 2-8 from the second were used to find a value for the visual category. The individual student results were then averaged to determine a mean for the population of both auditory and visual questions. Student values were compared to the mean and then a recommendation determined on their individual strength in each category. For example, a student with a total score of 6 in the oral category and a 4 in the verbal category received the recommendation of oral because the difference between the mean of 0.73 and the value of 6 is greater than the difference between the 4 and the mean of 3.2. If student's scores were greater than the mean in only one category the recommendation became that category. If their score in both categories was greater than the mean, the greater difference between the sum and the mean became the recommendation. If neither category exceeds the mean, then the initial recommendation has been coded as none and students were advised that their strengths did not favor either category.

Table 4
Student Choice Results N=45

Category	Number of responses
Initial Student Choice of Oral Presentation	22
Initial Student Choice of Visual Presentation	23
Students recommended for Oral Presentation	16
Students recommended for Visual Presentation	21
Students lacking a clear recommendation	8

The above table shows the choices of presentation style from the second assessment as compared to the recommended presentation styles from the combination of Likert Scale questions from the first and second assessments. The first two categories show what students chose when presented with the option of an oral presentation or visual presentation. The next three categories show what the results of the Likert Scale questions lead the researcher to recommend based on their strengths and learning styles. The individuals cannot be correlated in the above tables, but can be analyzed by viewing the full data in Figure C. This shows students chose oral presentations more frequently than their abilities are aligned to. This fact can be related to the draw of competing at Penn State for the state competition and its requirement to complete an oral presentation. A response from a good student shows that oral presentations allow students to have more than one chance at perfecting the presentation when presenting orally. “The board is once and done, if you mess up you can’t explain. And PJAS requires an oral presentation.”

The level of stress a student experiences during the project is highly individualized and depends on the character of the student. There are some findings that allow for generalizations, but most information related to stress came from conversations with students. A highly successful student said “Stress only affected me just before presenting my project to the judges, but as soon as I started talking it went away and my practice paid off.” The opposite experience was had by one student, “As I finished my project the night before I knew I was in trouble the next day.” Procrastination led to stress in the students who were willing to honestly admit that they pushed off the project and had to present something less than their best work. “I wish I had spent more time

practicing," was a common theme for oral presenters. The oral presentation method created more stress for students and was a major influence on the choice of presentation. Students that went against the recommendation had to overcome their fear of public speaking and engage in a character building experience to present their work.

The choice of presentation style is an individual choice; recommendations made were not a requirement of the oral or visual presentation. The style recommendation was meant to be a tool to help students decide which style suited their skills and beliefs and would help them be most successful. Other factors affect the students' final choice of presentation style. Parental input and the availability of competitions outside of the school science fair impact the choice. Table 5 is intended to provide more information on factors that affect the final choice.

Table 5
Impact of Penn State Competition on Initial Choice (N=12)

Category	Number of responses
Students Citing Penn State as the Primary Reason For Their Choice	12
Students with PSU as primary reason Recommended for Oral Presentation	5
Students with PSU as primary reason recommended for Visual Presentation	7

Table five shows the impact of the PJAS (Pennsylvania Junior Academy of Science) State Science Fair Competition which is held annually at Penn State University with this year's competition held May 14 and 15, 2012. Students who use the oral presentation method may compete at a regional high school in February to advance to the state competition. Students are graded on a rubric that is the same as the school grading

rubric and presented with a first, second or third place finish. All first place finishers (nine of sixteen regional competitors) were then invited to compete at the state level. This included a three day trip to Penn State about 200 miles away, two nights living in the freshman dorms and all meals. The students are exposed to the college and associated amenities while still in middle school. It is a wonderful program, but has an unintended effect on my project. The table above shows the influence of this on the students' choice of presentation. Seven of the forty six study participants (15%) made the choice of presentation style primarily due to the state completion and against the recommendation.. One student says "PJAS is awesome and I want to go to Penn State." Another felt that "I made it to Penn State last year and want to go again." Their results serve to alter the mean of the entire group and affect the results of the study. If those students were eliminated from the statistical evaluation (*n=12*), the results show an average grade of 90%. The one percent difference when eliminating those students is a very minor difference and is not enough of a difference to draw conclusions about the effect.

Table 4 and Table 5 show the effect of presentation style choice and allow for more in depth analysis of the overall group and their perceptions of themselves compared to their choice of presentation style. These tables show that the population of 45 students can be divided nearly evenly between those that choose to present orally *(n=22)* and those who choose visually *(n=23).* The recommendations that I provided to the students included 16 oral presentations, 21 visual presentations and 8 students that were not recommended to a specific category, but allowed to choose because of the lack of a clear recommendation to either category. This shows that students are not as confident in their ability to present orally as compared to visually, but more often choose oral presentations. This can be

attributed to the impact of the state competition being held at Penn State University. Twelve students chose oral presentations primarily because they allow for the possibility of competing at Penn State. Of these 12 students, 5 were recommended for oral presentations and 7 recommended for visual presentations. If these seven students changed their presentation style from oral to visual presentations, the percentage of students choosing oral compared to visual presentations would align with the recommended choice.

