Evaluation of the After School Science Program

At Granger Middle School and Fischer Middle School

Indian Prairie School District 204

And

Bednarcik Junior High School

Oswego School District 308

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In the spring semester of 2014, Aurora University's Institute for Collaboration developed a three unit After School Science Program which was implemented at Granger and Fischer Middle Schools of Indian Prairie School District 204, and Bednarcik Junior High of Oswego School District 308. Each unit consisted of four lessons, delivered one day a week over the course of four weeks.

CURRICULUM DEVELOPMENT

Each unit was prepared using Aurora University faculty, area teachers, and community partners consisting of area industries and nonprofit organizations with an expertise in science education. These units will become a part of the curriculum for the John C. Dunham STEM Partnership School at Aurora University, which will serve students in grades 3-8. These collaboratively developed units are aligned to the Next Generation Science Standards, the Common Core Standards in Mathematics, and best practices in inquiry-based learning. The units are also based on the supply chain process involved in manufacturing, which has broad implications throughout the STEM fields.

PARTICIPANTS

The lessons were presented by a team consisting of Aurora University faculty, professional educators from one of the school districts involved in the John C. Dunham STEM Partnership School, and Aurora University undergraduate students who served as student leaders. Approximately 142 students were impacted by the curriculum lessons. These students were enrolled as part of their involvement in Communities In Schools which provides after school experiences to middle school students in the Aurora area. Many of these students are considered at risk for academic and behavioral problems. Neither the students nor their families chose STEM as part of the curriculum beyond permission to participate in the Communities In School's My Time program. Attendance was inconsistent throughout each of the units.

EVALUATION PLAN

Evaluation consisted of both quantitative and qualitative data. In each unit, students were asked before and after the unit if they liked mathematics and science, if they wanted to take another after school class in mathematics and science, and what type of career they were interested in. To measure gains in content knowledge, students were asked five questions on the most important themes from each unit. Students were presented this material as "questionnaires" and told there was no grade given for the evaluation. This was done to reduce test anxiety and to maintain the enjoyable and "safe" learning environment. Results of these content questions were evaluated using an independent T test for unequal variances. Aurora University faculty was involved in a focus group to explore their experiences within the program. School district teachers and Aurora University student leaders were surveyed on their attitudes about and confidence in providing STEM education.

STRUCTURE AND FUNCTION

Sixth, seventh and eighth graders were given enriched curriculum based on Structure and Function of Organisms. The essential questions addressed included, "How do the individual structures in the system contribute to the overall functioning of the whole organism?" "What are the similarities and differences in the structure of systems and how they function in organisms?” and “What are ways cardiologists repair the circulatory system?” The goals of this unit are for students to continue to increase their understanding of the relationship between form and function. Students learn the importance of substructures to the overall function of organisms and investigate the similarities and differences of systems in plants and animals. They also investigate the function of the circulatory system in a human using a torso model. In each session the unit was delivered, students, showed statistically significant gains in their content knowledge. (See Graph) Several students in the three middle school programs also showed increased interest in careers that require a STEM education and in taking another after school class with STEM content.

ENERGY AND MATTER

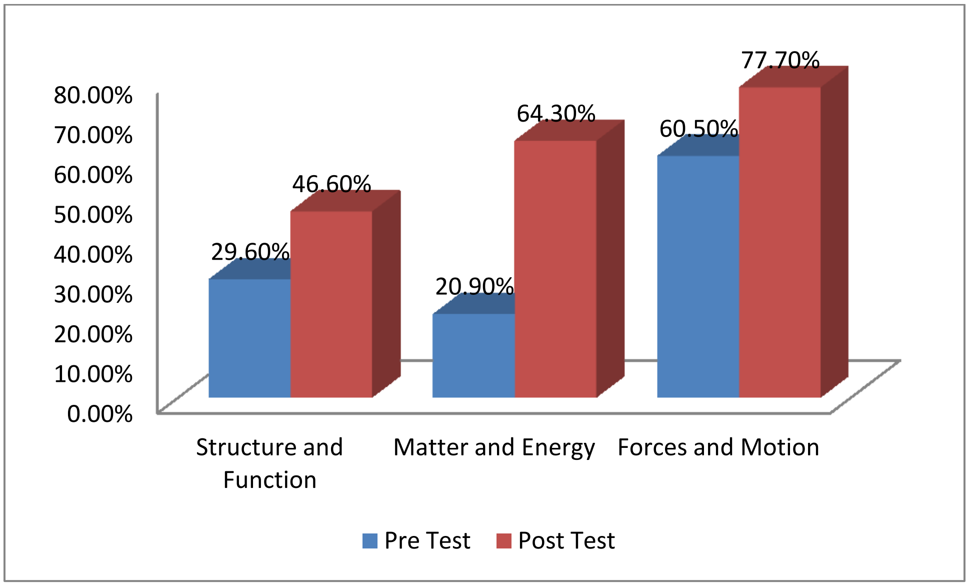
Enriched curriculum was implemented in Energy and Matter for grades six, seven, and eight in the middle school programs. The essential question addressed was “What is stuff made of?” Goals included having students explore the properties of different materials. Lesson questions and corresponding activities are summarized below.

