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Learning Effectiveness of the NASA Digital Learning Network

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Introduction

Student participation in actual investigations which develop inquiry and intellectual skills has long been regarded as an essential component of science instructions (Schwab, 1962; White, 1999). Such investigations give students an opportunity to appreciate the spirit of science and promote an understanding of the nature of science. However, classroom research conducted over the past 20 years describes science teaching as primarily teacher centered. Typical instruction consists of whole class, noninteractive activities in which individual seatwork has constituted the bulk of classroom interactions (Tobin and Gallagher, 1997). Students typically learn science from textbooks and lectures. Their main motivation is to do reasonably well on tests and examinations (Layman, 1999).

During the past five years, infrastructure constraints have reduced to the point that many schools systems can now afford low cost, high quality video conferencing equipment (International Society for Technology in Education, 2003). This study investigates the use of interactive video conferencing vs. face to face interaction with hands-on, inquiry based activities. Some basic questions to be addressed are:

- How does the delivery method impact the students understanding of the goals of the experiment?
- Are students' explanation of the strategies of experimentation different based on the method of instruction that was provided.
- Do students engaged in a workshop with the instructor in the room vs. an instructor over video conferencing have different perception of the understanding of the subject materials?

The following study took place during a four week period in the spring of 2004. The two control groups were rural 5th and 6th grade school classrooms, one that I was able to visit once each week to conduct a hands-on projects called "Return to the Moon" and the other I taught the same lessons by use of video conferencing.

The teacher in each school was involved in the teaching experiment. They sat with the students and participated as a student during each of the four lessons. Both teachers had over 10 years of experience in the classroom. However, they did not present any of the materials presented outside the class time allotted for either a face to face presentation or video conference. Each teacher did allow for one hour per week to be used in Internet based research by the students. Also, the teacher that participated with the video conference portion of the program had to act in the role as facilitator, due to the fact that these were hands-on activities and someone had to manage the classroom materials needed.

Participants in the study were 19 fifth and sixth grade students from Lincoln County and a class of 20 fifth and sixth graders from Moore County Tennessee. Both classes were provided with the same classroom materials and Internet resources.

Curriculum

The class used a series of hands-on, standards based curriculum materials generated from the TeachSpace Program conducted in Tennessee. The series of four meetings used the following curriculum units:

- How far away are the moon and the planets?
- What would you leave on the moon?
- History of moon exploration
- Introduction to Rocketry
- How do rockets fly?
- Build your own powered rockets.

For the investigative activity, students constructed paper model rockets and launched them on an air powered launcher which was provided to the students. Using an inquiry based curriculum each student built a series of rockets that lead to discussions basic on failure analysis of their current design. Each design by the students incorporated more facts about the physics of rocketry. Using air powered, paper based rockets made for quick turnaround of design and rocket testing. Each rocket had to be the same length (12 inches) and use the same weight of paper in construction. However, there was no requirement based on weight, thickness, number of fins, location of fins, type of nosecone, and weight of nosecone, of the rocket.

Tracking Device

By building an altitude tracker provided in the NASA Educational Product titled "Rockets – An Educator's Guide with Activities in Science, Mathematics, and Technology", students were able to track the altitude of their rocket in flight. Each flight was recorded in an Excel spreadsheet to be able to do analysis of their launches, as well as the launches of the entire class.

Data Corpus

The data corpus consisted of the following:

- Classroom Lessons: Four, 1.5 hour lessons, one lesson per week over a month time frame.
- Pre-test of objectives
- Observations by the classroom teachers: The goal of this data collection was to observe the patterns and shifts of interaction that occurred during classroom lessons.
- Informal interviewing of the children
- Field observation notes
- Teacher Interviews
- Post test of students

Due to the abbreviated nature of this document, no example will be provided of the student's data recording sheet. However, they did record the number of the test, launch

site conditions, data about their rocket (weight, design review and notes), altitude, and performance notes.

Results of the students understanding of the experimentation

For the purpose of this document, I will focus on the student's understanding of the rocket building experiment. After the four lessons, 5 students from each group were selected at random for a personal interview. Each interview lasted approximately 20 minutes. In addition, the entire class was interview twice during the course of the program, once at the midway point in the course and once at the end.

Upon the first interview, students were unclear as to what the model rocket activity was about. For the most part, students in both groups were not yet thinking in terms of building a rocket and going to the moon unit and connecting it to the rest of the curriculum activities. 62% of the video conferencing students and 54% of the face to face students felt that the reason for building a rocket was just "something to do" and had not made the connection to returning to the moon.