The choice by students of presentation style also includes some interesting demographics. The students who followed the recommendation were predominantly male with 15 of the 23 males (65%) choosing the style best fitting their skills and beliefs. When students chose to go against the recommendation, they were split evenly between males and females. The students grades show those with higher yearly averages chose to go against the recommendation more often. The mean grade of students choosing to follow the recommendation (90%) is lower than the mean of those who chose a different style than recommended (94%). This shows that females and better students are more likely to challenge themselves. The initial data can be presented as follows:

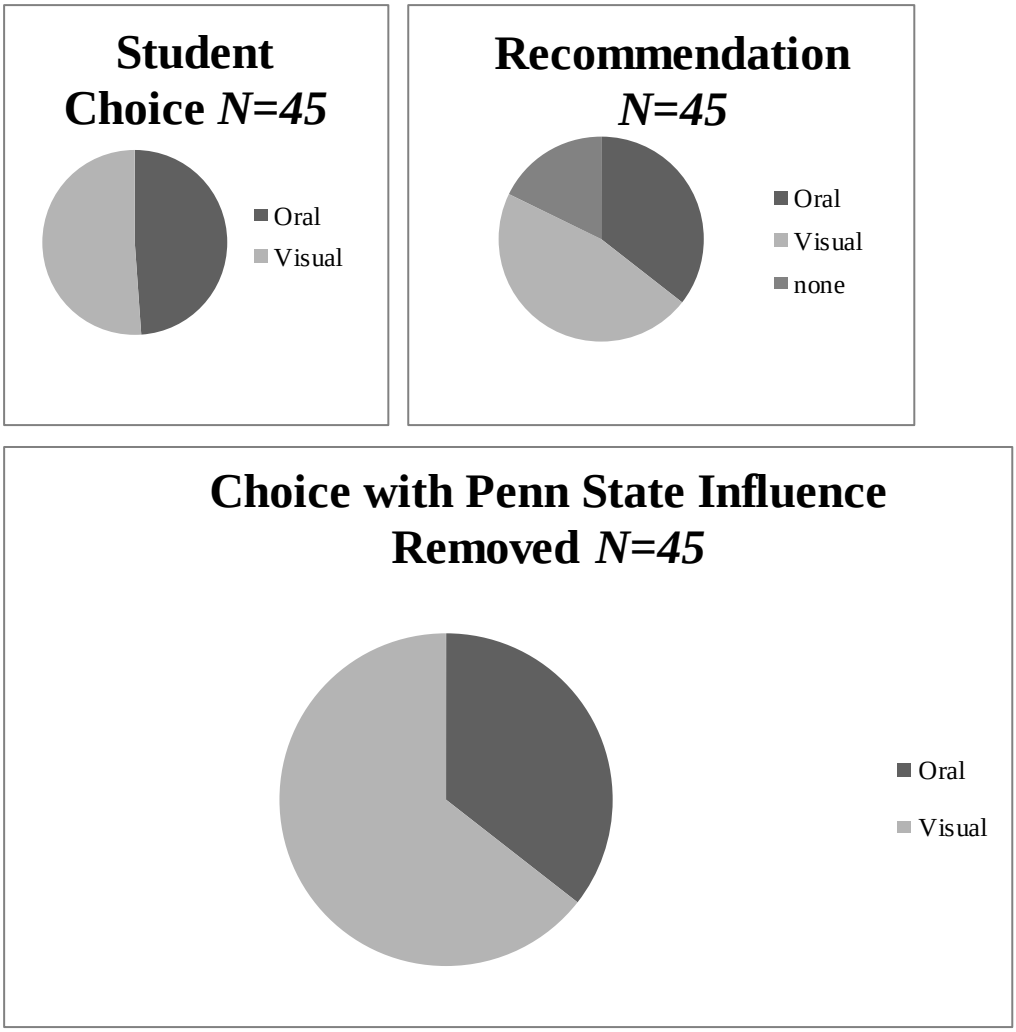

Figure 1. Science Fair Presentation Choice.

Figure 1 shows the student's choice in a visual format. Their initial choice of project is split nearly evenly, but the recommendations provided show that the majority of students that can be clearly recommended to a category should be presenting visually (57%). The final pie graph shows the choices of students if the impact of PJAS and the draw of a trip to Penn State to compete in the state competition are removed from the selection process. This shows that students would chose visual presentations more often than oral presentations at a rate of nearly two to one (65%).

The effect of the treatment in positively altering the science fair experience in general is difficult to determine. Following the completion of the project, the data show that most students were satisfied with the results of their project with a mean value of 1.09. Responses ranged from (-2) not satisfied to (2) extremely satisfied, with one being the median value and showing satisfaction. Student effort was slightly less with a mean of 1.02 showing that students felt that had put in the required effort. The amount learned from the project was less successful as the majority of students felt they learned some new things (37), while eight students felt they learned a lot of new things and only two students felt they had learned nothing new. Overall grade analysis shows students received a mean score of 91% on their science fair project. Of the 45 participating students, six students received the score of 100% and four students received a 75% or less with the lowest grade being a 66% which falls in the range of 60%-69% D in the Parkland School District grading scale. There were no failures (<60%). The amount of content that was remembered thirty days following the presentation of the project shows limited retention with 48% of the students remembering their hypothesis and 46% remembering their conclusion. This applies to both groups and does not discriminate among those that follow the recommendation and those that don't. This leads me to believe that students who put in the required amount of effort usually feel satisfied with the results of their science fair experience. This includes time spent during experimentation and time spent preparing the project. Those students who do not invest the effort into one of those places are often left disappointed, one student commented "I worked really hard on my project and didn't practice my speech before the school science fair and my grade showed it."

