AC 2008-1487: ENGINEERING AN ELEMENTARY SCHOOL ENVIRONMENT TO ENHANCE LEARNING

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PAT VAN DRIESSCHE is a fourth grade teacher at Douglas L. Jamerson, Jr. Elementary School Center for Mathematics and Engineering. She earned a B.S. in Elementary Education from the University of Wisconsin-Superior and her M.S. in Specific Learning and Behavior Problems from the College of St. Thomas, St. Paul, MN. Her teaching experiences include over 30 years

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Engineering an Elementary School Environment to Enhance Learning

Introduction

One prominent characteristic of a magnet school is the employment of an educational theme that attracts a broad spectrum of students. By their nature, academy models focus instruction around a "theme" or academic discipline. Magnet schools use an academic model to motivate students to stay in school, make learning relevant and fun, and to focus students on their futures (either academic or employment). In addition to developing qualified faculty and rigorous and relevant curriculum that supports the magnet "theme", the school's physical appearance needs to be enhanced to reflect the theme. This visual and sometimes tactile alteration of the school serves as a constant reminder to students, teachers, parents and visitors that the school's curriculum is anchored to its declared theme.

Douglas L. Jamerson, Jr. Elementary School is a magnet school with a mathematics and engineering theme. Located in an urban neighborhood, Jamerson receives Title I services for a student population in which 66% of students are eligible for free or reduced lunches. The school has set a standard of excellence for its teachers (requiring them to attain national board certification) and curriculum (total integration of all its subjects with the engineering theme). The appearance of the school plays a vital role in the projection of this theme and in the reflection of the school's high standards. The campus's physical elements add to the school's appearance. Interactive displays developed by the school are used by the students and faculty to provide integrated learning experiences throughout the curriculum. Grade levels have developed lesson activities based on the Sunshine State Standards and assessments that measure student achievement.

Overview

Throughout the school, eight visual and interactive learning spaces, featuring engineering concepts and history, engage and extend the learning beyond the classroom walls for the Jamerson community. They include:

- Building Wall Signs
- Learning Walls
- Jamerson Water System
- Pulley System
- Joia Tubes
- Find the Engineering
- Engineering Kids
- Gardens

Young children do not have the ability to think about the world in an abstract way, they need concrete examples of what is being taught. In light of the knowledge that we have about the way children learn, it is important that they are not limited to learning science within the confines of a classroom.[1] At Jamerson, we have chosen to extend the walls of our students' learning environment with these interactive displays.

For the purpose of this discussion, we will focus on the Jamerson Water System and the Building Wall Signs.

Jamerson Water System

The Jamerson Water System provides opportunities for students to observe a model of a river, canal, spring, waterfall, and pond in order to compare and contrast aspects of each. Other features include an erosion model, samples of various rocks of the rock cycle, weather data collection station, sundial, bridge, native plants and animals, data share board, and information signage. This centrally located, aesthetically pleasing feature allows all grade levels to integrate engineering concepts in a real world setting.

Due to limited life experiences for many of our students, we felt it was necessary to provide a realistic model of natural and man-made landforms found in Florida. Since many of our Florida rivers are spring fed, our model begins with a spring. Students can see erosion as the water from the spring moves small rocks in the stream bed towards the pond. Water leaves the pond in one direction into a stream and in the other direction into a canal. Students explore the differences between natural and manmade physical features and how they are used. Using the knowledge that engineers help solve problems, students are challenged to find solutions to various problems that might occur in real life (e.g., flooding, drought, elevation). Knowing that in natural systems water percolates back into the aquifer, we collect the water at the ends of the river and canal and pump it underground back to the spring.

Having divided our engineering curriculum into the three areas of earth, physical, and life science, students return to the Jamerson Water System many times throughout the year studying different aspects. In earth science, students learn about the water cycle as they monitor how much water has evaporated from the system over a period of time. They also check various instruments on the weather station and record the data for the school community. The area that houses the Jamerson Water System also has an area of mass wasting where the students can observe how water patterns can affect the land features through erosion. Different types of rocks are included so the students can compare and contrast the characteristics of metamorphic, sedimentary, igneous rocks.

Students will look at the forces acting upon the Water System and objects associated with water as they work through their physical science units. In their "Jack and Jill" unit, kindergartners will learn how gravity affects the flow of water while making connections to their literature. First graders will test the buoyancy of various materials they use to design boats while fourth graders will calculate the buoyant force and draw free body diagrams. A beam bridge has been included over the Jamerson Water System to help fifth grade students learn about various types of bridges and the forces acting upon them, such as tension, compression, and torsion. They will also use the bridge to study how to distribute a load and what it means when a bridge's forces are in equilibrium.

Since the installation of the Jamerson Water System, children have been able to expand their knowledge of life science as they watch organisms populate the system. Students have been able to observe the nymph and adult stages of a dragonfly's life cycle. They've watched algae grow and spread throughout the system as the rate of water flow and the amount of sunlight has changed during the year. Students can test the water for pH and salinity, dissolved oxygen, and nitrogen to assess the overall health of the system. They can design water filtration systems to keep the water clean.

