Science Investigations: Hands On…Minds On
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The mission of Graham Road Elementary School is to equip students with the necessary tools to become productive members of society. We believe that learning is a life-long process that begins at home, and continues in our school. At Graham Road Elementary we believe in:

♦ Honoring and respecting diversity
♦ Including all students in the general education program
♦ Providing learning experiences for the entire family
♦ Promoting high academic achievement
♦ Using a child centered collaborative approach to instruction
♦ Developing positive personal character and citizenship traits
♦ Fostering community involvement

Introduction

Often it is the case for the traditional education of students that making real-life connections to the concepts taught in the classroom can be challenging. But traditional instructional practices and techniques often pose new turns and twists for language minority students. Research shows that the “cognitive and linguistic burden will be much heavier because you [language minority students] will have to gain access to new scientific concepts and vocabulary through a language that you do not understand, speak, read, or write well” (McKeon, 46, 1994).

The announcement of a Science Fair sent the language minority students in our school through an array of emotions. Some students were a bit apprehensive about the new prospects, while others envisioned mounds of homemade lava oozing from their carefully handcrafted volcanoes. Ahhhh, the possibilities!

Science investigations lead students to independent research, the gathering of materials, and the infusion of all phases of the scientific process into one, simple presentation. The initial classroom conversation leads us, as teachers, to believe that the majority of out 5th grade students had previous experiences in completing a project of this magnitude. This assumption soon proved to be false. The lack of understanding among the students became more obvious as we began to review the question the students were developing, or the inability to develop a question, based on the topic chosen. Some beginning question examples were:
• "I'm going to build a volcano."
• "We're going to show how a lemon can be used to conduct electricity."
• "How to float an egg."
• "Which liquid can the sponge absorb?"

These initial responses showed that our students did not understand the scientific differences between investigation and demonstration. Much of this understanding comes from hands-on experiences. However, the textbook is the primary resource teachers have for science instruction. Texts are often conceptually dense, uninteresting, and often inconsiderate to the reader. Textbooks often provide the teacher with few suggestions for accommodating individual differences, which are often present with language minority students. (Schumm, Vaughn, & Leavell, 1994, p. 608) This is why teachers often use projects as a way to assess multi-conceptual theories and educational practices. Science investigations, in the form of extended learning projects, are one such method. These projects posed new challenges for our language minority students.

Focus of our Project

What is the impact of differentiation of instructional techniques as it relates to the achievement of language minority students who participated in a Science Fair?

Methodology

The main purpose of this research project was to motivate students to experience the scientific process and correct procedures for completing a scientific investigation, for the purpose of participating in the annual Science Fair. We selected a group of 30 5th grade students. These children primarily represented Hispanic and Asian cultures. The focus group was not selected based on academic achievement in the content area; but were chosen as a result of an informal in-class survey. We were specifically targeting those students whose primary language was not English. Students were lead through daily direct instruction from the Science teacher, and encouraged to take the role of principal investigator in completing their project. Each tasks (step) was clearly defined and students were given checklists, as a way to monitor their own progress. The students were actively engaged from the onset of the project. A "5-E" approach to teaching was used: Engage, Explore, Explanation, Elaborate, and Evaluate.

STEP 1-Engage

A variety of activities were used to capture the students’ interest and help to stimulate their thinking and help them access prior knowledge. In one activity, the students were shown one brand of paper towels. They brainstormed the various usages of paper towel. Then three additional brands were displayed.
Students were then required to think of reasons why a consumer would prefer one paper towel to the others. A list of reasons was generated and the students were given an assignment to investigate by conducting a poll. The poll reflected that the price was a major determining factor in consumer's purchases.

As an extension of this activity, students were challenged to become smart consumers by considering some of the other reasons; i.e. size and absorbency. The end of several activities conducted a demonstration conducted for absorbency.

**STEP 2-Explore**

In the second phases, students were given time to think, plan, investigate and organize. During Science class, groups of students used the resources available in the classroom and library to search for topics. The students had total access to books, periodicals, videos, websites, etc. The media specialist stopped the circulation of science related materials upon the students return from the winter holidays. In addition, she placed all the materials on rollaway carts and established and area for students to review those materials. Also, a Power Point presentation was used to provide an overview of an investigative approach.