Following the completion of the science fair process and entry of final yearly grades for all coursework, generalizations about successes can be made. Student preferences did not affect science fair grades. The overall grades of all students on their science fair projects as compared to yearly averages show that science fair grades are less than average grades. Students scored an average of 2.7% lower on their science fair projects than their yearly average. There were a significant number of individuals (10) that scored low on their project, but maintained an average of 90% or greater for the year. These students all had scores of 10% less on their project than their yearly average with a maximum of 25% less. Of the students that did poorly, their responses show a lack of effort. Six of these students did not follow the recommendation, while four did follow the recommendation. Visual presentations were more prevalent in the underperforming students (7/10) and are typical of lower performing students. A fellow teacher commented, “Students who don’t do as well in the classroom choose visual presentations.” One student felt “I had trouble keeping up on my experiment”. One low performer realized, “a lot of kids worked for weeks and I didn’t do that much.” The effort can be linked to the satisfaction and grade in most cases.

The results of content retained shows that there is no statistical difference between students who followed the recommendation and those who did not. Both groups had the same mean with two-thirds of students remembering their hypothesis after 30 days and 71% remembering their conclusion. There is a difference in content retention between students participating in PJAS as compared to non-participants.

Table 6
Student Content Retention N=45

	Total population (*N=45*)	PJAS participants (*N=12*)	Non-PJAS participants (*N=33*)
Students recalling hypothesis after 30 days	67%	75%	64%
Students recalling conclusion after 30 days	71%	83%	67%

The students who were involved in PJAS and advanced to the competition at Penn State retained content longer than those who did not. This fact can be related to the number of times students had to present their project. These students were also higher soring students. Students participating in PJAS had to present at the regional level following the school science fair and then had to present at Penn State in May. A typical response shows that as the number of times presenting increases, so does the success, "I had to look over my project like 20 times to know I would do a good job." Their external motivator required a repeated performance that caused them to remember their project and content for a longer period of time. The numerical difference shows a difference of 16% more students who participated in PJAS remembering their conclusion thirty days after science fair.

Individual student performance data analysis show that the majority of students performed at a level that is comparable to their typical performance. There are students who made great strides and focused their abilities and skills into this project. One specific student focused on the ability of peppermint oil to curb hunger. She used 20 teachers within our building and braided bracelets for teachers to wear and sniff on a regular basis throughout the day. Each teacher then recorded the amount of hunger they felt by

completing a Likert style scale. The results showed that peppermint oil helped to curb hunger over a short period of time, but did not affect weight loss over a two week period. Her drive to be successful and her findings were used to present an above average science fair project and one that received a 100% which is 8 percentage points over her yearly average. Her success was evident in her response to a question about satisfaction, "…a perfect score never seemed to be possible, but I worked really hard every morning before school for two weeks to be sure I had a good setup and lots of data for my project. It paid off."

Another example of the internal drive of students can be shown in the opposite scenario. A student who studied terrariums and their ability to thrive in certain conditions did very poorly on her science fair project. She began the project late and collected limited data to determine the effect of soil types on plant health. Her two week trial was not enough to determine the effects and her grade suffered. She received a 70% which is 25 points lower than her average of yearly average of 95%. Her meek manner and lack of communication plus not getting an early start and staying within deadlines led to a disappointing science fair experience. Her disappointment can be summed up by her response, "I wish I had started earlier and been able to have more data to base my conclusions on." The science fair project is no longer required in 9^{th} grade science at Parkland High School, but is offered as an extra-curricular club. Therefore, students use this experience as a way to understand their skills and abilities and hopefully transfer their successes and failures to other projects they work on in the future.

The results from teacher feedback of the science fair process reiterate what the students experience and recount. Teachers felt that student effort directly relates to

success. The grading teams felt “student successes are evident in their presentations, a judge can see if the student made an effort and their grade typically reflects their effort.” The difference in the type of student who chooses oral presentations was evident to one of the teacher/judges. She felt “better students choose oral presentations because they can show their work more directly to the judges. The converse is true of display boards, students feel they can hide the lack of effort with pictures.” Students are judged at the school science fair by a team of two teachers other than their own. Students are aware of this prior to beginning their project. The teachers intentionally designed the process this way to eliminate any bias and remove prior knowledge of students that could affect grading. The system works for teachers and leads to a fair grade for students.

INTERPRETATION AND CONCLUSION

The purpose of this study was to determine whether an informed choice of presentation style of science fair project would improve the science fair experience. The overall question can be broken into three categories including retention of content, stress, and grade. The initial surveys were intended to determine whether students preferred auditory or visual presentations and then provide a recommendation of the style of presentation that would allow for a better experience in science fair.

After the completion of the project, the following trends are evident. Most students have positive attitudes about their abilities in general which leads to a better overall experience. This includes both visual and oral presenters and is shown by the positive mean values of the individual questions. These trends were used to properly place students in appropriate categories and help them achieve the success they feel they are capable of during science fair. Important facts about student beliefs include:

- Middle school students strongly believe they work well with their hands (mean of 0.78) and prefer visual aids (mean = 0.64).
- Students are not often as positive about their auditory skills as visual skills. The overall mean of scores among all questions and students is significantly greater for visual categories (3.24 as compared to 0.73).

This shows a definite preference for visual presentations and a hesitation to present orally. The attitude survey results presented in Table 2 show that students feel they can present their work neatly and in an organized manner and are confident when presenting to their peers. It also shows that this presentation confidence is less when presenting to adults evidenced by their responses “I am nervous when presenting to adults” and the fact that the question that relates to being nervous when presenting to adults has the lowest mean value of all of the questions (0.00) on a scale of -1 to 1. Overall, students have a variable opinion of their oral presentation skills which can be determined from the standard deviation values that range from 0.48 to 0.75 being greater than the visual categories. The lesser standard deviations for questions relating to visual presentations (0.42 to 0.71) show that more students are generally more comfortable with visual presentations. The fear of presenting orally and the lack of practice in it lead students to show a preference toward visual presentations that do not require public speaking. Students that left their comfort zone and presented in a way that was uncomfortable to them achieved growth. It is those students who matured and grew academically.