Upon the 2nd interview, 88% of the student responses of the face to face group knew that the building the rocket exercise was to determine which type of rocket would go the highest. Many students articulated the various design features of their models. The students were also able to answer questions outlining the steps needed to build a rocket and also explanation of why some rocket designs work and others do not. In addition, they spoke of the problems in going to the moon and then on to Mars without prompting.

Only 69% of the video conference group could outline in detail the steps to construct the rocket or answer questions regarding different design features and their effect on the flight of the rocket. To reduce this difference (88% vs. 69%), it is thought that the video based group needed more follow up and also needed another class in which more discussions could take place in the discussion of design. As they built their rockets and launch them outside, the video based group did not get the instant feedback that that face to face group received. Even though they recorded notes and data regarding their flight, maybe small details were left uncovered.

Student Perceptions of the Classroom Environment

A classroom survey was created for the students to complete at the end of the program. The survey was made up of 25 items encompassing five constructs: Participation, Autonomy, Relevance, Commitment to Learning, and Disruptions to Learning. Again, due to the abbreviated form of this document, I will highlight just a few of the findings.

Given the nature of the hands on activities conducted in the program, students gave very high marks in the participation category. However, the difference of knowledge gained between the pre and post test with the video conference class was lower than expected. While mean scores did improve in the area of understanding content, the increase was not significant when compared to the face to face group.

Both groups scored very similar in all categories with the exception being in the understanding of the curriculum. Commitments to Learning and Disruptions to Learning were almost identical.

It is apparent that the face to face group had more opportunities to experience reflection and examination of each activities. Sometimes the reflection might be nothing more than a question that is posed as the rocket is flying in the air. However, from these combined observations, students gained a wealth of knowledge. Both programs were interactive and with the exception of live feedback at the launch site, were the same. However, the nature of TV is to sit and listen, which was noted by the lack of questions during each presentation, where as the face to face group was much more active in the lecture and hands on portion of the program.

Findings

The present study had a number of limitations due to variables between the two groups. Also, the short time period involved provided for a shallow baseline. However, the results produced a marked difference in results between the two groups.

Students involved in video conferencing activities such as the NASA Digital Learning Network, will need a great number of interactive lessons to balance the increase in gains as provided by the face to face interaction. Teachers cannot be responsible for providing the needed information before the video conference. Not only do the video lessons need to be in greater number, they need to be in shorter duration. Students enjoyed the hands on nature of the class, however, for greater gains with the video conference group, students needed more time with the conferencing mentor to be able to provide more in depth interaction. The students that were involved with the video conference often felt that they were just "doing" an experiment, where as the face to face group seem to look at the broader picture and were excited to do multiple experiments on rocket design. This desired goal will require more research to be able to provide the same level of teaching excitement in a video conference.

Student involved in video conferencing learning activities will need lessons that encourage maximum interaction to keep their interest. There should be no "talking heads", but programs that require the student to become an active part of the lesson. The Digital Learning Network should never be used to just review the students findings. Students should feel the technology is empowering them to become active participants in the exercise. One could think of a make believe mission into space as a good example of this level of activity. The mission control would be located with the person conducting the lesson and the students would be given a set of problems to solve during the activity. Then mission control could add at random times problems or changes for the students to solve in real time. The students would be divided into teams and each team would be solving problems and reporting their findings to mission control. If students and teachers are just given a set of problems to solve or research prior to the video conference and

then students just report their findings or reports over the video conference, students will not be very impressed or inspired.

Finally, the reflective learning aspects of this study provide a beginning to an increased understanding of what students can do in a hands on, reflective classroom environment. For any video based series of lessons, students must have follow up lessons that engage the classroom teachers and students.

List of Recommendations

- Interactive lessons should be interactive, not to just review the findings of a class work project with an authoritative figure. This will place much great pressure of creating good lessons for the DLN that are interactive and not just a lesson that the students and their teacher conduct and then there is a wrap-up and review of the lesson over the DLN.
- To reach the same impact level as face to face, more lessons of shorter duration are needed.
- Teachers need to be mentored prior to conducting the lesson with regards to inquiry based learning. Often the teacher needed more help in changing teaching styles than the students needed in conducting the lesson. This mentoring could take place with a pre-recorded interview with the people that will conduct the video conference that will highlight the best practices of the process.
- Students need more assistance in seeing the big picture when conducting a class by video conferencing.
- Lessons have to be much more detailed when using the Digital Learning Network due to the fact that it is harder to recover from any mistakes made.
- A pre-recorded lesson needs to be made available to the students to provide instructions on how to interact with the video conference so that the "newness" of the medium does not detract from the learning experience.