**STEP 3-Explanation**

Students were now involved in an analysis of their exploration. Using the data collected (varied by project) students made graph and charts to display their results/findings. This was the most difficult stage of the entire project. Majority of the students exhibited a lack of analytical skills. Therefore, the students were unable to analyze the information gathered from the exploration stage and generate a scientific question. Whenever a student was called on to explain his/her science fair project, invariably the explanation would describe a demonstration rather than an investigation. We used questions to help guide the students in their organization. Questions such as "Can you display your findings using a bar graph of a line graph" Or "How do your results relate to your question?" or "What did your investigation prove?" The Spanish translators were involved on a daily basis throughout this project. However, they were more active, at this level, conferring with parents and translating materials.

**STEP 4-Elaborate**

Students were provided the opportunity to expand and solidify their findings, by having several opportunities to repeat the investigations. Some investigations were completed at home, with no guidance, and then repeated in class, with the assistance of the teacher. Those investigations yielded more accurate results. Those students were able to compare what was done in school, to the way the investigations were performed at home. Which, ultimately, yielded a better understanding of the scientific process. Once the students were able to generate their question and hypothesis, the materials, procedures and
results were much easier for them to formulate. The challenge arose when they had to formulate their conclusion.

**STEP 5-Evaluate**

The evaluation was ongoing throughout the project. Scoring tools used included rubrics, checklists, and teacher observation. Students were evaluated based on what they must know and do. Scores were given based on whether the project was given a judge-awarded ribbon, or not. Three grades were generated from this project: oral presentation (in class), written presentation (research paper, backboard), and submission of entry into the science fair.

The students created a rubric for assessing the oral presentation. Teacher-created rubrics were used for assessing the written presentation. The final grade was determined strictly on a pass/fail basis. If a student or group of students submitted a completed project into the Science Fair, they were given a grade of 100%; and if an entry was not submitted, a grade of 0% was assigned.

**Home-School Connections**

"Parent involvement is a critical element if schools are to provide a quality education for their students" (Cooper & Gonzalez, 1993). Language minority students have more experiences with acquiring the majority language, than their parents. In most cases, they are immersed in the English language throughout the day in school, and other socialization setting. It became more obvious to us that the ongoing success of this project needed to be greatly supported by the parents.

Graham Road's primary languages consists of 64% Spanish; 25% Vietnamese; 3% English; and 8% other. Many phases of the project required preparation that took place outside of the classroom. It was vital that our parents completely understood the intended outcomes of completing the projects. The teachers carried out additional efforts, in order to increase parental awareness and involvement. For example, the Science teacher provided a translated (Spanish, Vietnamese) 'Home-School Communications' newsletter that thoroughly explained the objectives of the Science Fair Investigations. (Appendix A) Information provided in the newsletters included description of projects, due dates, suggested topics, and possible resources.

**Student Impact & Feedback**

Required Science Fair at the elementary school level is atypical. At Graham Road Elementary all students are provided this invaluable opportunity to enhance their learning. Participation was required. It is said that often ESL students are familiar with common scientific concepts but need the English vocabulary to match their knowledge. Second language learners bring previous knowledge and hypotheses with them. Through previous schooling, perhaps in the native country, personal experimentation and life experiences, they have an understanding of science in their environment (FCPS ESL Handbook, 1997).
The announcement of a Science Fair sent the language minority students through an array of emotions; many due to a lack of experience with completing such a project. Upon completion of their projects each student gave feedback regarding their experiences, both positive and negative. Here are some of the student responses:

1. "The Science Fair was lots, and lots, of fun. It was fun because we all worked together. The bad part of the Science Fair was everyone didn't win a prize." {A female student from Mexico}

2. "We worked hard and did a great job explaining our project to the judge. That's how we won a prize." {A male student from Venezuela}

3. "I discovered that it may look easy when you first see it, however it is hard. I also discovered that the steps you take to completing this project are not easy. After doing this experiment I have learned that it isn't easy doing a Science Fair project. You have to take your time and get straight to work. Thank you to Mrs. Hill, Ms Hamilton, and Mrs. Barnes for what you have done for us in preparing for the Science Fair. I am glad you were here to help." {A female student from Laos}

4. "During the making of our project, I learned more about teamwork and cooperation. This is because we fought a lot with each other. Then we figured the more we fought, the more we messed up our project. Out of all the experience I got from this year, I think I'm ready for next year's Science Fair." {A male student from Honduras}