Science fair is an annual process and allows me to assist a new group of students every year. I intend to explain to future students the importance of effort and practice in improving the experience. I will also explain the ability to practice new skills that may be

out of their current comfort zone. I will also discuss with other teachers and attempt to implement a system of practice that helps all students be better prepared.

This information helps to answer sub question two of the study relating to stress levels and leads to additional data analysis that relates to specific individuals and their attitudes and perceptions about oral presentations. Interviews with select students conducted during the science fair process (December 2011) verify that students did not feel as comfortable presenting orally due to lack of practice and general anxiety while speaking in front of adults. As exemplified by the following quotes: “Speaking in front of teachers scares me more than standing in front of lions,” and “I get so nervous I can’t think.” This leads to a conclusion that students who had less anxiety when presenting in front of adults and chose an oral presentation had a better experience. The amount of practice they invested into the project also affected their stress and success. As seen in this response, “I practiced like 200 times and got an A.” These quotes show that the effort of the student to be successful is more important than the choice of presentation style.

According to calculations, when students were given the choice of presentation style; 50% choose visual presentations and 50% choose oral presentations. The recommendations for students based on their skill and attitude surveys show that 58% were recommended for visual presentations and 42% were recommended for oral presentations. This recommendation better aligns with the adjusted data when students choosing based primarily on Penn State are placed in the appropriate category. The adjusted data shows 67% should have chosen visual presentations and 33% should have chosen oral presentations. The results of the Penn State factor showed that nine students of the 45 in the group achieved the goal of reaching Penn State for the PJAS state

competition. Of these nine the average score of their science fair project was a 96%, this is significantly higher than the group mean of 90%. The draw of the competition caused students to excel at their project and instill more effort and remember their presentations for a longer period of time. "I worked hard on my presentation, not my project and made it to Penn State," was a response by a Penn State first place winner. The results of the projects at the school level show a mean score of 91% which is higher than the results of the state competition. Although the grading system is alike, the rigor of application varied between Penn State and the school science fair. Following the PJAS State competition students are presented with a first, second or third place finish. These awards can be aligned to scores that show a first place equivalent to 80% -100% for first place, 60%-80% second place and < 60% being third place. Overall, the 51 students from Orefield Middle School received 28 first places, 23 second places and 6 perfect scores. This category can be further broken down into the nine students who participated in this project as three receiving first place and six receiving second place with one perfect score. The scores from the state competition do not correlate to the scores at the school level. Judges are more scientifically qualified at the state competition as most are graduate students at Penn State in fields aligned to the focus of the project instead of general science teachers. The success of students who scored high at Penn State can be correlated to their continued effort and comfort in presenting a well-practiced project. One item that teachers need to address is the fact that practice leads to a better experience and institute a means of encouraging practice and providing feedback prior to the science fair.

The intent of my research was to lend credence to the value of helping students make informed choices when choosing a method of presenting information and to have an overall positive experience. When students are allowed to choose the style of presentation that best aligns with their skills, this information will help them choose a style that makes them more successful. Unfortunately, the data does not reinforce this with the mean score being only one percent different between those students who chose the recommendation as compared to those who did not follow the recommendation. As students get older, they may base their careers on their ability to synthesize and present findings to an audience. Having knowledge of how they can be more successful will be important to them. The overall results show that the process of informed choice did not assist the students in the scores received for the project. The subgroup that followed the recommendation received an average score of 90% and those who did not follow the recommendation received a score of 91%. The importance of the recommendation did not justify the result, but assisted students in being aware of the need for effort. One student who was recommended for a visual presentation, but chose an oral presentation summed their experience as “I knew I had to work even harder to be successful because I was nervous about the oral presentation.” Although the difference is small, the difference does not justify students following the recommendation for a grade benefit. Students who invested effort into the project showed a more satisfactory result. The positive correlation between effort, grade and satisfaction can be seen in Appendix 2 Student data. One student during their interview cited the last minute timing of completing science fair led to a poor grade at the school science fair Her ability to present improved when competing at the regional level and she was able to achieve a first place finish and a trip

to Penn State. The question that arises relates to the value of recommending the style of presentation to students. In the future the recommendation will be done more generally at the beginning of the year and shared with all teachers to help students and teachers realize their strengths and improve in the areas that they feel are weaknesses.

Students who chose the recommended method of presentation were intended to retain content longer than those who went against the recommendation. The retention of content by participants shows no difference between the students who followed the recommendation and those who did not. Both groups ended up having an equal mean score of 67% of students remembering their hypothesis 30 days post science fair and 71% remembering their conclusion at the same point. This shows that the process did not benefit content retention, but it was not detrimental either. The intended content retention effect was seen in students who participated in PJAS and had to present their project more than once. Their knowledge and comfort in presenting multiple times created an unforeseen value that assisted in those students retainer content beyond the 30 day period at a much greater rate than those who completed the process at the school science fair. If the intent of a lesson is for students to remember the content for a long period of time it is important to go over the content after a period of thirty days elapses. This transfers to all areas of study, not just science fair.

