

Work in Progress: Applying Research Experience of 7th Grade Science and Math Teachers in Traffic Analysis into Update of Classroom Teaching

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Abstract - The paper presents a work in progress of National Science Foundation (NSF) funded research which is to facilitate the professional development of science and mathematics teachers through cutting edge research. The project addresses a real traffic problem by the participating teachers in a math or science classroom and develops a lesson for students to conduct an impact analysis of traffic control at an intersection through simulations and field observations. The involved students are 7th graders at a middle school, and the project's year long focus is the study of the scientific method. This WIP demonstrates that students may experience the trial and error of developing research and experimentation through the scientific method. The experiments that are performed by the students normally in science class are thoroughly researched, studied, and conclusions derived. The outcome of the students' traffic research will not come to conclusion until fourth quarter. By the FIE conference, all data will be collected and analyzed. The ultimate goal is to inspire students' to aspire to seek careers in engineering, math, and science. The implementation of the activities has resulted in increased scores on the district's common semester Science Examination.

Index Terms – NSF RET experience; Math Teachers; junior high students; Science Teachers

IMPORTANCE TO THE EDUCATIONAL COMMUNITY

In an editorial dated May 21, 2006 in *The Cincinnati Enquirer*, Samuel Bodman, Secretary of the U.S. Department of Energy stated that the United States lagged behind South Korea, France, China, and Singapore as students enter college pursuing degrees in science and engineering. Bodman was quoting the National Science Board's figures, South Korea – 38%, France – 47%, China – 50%, Singapore – 67%, and the United States a meager 15%. The leadership in science and technology and the strong economic growth that the U.S. currently enjoys could be put at risk [1].

In order for the U.S. to compete with the global scientific and engineering community, students and the public must be groomed academically to reach this goal. The NSF Summer Research Experiences for Teachers (RET) Opportunity for 7th

to 12th Grade Teachers is an educational linkage. The goal of the project is to facilitate professional development of science and mathematics teachers through cutting edge research which enables their students to directly link their education to practical issues occurring within scientific and engineering community and inspire their motivation to become effective citizens in a technology-driven society.

THE "INTERSECTION" ACTIVITY

This research addresses the Impact Analysis of Traffic Control Infrastructure using microscopic traffic simulation tools to explore the solutions to traffic problems at a local intersection. The students involved in the project are 7th graders at Mt. Healthy North Middle School, enrolled in six 7th grade classes. The project's year long focus is the study of the Scientific Method and relating the "Intersection" activity to as many of the Ohio Department Education Indicators that are studied on grade level 7. The students will engage in hands on lessons, traffic simulation software, speakers, and field trips.

Oftentimes, the 7th grade science experience is relegated to prepared labs and research experiences with the same and expected outcomes for all students. The "Intersection" research experience is designed for maximum repetitive learning of the Scientific Method combined with big fun and if good problem-solving strategies. In a safe environment, the students may manipulate traffic signals, vehicles, lane widths, and pedestrians to achieve the best working intersection for their neighborhood.

First quarter students learned the Scientific Method through a variety of prepared labs and research experiences from the textbook. Alongside, the textbook experience students began the arduous fun process of the Scientific Method with "Intersection". Students play with toy vehicles, make intersections, and practice their hypothesis with the toys. Students view videos depicting all types of traffic scenarios.

During second quarter students continue to practice the Scientific Method through data collection. Students practiced vehicle counts from hypothetical situations. Student practiced performing the following calculations without calculators: flow rate, actual flow rate, critical flow rate, critical volume.

Third quarter students continue to practice the Scientific Method through data collection. Students are performing

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vehicle counts (from a teacher prepared video), flow rate, critical flow rate, critical lane groups and critical volume, and delay estimate. Students are not permitted to use calculators; but may check their calculations with the calculator. Students must keep a timesheet to log in actual working hours on the project, as if they were Traffic Engineers.

In fourth quarter students will design lanes, traffic signal phase, speed limit, and channelization. Any feasible research applications to the Intersection are permitted. The objective is to learn and apply the Scientific Method and relate the activity to as many Ohio Department Education Indicators for grade level 7. The students will present their research findings to their classmates and invited community guests in May, 2007.

ANALYSIS

The lesson was developed as part of the RET experience and was evaluated by a team of professional engineers. Engineers rated the teacher’s technical report to document subject knowledge, lesson, and lesson poster showing the presentations was clear and informative; and the lesson used information related to real world applications.

The District practices Common Semester Examination and Curriculum Alignment by grade levels. Therefore, the “Intersection” data collected on Semester Exams and Science and Math GPAs compared to a sister school in the district.

Prior to the lesson, consents and assents were obtained from parents and students. Student demographics were gathered (Table 1) and students were administered a subject preference survey (Table 2). 26% of students are planning a career in math and 26% of the students are planning a career in science, with females slightly outnumbering males in both math and science. Overall students ranked physical education as the most useful area of study and ranked science as the 2nd and math as the 3rd most useful subject of study. Males ranked physical education 1st; social studies 2nd; females ranked art, physical education, and science 1st and language arts and math 2nd. Overall students ranked physical education 1st, science 2nd, and math 3rd as subjects of preference. Males rated physical education 1st, science 2nd; females ranked physical education 1st and science 2nd. 84% of the students planned to continue their education beyond high school.

**TABLE 1
STUDENT DEMOGRAPHICS**

Seventh Grade	African American	American Indian	Hispanic	Multi Racial	White	Total
Males	43	1	1	4	18	67
Females	37	2	1	1	14	55
Total	80	3	2	5	32	122

**TABLE 2
SUBJECT PREFERENCE SURVEY**

Topic	Response	All	Males	Females
Plans for Career in Math or Science	Math Career	32	13	19
	Science Career	32	14	18
Most Useful	Art	9	1	7

Area of Study to Student	Language Arts	9	3	6
	Math	10	4	6
	Music	7	5	3
	Physical Educ.	44	37	7
	Science	12	5	7
	Social Studies	5	12	4
Subject Preference Survey	Art	323	166	157
	Language Arts	191	81	110
	Math	326	179	147
	Music	276	141	135
	Physical Educ.	468	271	197
	Science	380	187	193
	Social Studies	218	104	114
Plans After High School	4-year	77	37	40
	2-year	25	18	7
	workforce	1	0	2
	Technical/Trade	1	1	0
	Delayed college	4	4	0
	Undecided	13	7	6

At the end of the lesson students will be administered a Lesson Feedback Survey that they will be able to anonymously provide feedback on the lesson. They will be able to indicate their interest in the field of engineering, if their interest in engineering increased from the activity, if they learned from the activity, and rate the confidence about their ability to learn math and science from the activity. The feedback for this lesson will be administered at the end of the school year since this lesson lasts the entire year.

In addition, the opportunity to ascertain learning from this research project through review of GPA’s, semester examinations scores and Ohio Achievement will be possible.

CONCLUSIONS

This paper illustrates how research experience gained by teachers through the NSF RET project developed authentic learning activities. The teachers have become familiar with the importance of the scientific method of inquiry and the critical research skills that engineers use to solve open-ended real world problems. The feed back received from students post the RET experience showed their increased interest in engineering and increased their confidence in learning science and mathematics. Further details about lessons and achievements can be found at the Project RET website [2].

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REFERENCES

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