5. "It was fun, but we took so long to work on the project. On the day of the Science Fair, we were very nervous when the judges came around to talk to us. At the end of the Science Fair, we were proud of ourselves." {A female student from El Salvador}

6. "It was boring when I had to start my project over again and when I had to do the back board. I didn't like when the judge interviewed me because it made me nervous. The Science Fair wasn't fun because I did not win." {A male student from Bolivia}

7. "The Science Fair is a lot of fun and work. Even though it was my first time participating in the Science Fair, it made me very, very happy. I learned a lot about how to write out the scientific process and how much time it takes to finish my project. I also discovered the Science Fair is not all about having a demonstrating like how volcanoes blow up. The real thing about Science Fair is displaying an investigation where you compare something like what type of battery can lift the most iron fillings." {A female from the Philippians}
8. "I couldn't believe we finished on time." {A male student from El Salvador}

9. "I was proud of myself. The judges even gave me a compliment by saying, "You worked hard on your project. Great job. It was very interesting." {A male student from El Salvador}

10. "As I was doing my project I found out that you should always read carefully to make sure you understand the process of your project." {A female student from Puerto Rico}

11. "Completing my project was hard because my partner did not help and now I know how the teachers feel to have a lot to do and little time. However, I realized that science is really fun is you understand it." {A female student from Mexico}

12. "When I heard about the Science Fair I didn't want to participate because I had tried for two years to finish a project on time but was unsuccessful. This year, I worked really hard, I stayed after school for 2 days to finish my project, and I finally did it. I finished my first Science Fair experiment!" {A male student from India}

13. "While doing the Science Fair project, I discovered it was not easy this time. My teachers helped me with my results and procedures after school. At the end of the Science Fair, I felt that I tried my best and that I had a great time doing my Science Project." {A male student from Vietnam}

14. "I enjoyed participating in the Science Fair because I liked creating my own experiment and working with my friends." {A male student from Sri Lanka}

Despite the initial fears, the students were pleased with the end result, and expressed a strong desire in participating in future/similar projects and investigations. Initially, we sought to motivate the students to actually want to participate in the Science Fair. However, the projects produced demonstrated a higher-level of learning that we did not anticipate, but were pleased with. The overall quality of the exhibits presented by our target group as compared to others, was well noted. One judge, a Science teacher at a local middle commented, "Wow! I have never seen such quality work in a Science Fair. I just judged a middle school Science Fair; and in that Fair I did not see one project that could compare to the projects from these 5th grade students I've seen today." As a result, he would like to come and observe what 5th grade teachers do to prepare their students for the Science Fair.
Reflections

Throughout our project we have gained a better understanding of language minority students. Through active research and collaboration, we have an increased understanding of how language minority students learn. As teachers, we entered the project with many misconceptions. By the 5th grade level, we expected the students to have had several experiences in scientific investigations. Students should know the difference between a Science investigation and a demonstration. With that lack of prior knowledge, the students had nothing to build a foundation on in order to self-initiate their projects. Initially, this was very frustrating for the teachers. We came together as a group, and redesigned our approach (5 E’s). The students and parents responded well to the scaffolding of the project.

We found that a hands-on approach where the students were actively engaged worked well for language minority students. Having parents actively participate in the process had a large impact on student success. More fifth grade students placed in the Science fair than any other grade. (Appendices B)

We firmly believe that the infusion of varied alternative methods of instruction, along with the standard scientific process, yielded the successes our students discovered throughout this project.

References

Fairfax County Public Schools. (1997). *ESL Students in the Classroom*. County School Board of Fairfax County.

Cooper, Kelt & Gonzalez, Maria. (1993). Communicating with Parents When You Don't Speak their Language.


Appendix A

Due Dates for Science Fair Project

**Wednesday 1/23:** Science Fair Application with parent signature. Statement of problem (written in the form of a question), hypothesis, procedure and materials list are due for review.

**Tuesday 1/29:** Daily logs are due for teacher review.

**Tuesday 2/5:** Data (charts, graphs), results and conclusions are due for teacher review.

**Friday 2/8:** Folders are due (must include the following: final copies of log, a summary of the project and list of materials.

**Tuesday 2/12:** A Night at the Fair - Parents and students are invited to work on creating their display boards at the school. Place: School Cafeteria Time: 6:00 - 8:00 p.m.