Another very important consideration was the stress level of individual students during the process. This phenomenon related both to the individual personality of the student and their planning and execution of their project. The experimentation portion of the project is a very individual process and procrastinators led themselves into a stressful situation regardless of the recommendation of type of presentation aligning to their

interests and abilities. Following the completion of science fair, there is no correlation between stress and the recommendation of presentation style. Most students interviewed did not allude to a stressful experience and only felt stress if their experimentation did not progress as planned. The students felt a more personal interaction with an adult mentor reduced any stress and felt that the level of performance reduced stress for the future. The effort of students primarily affected stress and most students felt they invested enough effort or more than enough effort (91% of the total group) which led to a limited stress issue. Future considerations will include a practice session prior to the science fair and a requirement that includes outside adult involvement in the project to reduce stress.

The intended focus of grade improvement did not materialize in the project. The subgroups had very close scores when the means were analyzed for grades. The students that chose the recommended project style scored a mean of 90%, while those that did not choose the recommendation had a mean score of 91%. This mean shows the success of all students who participated in science fair and proves that the process is geared to students being successful regardless of the presentation style chosen. Parkland works on a 10 point grade scale with 90-100 being an A, 80-89 being a B and so on. The average score falls in the low A range and so do both sub groups (follow recommendation and do not follow recommendation). The only discernible difference can be seen in the group that presented orally to be able to compete to go to Penn State. Those 16 students scored an overall mean of 93% and were more successful than the other students participating in science fair. The drive to be successful seems to be inherent in students and is independent of their choice of presentation.

The project led to an initial intensive placement process that intended to assist students with having an improved science fair experience. The ultimate results show no improvement in the process that can be attributed to the treatment. The quality of the science fair experience is more directly related to the effort of the students to complete their project in a timely manner.

Implications in my classroom lend me to believe it is important students are aware of their skills and beliefs and can use this information to make informed choices when choosing a presentation method for projects. Individual interviews show that students value the awareness of the teacher and appreciate the time invested into their individual learning and skills. The effort of students is the ultimate reason they are successful, this is based on the negating of the intended factors, and shows that an awareness by the educator of the individual's skills and styles compels them to perform better.

Although, the findings of my research do not lead to a definitive conclusion that an informed choice benefits students in content retention, stress or grade; the process of discovery and informed decision is still important in helping students be comfortable in long term projects. In future years, the process of assisting students in their choice will still be used. Individual students overcame nervousness and lack of presentation skills to be successful and show their skills. The main successes are seen in oral presentations because of their recognition at PJAS and Penn State, but many visual presenters score high as well and attributed their success to prolonged effort.

VALUE

The value of the research can be used to build relationships between students and teachers. The findings are also directly beneficial to the other members of my middle school team. Teachers can base assignments on the strengths of students and create projects that allow students to be successful and train them to do well on their science fair presentation. Continual feedback throughout the year on their choice of presentation style will make them more successful when presenting their science fair project. The practice of skills that help with science fair can be integrated into all subject areas and the information about individual students can be shared at the beginning of the school year to help differentiate assignments based on student preferences and skills.

This research led to more questions than answers and makes me step back and consider if a regular log book of science fair activity would help the student organize their project and allow for the educator to better monitor progress of the project. This would require a more invested effort by the student and educator, but could lead to a better experience. It may also be important to have a club that assists in science fair pairs mentors with participants to ensure that students remain on track. The middle school philosophy of mentoring should be extended to the science fair process to ensure a good experience for the participant. The number one recommendation of the research is for the educator or other adult to be an involved part of the project and ensure that the student's effort meets or exceeds the required effort to have a successful project. Overall, the project taught me many things and will lead me to be more involved in the individual science fair projects to guide students through the processes.

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APPENDICES

APPENDIX A

INITIAL ASSESSMENTS

Likert Scale

LEARNING STYLE INVENTORY (Highlights are for scoring only, not for student version)

Instructions: Choose the best answer after each statement.

I can remember more about a subject by someone telling me information, explanations and discussion. (AUDITORY)

Seldom (-1)	Sometimes (0)	Often (1)

I prefer information to be presented with the use of visual aids like posters, graphs and pictures. (VISUAL)

Seldom (-1)	Sometimes (0)	Often (1)

I like to write things down or to take notes for visual review. (VISUAL)

Seldom (-1)	Sometimes (0)	Often (1)

I prefer to make posters, physical models, or drawings to provide information. (VISUAL)

Seldom (-1)	Sometimes (0)	Often (1)

I require verbal explanations of diagrams, graphs, or visual directions. (AUDITORY)

Seldom (1)	Sometimes (0)	Often (-1)

I enjoy working with my hands or making things. (VISUAL)

Seldom (-1)	Sometimes (0)	Often (1)

I am skillful with and enjoy developing and making graphs and charts. (VISUAL)

Seldom (-1)	Sometimes (0)	Often (1)

I can tell if sounds match when presented with pairs of sounds like bird songs. (AUDITORY)

Seldom (-1)	Sometimes (0)	Often (1)

I remember best by writing things down several times. (VISUAL)

Seldom (-1)	Sometimes (0)	Often (1)

I do better by listening to teachers talk as opposed to reading a textbook. (AUDITORY)

Seldom (-1)	Sometimes (0)	Often (1)

I learn to spell better by repeating the words out loud than by writing the word on paper. (AUDITORY)

Seldom (-1)	Sometimes (0)	Often (1)

I can better understand information by reading about it in the newspaper than by listening to the radio. (AUDITORY)

Seldom (-1)	Sometimes (0)	Often (1)

I feel the best way to remember is to picture it in your head. (VISUAL)

Seldom (-1)	Sometimes (0)	Often (1)

I obtain information on an interesting subject by reading relevant materials. (VISUAL)

Seldom (-1)	Sometimes (0)	Often (1)

I follow oral directions better than written ones. (AUDITORY)

Seldom (-1)	Sometimes (0)	Often (1)

Attitude Survey

SURVEY questions to be done electronically through Google docs on team website

1. Which style of presentation would you like to pursue?
    - Oral - answer questions 2 and 3
    - Visual – answer questions 2 and 4
2. Why is this style of presentation appealing to you?
3. If you chose an oral presentation why do you think a visual presentation is not well suited for you?
4. If you chose a visual presentation why do you think an oral presentation is not well suited for you?