Engineering is connected throughout student lessons as they learn about open and closed systems, what fields of engineering would be connected with each area of science, what technology has been developed by advances in society, and how engineers use or control natural resources to benefit society. We have included a Data Sharing Station at the Jamerson Water System for the posting of data that has been collected and the conclusions drawn after the analysis of that data. Other members of the Jamerson community can easily access this information for their own knowledge. At Jamerson, sharing is an important component of all learning. From the time students enter our kindergarten, they are taught that engineers need to share their ideas and findings in order to validate their work. Our intermediate students have taken ownership by expanding and managing the Jamerson Water System. They monitor the system daily to ensure that all components are functioning properly. Sharing is one of the steps in the Jamerson Design Process and by coming together as a community, it has become embedded as a way of work. As we are in the first year of implementation with the Jamerson Water System, we are collecting data as to how this interactive display has impacted the learning of our students. We will share data specific to our fourth grade students.

Building Walls Signs

As you enter Douglas L. Jamerson, Jr. Elementary, you will begin to see wall signs throughout the school that incorporate engineering concepts and highlight various scientists and engineers. In an effort to engage the community and promote engineering, these signs focus on famous people from the past. They are strategically placed around the school, matching the curriculum content taught within that physical area. For example, the sign depicting Leonardo da Vinci is placed on the building housing the art room, as much of his work centered on drawings and sketches of ideas he had. Another example, the 5th grade wing has the Roebling Family sign in order to make connections to their study on bridges. Each sign includes a picture of the person, significant dates, and highlights of their accomplishments, connections to the real world and questions that foster critical thinking. The table below highlights some of the ongoing curriculum activities centered on the wall signs.

Topic	Content Integration	Activities	Engineering Connections
Timelines	Social Studies Reading Math Science	• Create timelines using information from the signs • Read and understand a variety of materials • Scale	• Recognition of fields of engineering • Contributions of people to society • Impact of engineering over time

			• Improvements of technology over time • Characteristics of engineers
Biographies	Social Studies Writing Reading Science Technology	• Read a variety of biographies • Research information on engineers/scientists • Write biographies using the signs as a formatting guide • Recognize influential people in history including women and minorities	• Contributions of engineers and scientists to society • Understanding engineers need to overcome obstacles and persevere in order to achieve • Recognize engineers use plans, designs, models within their work • Characteristics of engineers • How engineers solve real world problems
Analyzing data	Math Social Studies Technology	• Using dates on the signs to calculate life span • Use data to find average life span • Research and compare engineers life span to that of the average person during that time • Graph results	• Awareness of engineers and scientists • Graphs are used to show data and make inferences
Careers	Social Studies Technology	Using the signs as a springboard for discussion: • Recognize various careers and the requirements of each • Recognize past gender differences in various careers • Research careers and identify traits of a person and what jobs might be best	• Awareness of engineering fields • Recognize women and minorities in engineering • Understand the high school course requirements needed for college entrance to engineering fields • Recognition of other jobs available related to engineering

As you can see, the engineering wall signs have enhanced not only the aesthetics of our school, but also the curriculum. When the students returned to school this year, the signs were in place. In order to draw attention to them, the fourth and fifth graders participated in a scavenger hunt utilizing the signs to gather information that answered questions related to the sign. This was a very engaging activity and for several weeks students continuously discussed the signs and information that surprised them. At our Fall Jamerson Engineering Expo, families participated in

a similar scavenger hunt. This allowed students to guide their families using information they had gathered and at the same time, parents were introduced to the wall signs.

We are continually looking for ways to enhance our curriculum by focusing the students back to the signs. Students and faculty are being encouraged to use the building signs as names when referring to a location. For example, instead of saying "Go to the library", they say "Head to the Franklin building". In an effort to "scream the engineering theme" to the school community, the wall signs provide a visual reminder that Douglas L. Jamerson, Jr. Elementary is different from other schools.

Conclusion

At Jamerson, we believe that the campus environment can be as important to student learning as the teaching inside the classrooms. We have augmented the outdoor spaces to draw students and excite their curiosity. According to Deci and Ryan (1982), "The self-directed learning of little children is paradigmatic of intrinsically motivated behavior; it is active, involving, open minded; it includes surprise and wonder; it leads children towards mastery to their environments and provides them with the tools to be more self-determining.[2] The spaces provide a springboard to the many concepts they will learn throughout the years as well as connect classroom learning to real world situations. The enhancements we have made not only add aesthetic value, but they have sparked enthusiasm for learning from not only our students but their families as well.

Bibliography

[1] Charlesworth, R., & Lind, K.K. (1999). Math and science for young children. Albany, New York: Delmar.

2 Deci, E.L., & Ryan, R.B. (1982). Curiosity and self-directed learning: The role of motivation in the classroom. Current Topics in Early Childhood Education, IV. 1-2.