**Wednesday 2/18:** Projects are due at school, in the classroom. Students will practice giving oral presentations and answering questions with classmates.

**Thursday, 2/21:** SCIENCE FAIR 7:00p.m.
Fechas de Vencimiento para la Exposición en Ciencias Naturales

Martes, Febrero/ 12: Una noche en la Exposición - Padres/ Madres de Familia están invitados a trabajar en la Demostración del proyecto de su niño (a) en la escuela.

Lugar: Cafetería de la Escuela
Hora: 6:00-8:00 pm

Miércoles, Febrero/18: Vencimiento de entrega de los proyectos. En la clase; los estudiantes practicarán dando su presentación oral y respondiendo a preguntas de sus condiscípulos o compañeros.

Jueves, Febrero/21: EXPOSICIÓN DE CIENCIAS NATURALES
A horas: 7:00 pm
Hạn nộp bài cho dự án môn khoa học

Thứ tư 23/1: Đơn để tham dự hội dự án khoa học với chủ đề của phụ huynh.
Bản tường trình của dự án (Viết xướng những câu hỏi), giải thuyết, một bản liệt kê về cách thức và dụng cụ để ôn lại.

Thứ ba 29/1: Bản nhật ký ghi chép hàng ngày để cho giáo viên ôn bài.

Thứ ba 5/2: Dự kiến (sơ, đồ biểu), ngày cuối cho kết quả và tổng kết để giao viên kiểm chứng lại.

Thứ sáu 8/2: Hạn cuối của hồ sơ (phải đầy đủ như sau: Bài viết cuối cùng về dự án, tổng quát về dự án và liệt kê những dụng cụ đã dùng cho dự án.)

Thứ ba 12/2: ĐÊM HỌI CHỌ' - Phụ huynh và học sinh đều được mời đến để trình diễn công trình dự án của mình. Địa điểm: Phòng an của trường, Thời gian: 6:00 - 8:00 pm

Thứ tư 18/2: Hạn cuối của dự án, trong lớp học. Học sinh sẽ thực tập trình bày dự án của mình trong lớp và trả lời những câu hỏi cho các bạn trong lớp.

Thứ năm 21/2: HỘI CHỌ' KHOA HỌC 7:00 PM (Tối)
Appendix B

Science Fair Evening

5:45 p.m. Students go to their projects
7:05 p.m. Welcome, Opening Comments
    Ribbon Cutting
7:45 p.m. Conclusion

Acknowledge Committee
Judges
SCA Student Helpers: Alex Nanthavong, Minh Le,
Johana Gonzalez, Tien Nguyen

PROGRAM - Shabnam Asifi, 6th gr, Mr. Bradley's class

Award Prizes
K-3 class entries: Pippitt, Miller, Yeow, Ice Cream Party

4-6 Awards

"Best in Category"
(1) Plants/Animals - Entry #79: Wendy Alvarez
(2) Food - Entry #25: Sergio Bonilla, Emmanuel Molina, Robrei Harrington, Billy Nanthavong
(3) Physical - Entry #28: Gaston Ghersi, Alex Nanthavong
(4) Weather/Space - Entry #44: Minh Le, Amy Tran, Loan Nguyen, Jennifer Le

"Most Category"
(1) Most Original - #26 Janina Angeles and Karol Mendez (5th)
(2) Most Practical - #87 Julio Villegas (5th)
(3) Most Thorough - #75 Roberto Reyes, John Salcedo, Frank Ribera

Award of Excellence
#43 Beyan Dastin, Shabnam Asifi, Brenda

3-4th Grade Awards
Second Prize: #22 - Nobel Dastan, Rizky Hidayat, Kahleef Chambliss, Colored Plants
First Prize: #64 - Lalia Asifi, Cristina Salguero, Lemon Batteries

5-6th Grade Awards
Second Prize: #48 Paola Suazo, Helen Iglesias, Consuelo
Amaya, Leslie Vega, Mireyda Villabos (6th) Lemon Saved that Apple
First Prize: #47 Madelein Montes, Marie Codillos (6th) How to Grow Stalactites

GRAND PRIZE
#32 Lisa Senedara and Mimi Xaysana In Which Direction Will an Egg Tolerate the Most Pressure?