5. Why do you feel this way?

6. I feel confident when I stand up in front of the class and present information.

Strongly Agree	Agree	Disagree	Strongly Disagree

7. I feel nervous or scared when I present information to others.

Strongly Agree	Agree	Disagree	Strongly Disagree

8. I have the ability to make a very neat and well organized poster that presents information for others.

Strongly Agree	Agree	Disagree	Strongly Disagree

9. When speaking in front of a group of adults I get stressed out.

Strongly Agree	Agree	Disagree	Strongly Disagree

APPENDIX B

THIRTY DAY POST ASSESSMENT

THIRTY DAY POST SCIENCE FAIR SURVEY

Name:_____

Participation in this research is voluntary and participation or non-participation will not affect a student's grades or class standing in any way.

1. Which style of presentation did you complete? (circle your answer)
   - o Oral
   - o Visual

2. What grade did you receive for the project? (circle your answer) A B C D F

3. How satisfied were you with your grade?

Very Satisfied	Satisfied	Disappointed	Very Disappointed

Why do you feel that way?

4. How much effort did you invest in your project?

More than required	Required Amount	Less than Required	Almost None

Why do you feel that way?

5. How much did you learn from Science Fair

A lot of new things	Some new things	Nothing new	

Why do you think the above?

6. Did you go to Easton for the Regional PJAS Competition? (circle your answer)

Yes No

7. Will you be going to Penn State to present your project? (circle your answer)

Yes No

8. What was your hypothesis?

9. What was your conclusion?

APPENDIX C

STUDENT DATA

Student	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	6	7	8	9	o or v	reason	o sum	v sum	recomme	notes
boyer	1	0	0	0	-1	1	-1	0	1	1	-1	0	0	1	0	2	1	1	1	o	PSU	4	3	o	likes talking
hija	-1	1	0	1	-1	1	1	0	0	0	-1	0	1	-1	1	1	1	1	-1	o	PSU	-1	5	v	knowledge= ease
gianna	0	1	0	0	0	1	1	-1	0	1	-1	0	0	-1	0	1	-1	2	-1	o	PSU	-2	4	v	like to talk
soheil	0	1	1	0	0	0	0	-1	0	0	0	-1	1	0	1	1	1	1	1	v	others understan	2	3	o	poor handwriting
shara	0	0	-1	1	-1	1	0	0	1	-1	-1	0	1	0	-1	1	-1	1	-1	o	PSU	-5	5	v	like to explain thr
kocher	1	1	0	1	1	1	1	0	0	-1	0	0	1	1	0	1	-2	1	1	o	PSU	1	7	v	easy to explain
hamburg	0	0	-1	0	-1	0	0	-1	-1	0	-1	0	0	-1	0	0	-1	1	-1	v	nervous	-5	-1	none	all negative
gelb	0	0	1	-1	1	1	0	1	-1	1	-1	0	1	0	0	1	1	1	1	o	PSU	5	1	v	easy to explain
trotta	1	1	-1	1	1	1	0	0	-1	1	0	0	1	-1	0	1	1	1	1	v	show in real life	6	3	v	in plays
heller	0	1	0	1	0	1	-1	0	-1	0	0	0	-1	-1	0	1	-1	1	-1	v	like making poste	-1	0	none	
burke	1	1	1	1	0	1	0	-1	0	0	0	1	0	0	0	1	-1	1	-1	v	get nervous	0	4	v	
mendez	0	1	1	1	0	1	0	0	0	-1	-1	1	0	1	-1	1	1	2	1	v	artistic	1	6	v	
gaspar	0	1	1	1	0	1	0	0	1	0	1	1	1	0	1	1	-1	-1	1	o	see visually	4	4	o	
cos	1	1	1	1	1	1	1	-1	1	1	1	1	-1	0	1	1	1	2	1	o	easier to explain	8	6	o	
hockenbe	-1	1	0	1	0	1	1	-1	0	1	-1	0	1	0	0	1	1	1	-1	v	learn by watching	-1	6	v	good at art
meyer	1	0	0	1	-1	1	1	0	1	-1	-1	1	1	1	-1	1	2	1	1	v	hands on	2	7	v	
ross	1	1	0	1	1	1	1	0	-1	-1	0	1	1	1	0	2	2	2	2	o	PSU	8	7	o	not nervous
rappold	0	1	-1	1	0	1	-1	-1	0	1	-1	1	1	-1	1	1	1	2	1	o	PSU	4	4	o	know what talkin
ordway	0	0	0	-1	0	0	0	0	0	0	0	0	-1	0	0	1	1	1	-1	o	previous experier	1	-1	o	
goldner	0	1	1	1	-1	1	1	-1	-1	-1	0	1	1	0	-1	1	1	1	1	v	process orally	0	5	v	prepared
miller	-1	1	0	0	0	1	1	-1	0	0	0	0	0	0	0	-1	1	1	-1	v	don't have to talk	-3	4	v	