Questions	Corresponding Activity
• What is matter and how does the periodic table relate to different materials? • How is the periodic table arranged?	Modeling Atoms
• What are metals used for and why are they used?	Electrical Conductivity
• What are non-metals used for and why are they used?	Creation of Polymer Superballs

This unit also showed the students made statistically significant gains in content knowledge throughout the unit. (See Graph). Though students did not often report changing their minds about potential careers, those who did identified a STEM career as their new choice. Several also identified a preference for taking another STEM related after school class in the future.

FORCES AND MOTION

Students from sixth, seventh and eighth grades were given after school curriculum enriched in concepts involving forces and motion in the theme of Materials of Sports. The essential questions explored were “How do we describe motion?” and “What material properties affect motion?” The goals of the unit include helping students develop a deeper understanding of the forces that cause the motion of an object within the context of various games; helping students become proficient in using tools to collect measurement data and the language to describe their observations, and predict motion and the effects of gravity on moving objects. Students also observed energy transfer between potential and kinetic energies and learned that energy cannot be created or destroyed, but can change in form. Activities included comparison of rebound heights of balls made of different materials, fabricating a ball, and determining the factors that affect energy transfer. Students showed gains in content knowledge, but they were not statistically significant. (See Graph) Student interest in STEM careers increased over the course of the units, as did their interest in taking further mathematics and science classes.



Graph

AURORA UNIVERSITY FACULTY, DISTRICT TEACHER, AND STUDENT LEADER EXPERIENCE

Three Aurora University faculty, eight school district teachers and fourteen Aurora University undergraduate student leaders were involved in the delivery of the program. Growth and development took place at every level for the instructors. Undergraduate Aurora University student leaders felt adequately prepared for their positions, enjoyed working with Aurora University faculty and school district teachers, and felt that communication was efficient and helpful. They were far more aware of the commitment and preparation necessary to be a successful educator upon finishing the program. 87.5% of the respondents increased both their knowledge of and interest in STEM content.

Both the Aurora University faculty and the student leaders were grateful to have a school district teacher on the team who could provide developmentally appropriate learning experiences and classroom management techniques. In turn, the student leaders and school district teachers were helped a great deal by the content knowledge expertise of the Aurora University faculty. The connection between the student leaders and the faculty from Aurora University was also beneficial. Student leaders found the children bright and well behaved, and the college students were well received by the children. Faculty also had the opportunity to get to know undergraduates outside of the classroom, and mentor them in workplace and instructional skills.

School district teachers responding to a survey felt more confident about teaching STEM content as a result of teaching in this program. Respondents also reported either an increase in STEM content knowledge, or appreciation for the opportunity to revisit areas that they had some familiarity with in the past. Several commented that they had carried the lessons over into their own classroom. District teachers also appreciated that “everything was available for hands-on experiences” and that having the materials organized was of tremendous help to them. Both the faculty and district teachers recognized that it was difficult to maintain the attention of some of the children who were assigned to the program, and that those with a pre-existing interest in the STEM fields benefited the most.

Aurora University faculty and school district teachers were satisfied with the curriculum, and district teachers had success implementing portions of it in their own classrooms.

DISCUSSION

Implementing the curriculum for the John C. Dunham STEM Partnership School at the middle school level in an after school format presented several challenges. The students had not self-selected into a STEM based program; in fact, many were required to participate. Parents had also not expressed an interest in providing a STEM-based program for their students. Possibly related to these issues was the inconsistent attendance for the program. Some programs had a high attendance of thirty and a low of six students over the course of a unit. This made planning for materials and staffing difficult. It also made rigorously matched pre- and post-testing of every participant impossible.

However, once engaged, students did make gains in content knowledge, and develop awareness of STEM related careers. Perhaps most importantly, they had role models at several different career and educational levels consistently providing STEM awareness, content knowledge, and support for exploration. As one of the Aurora University student leaders describes, “We passed out a survey and one of the questions asked if they liked science and math, and a little girl told me she didn’t know how to answer because she liked science but she didn’t like math. At that moment I really understood how imperative STEM is to help these students understand and become more comfortable with these topics.”

CONCLUSION

Impacting 142 students, many considered high risk for academic and behavioral problems, the three units delivered for three middle schools by 25 committed instructors at different levels of expertise increased content knowledge, interest in STEM careers, and developed multigenerational relationships between STEM professionals, educators, and students. Aurora University student leaders increased both their STEM content knowledge and their knowledge of STEM education. Aurora University faculty members worked with school district teachers and the student leaders to implement the curriculum units, and were pleased with the curriculum development, as were school district teachers, who also increased their STEM content knowledge and confidence in teaching.