feichtel	1	1	0	0	1	1	0	0	0	1	0	0	1	0	0	2	2	2	2	o	PSU	9	5	o	very positive
hickey	0	1	1	-1	1	0	0	0	1	0	0	0	0	0	0	1	1	2	1	o	PSU	4	3	o	board=no second
barna	0	1	0	1	-1	1	0	-1	-1	0	0	0	1	0	0	-1	1	1	-1	v	do not like talking	-3	4	v	love making thing
edinger	0	1	1	1	0	1	0	0	0	0	-1	0	0	-1	0	1	1	1	-1	o	PSU	0	3	none	
antoine	1	0	1	1	0	0	0	0	-1	0	1	1	-1	0	-1	1	-1	2	-1	v	like to show work	1	1	o	stutter, new stud
maritch	0	1	1	1	1	1	-1	1	0	0	-1	-1	1	0	0	-1	-1	2	-1	v	embarrassement	-3	5	v	did well last year
badilla	0	1	0	0	1	1	0	-1	0	0	0	1	0	0	0	1	-1	2	-1	v	nervous stutter	0	4	v	neat and excited
steele	1	0	1	-1	0	0	-1	1	-1	1	0	-1	0	-1	1	-1	-1	1	-1	o	auditory learner	0	-3	none	feel judged by pe
kates	1	0	0	0	0	1	-1	0	0	1	-1	0	1	0	1	1	-1	2	-1	o	want to explain	1	3	o	squares not circle
brouse	0	0	1	0	0	1	0	0	1	0	-1	0	0	1	-1	1	-1	1	1	o	PSU	-1	4	v	past experience
bavlack	0	1	0	0	-1	1	1	0	1	1	1	-1	1	1	0	1	1	1	1	o	challenge	3	7	v	
davies	1	1	0	0	0	1	0	0	-1	0	0	1	1	0	0	1	-1	1	-1	o	nervous	1	3	o	
granahan	-1	0	1	0	-1	0	1	0	-1	1	0	-1	0	1	-1	1	2	-1	-1	o	outgoing, interact	-1	0	none	not organized
marshall	0	1	0	0	1	1	-1	-1	0	0	-1	-1	0	0	-1	0	1	2	-1	v	no presentation s	-3	3	none	
morrison	1	0	0	-1	-1	1	-1	0	0	-1	0	1	1	0	-1	2	2	-1	1	o	like talking things	4	-1	o	bad at art
gillespie	0	0	0	0	1	0	0	0	0	0	0	0	0	-1	0	2	2	2	2	v	like to talk	7	1	o	because I am awe
pope	0	0	-1	1	0	1	1	0	0	-1	-1	0	0	0	-1	1	-2	1	1	v	bad memory	-3	4	v	
haberern	-1	1	-1	1	1	1	0	1	0	1	-1	1	1	1	0	2	-2	1	-1	o	can explain	1	6	v	
durkin	0	0	1	0	0	1	0	0	-1	-1	-1	0	-1	1	-1	-1	-1	1	-1	v	shy	-6	1	none	
cregger	0	1	0	1	0	0	1	-1	0	0	-1	1	0	0	-1	1	-1	2	-2	v	quiet	-4	5	v	creative
dreisbach	0	1	0	1	-1	1	0	0	1	0	0	0	0	1	-1	1	-2	-1	1	o	explain well	-2	4	v	not artistic
smith	0	1	0	1	-1	1	1	-1	-1	0	-1	1	0	1	0	-2	1	-1	1	v	doesn't want to ta	-2	3	none	
lucas	0	1	0	1	0	1	-1	0	-1	1	1	-1	0	0	1	1	-1	-1	-1	v	doesn't want to ta	1	0	o	
colon	0	0	-1	-1	1	0	-1	-1	0	0	-1	-1	1	1	1	1	1	-1	-1	o	less money	1	-1	o	bad grades on pro
STDEV	0.48	0.48	0.68	0.72	0.75	0.42	0.73	0.61	0.71	0.71	0.68	0.71	0.68	0.7	0.7	0.89	1.3	0.98	1.14						
Mean	0.2	0.64	0.18	0.4	0.02	0.78	0.09	-0.2	-0.1	0.11	-0.4	0.16	0.36	0.09	-0.1	0.8	0.16	1	-0			0.733333	3.244444		
Median	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	1	1	1	-1						

Students Who Followed Recommendation

	satisfaction	effort	learning	EAHS	PSU	hypothesis	conclusion	science fair	year average	difference
boyer	-2	2	0	1	1	0	0	80	89	-9
kocher	1	1	0	0	0	1	1	92	97	-5
hamburg	2	1	0	0	0	1	1	98	96	2
burke	2	1	1	0	0	1	1	100	95	5
trotta	1	1	0	0	0	1	1	74	89	-15
cos	2	-1	-1	1	0	0	0	92	80	12
hockenberry	1	2	0	0	0	1	1	92	97	-5
heyer	2	2	0	0	0	1	1	100	94	6
ross	2	2	0	1	1	1	1	94	91	3
rappold	-1	2	0	1	0	1	1	88	97	-9
ordway	2	1	0	1	1	0	0	100	93	7
goldner	2	2	0	1	1	0	0	98	95	3
miller	2	-1	0	0	0	0	0	98	97	1
feichtel	2	1	0	1	1	0	1	96	92	4
hickey	1	1	0	1	1	1	1	100	97	3
barna	1	1	0	0	0	1	1	90	96	-6
maritch	1	1	0	0	0	1	1	98	97	1
padilla	-1	1	1	0	0	1	1	66	88	-22
kates	1	1	0	0	0	0	0	82	89	-7
davies	-1	1	0	0	0	1	1	72	90	-18
cregger	2	1	0	0	0	1	1	98	96	2
pope	-1	1	0	0	0	0	0	80	91	-11
morrison	2	1	1	0	0	1	1	92	85	7
colon	1	1	0	0	0	1	1	86	93	-7
St. Dev	1.25	0.78	0.41	0.48	0.44	0.48	0.46	9.84	4.43	8.62
Mean	1.00	1.08	0.08	0.33	0.25	0.67	0.71	90.25	92.63	-2.38
Median	1	1	0	0	0	1	1	92	93	1.25

Students who Did Not Follow Recommendation

	satisfaction	effort	learning	EAHS	PSU	hypothesis	conclusion	science fair	year average	difference
nija	1	1	1	1	0	0	0	96	96	0
gianna	2	1	0	1	1	0	1	94	90	4
soheil	-2	1	1	0	0	0	0	80	91	-11
shara	1	2	0	1	0	1	1	96	96	0
gelb	2	2	1	1	1	1	1	98	92	6
heller	1	1	0	1	0	1	1	96	97	-1
mendez	2	1	0	0	0	1	1	98	96	2
gaspar	2	2	1	1	1	1	1	92	96	-4
edinger	2	1	0	0	0	0	0	86	96	-10
antoine	1	1	0	0	0	1	1	70	95	-25
steele	1	1	0	0	0	0	0	100	97	4

brouse	2	1	0	1	1	1	1	96	96	0
pavlack	2	1	1	1	0	1	1	96	87	9
granahan	1	2	0	1	0	0	0	94	90	4
marshall	2	1	0	0	0	0	0	92	98	-6
gillespie	1	-2	-1	0	0	1	1	84	94	-10
haberern	2	2	0	0	0	1	1	100	92	8
durkin	1	1	1	0	0	1	1	82	92	-10
smith	1	1	0	0	0	1	1	84	94	-10
lucas	-1	-1	0	0	0	1	1	86	91	-5
dreisbach	1	1	0	0	0	1	1	86	95	-9
St. Dev	1.03	0.95	0.54	0.51	0.40	0.48	0.46	7.81	2.91	8.13
Mean	1.19	1.00	0.24	0.43	0.19	0.67	0.71	90.76	93.74	-2.98
Median	1	1	0	0	0	1	1	94	95	-0.67

APPENDIX D

IRB Status

MONTANA STATE UNIVERSITY
Request for Designation of Research as Exempt
MSSE Research Projects Only

(4/27/11)

To qualify as exempt, this research **must**: 1) involve minimal risk and 2) be conducted in established or commonly accepted educational settings, involving normal educational practices. These include, for example, research on regular and special education instructional strategies or research on the effectiveness of or comparison between instructional techniques, curricula, or classroom management methods.

THIS AREA IS FOR INSTITUTIONAL REVIEW BOARD USE ONLY. DO NOT WRITE IN THIS AREA.

Confirmation Date:
Application Number:

DATE of SUBMISSION: 12/5/2011

I. INVESTIGATOR:

Name: **Brian Holtzhafer**
Home or School Mailing Address:**1207 S. 10th St., Emmaus, PA 18049**
Telephone Number: **6109667566**
E-Mail Address: **holtzhaferb@parklandsd.org**
DATE TRAINING COMPLETED: **12/5/11**
Investigator Signature **Brian Holtzhafer**

Name of Project Advisor: **Walter Woolbaugh**
E-Mail Address of Project Advisor: **walter.woolbaugh@ecat.montana.edu**

II. TITLE OF RESEARCH PROJECT: **Does an informed choice of Science Fair presentation method improve a student's experience?**

III. BRIEF DESCRIPTION OF RESEARCH METHODS (If using a survey/questionnaire, provide a copy). **Students will be surveyed as to their attitudes and beliefs regarding their personal strengths relating to oral and visual learning. These responses will be used to recommend that they choose either a visual or oral science fair presentation. After they complete the science fair process data will be used to determine whether there was a positive benefit.**

IV. RISKS AND INCONVENIENCES TO SUBJECTS: **None**

V. SUBJECTS:

A. Expected numbers of subjects: **46**

B. Will research involve minors (age <18 years)? **Yes** No
(If 'Yes', please specify and justify.) Subjects will be 8th grade science students in my 8th grade Gifted High Potential Physical Science classes. As part of their curriculum they are required to participate in science fair. The subjects will assume no risk and may receive a benefit of ease in completing the science fair process.

C. Will research involve prisoners? Yes **No**

D. Will research involve any specific ethnic, racial, religious, etc. groups of people? (If 'Yes', please specify and justify.) Yes **No**

VI. FOR RESEARCH INVOLVING SURVEYS OR QUESTIONNAIRES:

A. Is information being collected about:

Sexual behavior?	Yes	**No**
Criminal behavior?	Yes	**No**
Alcohol or substance abuse?	Yes	**No**
Matters affecting employment?	Yes	**No**
Matters relating to civil litigation?	Yes	**No**

B. Will the information obtained be completely anonymous, with no identifying information linked to the responding subjects? Yes **No**

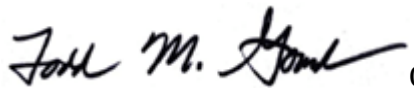
C. If identifying information will be linked to the responding subjects, how will the subjects be identified? (Please circle or bold your answers)

By name	Yes	**No**
By code	**Yes**	No
By other identifying information	Yes	**No**

D. Does this survey utilize a standardized and/or validated survey tool/questionnaire? **Yes** No

Administrator Approval

I, Todd Gombos, Principal of Orefield Middle School, verify that I approve of the classroom research conducted by Brian Holtzhafer.



Orefield Middle School Principal

(Signed Name, Title of Position)

Todd Gombos, Orefield Middle School Principal
(Printed Name)