PROJECT REPORT

Teaching Research to Undergraduates through an Outdoor Education Program

KEVIN FINN
Merrimack College

Abstract

There has been an increased emphasis in recent years on implementing active learning strategies in science courses for undergraduate students. Particularly, undergraduate research methods courses have focused on incorporating pedagogies that utilize a practical application of the course content. As a result, we created a research methods course for undergraduate health sciences students to teach them about research methodology through a hands-on project. The health sciences students were part of an outdoor education program, where for one week third and fourth grade students from an elementary school came to a camp as part of an outdoor education experience. The health sciences students taught the children a variety of STEM (Science, Technology, Engineering and Mathematics) and health/wellness skills and content. In addition, the undergraduate students learned about research methods by conducting their own studies during this outdoor education program. The benefits were twofold. The health sciences students learned about research methodology in an applied and practical manner and the elementary school children experienced STEM education in an outdoor environment.

Introduction

The value of active learning in science education has been emphasized by many national organizations (American Association for the Advancement of Science 1993: Association of American Colleges and Universities 2007; National Research Council 1999, 2003a, 2003b; National Science Foundation 1996). Encouraging students to formulate their own ideas, interpret data, generate conclusions from experimental evidence, and participate in other hands-on activities can be more effective than the passive learning that typically occurs during lecturing. The increased recognition of the value of active learning is supported by a growing body of evidence demonstrating the effectiveness of incorporating active learning techniques in the undergraduate classroom (Prince 2004). The literature has shown improved learning when a variety of active learning strategies were used in a wide range of science disciplines including physics (Hake 1998), chemistry (Niaz et al. 2002; Towns and Grant 1997), biology (Burrowes 2003), nursing (Clark et al. 2008), and physiology (Mierson 1998).

In most health sciences undergraduate programs, a research methods course is part of the curriculum. Many faculty who teach undergraduate research courses are aware of the challenges that are associated with making this material practical for students. Research is an area that students have unfavorable attitudes toward, attitudes that may become even more negative upon taking a research methods course (Sizemore and Lewandowski 2009). One potential reason for the lack of interest is students' inability to perceive themselves as engaged in meaningful research activities as undergraduate students (Rash 2005; Macheski et al. 2008). The literature has demonstrated that students tend to learn abstract concepts more fully when they can apply them to their to "real world" settings (Macheski et al., 2008). In our health sciences department, we have implemented active learning strategies utilizing other approaches (FitzPatrick and Campisi 2009; Campisi and Finn 2011; FitzPatrick et al. 2011; Finn and Campisi 2015), but we wanted to create a way to specifically teach research methods using active learning in an outdoor education program. After examining the effects of active learning pedagogies on student learning and perceptions for a number of years, we have implemented different pedagogies such as clickers, peer-led team mentoring, and group and collaborative learning, to examine how active learning effects both student learning and perceptions. Many of these pedagogies have improved student learning and have had positive impact on student perceptions.

For the outdoor education project, we redesigned our undergraduate research methods course to incorporate participation in a research project. We hoped that stimulating interest in research through active and collaborative learning would allow students to understand the practical implication of research.

The Outdoor Education Program

During this project, 100 third and fourth grade children participated in a five-day, five hour/day outdoor education program that took place at a local day camp owned by the YMCA. This program was a joint venture between the city's school district and the local YMCA to provide elementary students with an exciting opportunity to participate in active learning in a camp setting. This was the first outdoor experience in a camp environment for many students who participated in this program. As part of being enrolled in the research methods course, the health sciences undergraduate students implemented this outdoor education program by utilizing the camp's program areas and natural ecosystems to provide the children with unique experiential learning activities in four main curricular areas: science and math, healthy living, environmental education, and team building. These engaging activities and the use of natural surroundings encouraged the children to explore their interests and abilities in a safe and nurturing environment. Below is more detail on each section of the curriculum.

1. **Environmental Education:** This component of the curriculum corresponds with the goals of the school system, the Massachusetts State School Standards, and the New National Science Standards. Each day, students learned about a different ecosystem at the camp (e.g. the wetlands, fresh water lake, forest, and open field) through a combination of hands-on experiments and lectures. In each ecosystem, students learned about the different types of animals, plant life, rocks, the cycles of natural resources, and the dangers

that each ecosystem faces, among other topics. Students also took nature hikes and performed on-site field tests, including taking water and soil samples and testing pH.

2. **The Science and Math of Camp:** This component of the program included several physical activities that provided the opportunity for students to learn math and science skills. These activities included
   - *Maps* –The goal of this module was to allow students to develop and make maps using scale, topography, measurements, and other skills.
   - *Archery* – While participating in archery, students were provided the opportunity to learn about velocity, rate of speed, distance, inertia, and gravity.
   - *Canoeing* – While participating in this activity, students could learn about propulsion, angles, planes, kinesiology and biomechanics, resistance and friction, and wind and currents.
   - *Gaga* –The goal of this activity was for students to learn how to play the popular camp game Gaga. While playing, they wear devices such as a pedometer, to measure steps, distance traveled, and overall activity levels. Students took the data from these devices and recorded it, and then, using the Active Science curriculum, analyzed the data, answered questions, and drew conclusions about the data.
3. **Team Building:** The team-building component was a progressive learning experience where students were encouraged to challenge themselves in a variety of different ways. This provided emotional and physical growth and gave each student the feeling of self worth and self-accomplishment. The week began with team-building activities on land, such as "get to know you" games, trust falls, spotting techniques, and problem-solving games. As the group mastered the land activities, they moved to the low ropes course. At the camp, there were seven low ropes elements. Each element had two groups participating (one group spotting and one group climbing). After mastering the low ropes course elements, students over the age of ten had the option of trying the high ropes course. There were seven high ropes course elements, including a zip line. Younger students (over the age of eight) had the chance to try the giant swing. The camp's ropes course offered a variety of fun opportunities to build trust, solve problems and learn the value of collaborative teamwork.
4. **Healthy Living:** During this component of the program, students were exposed information about living healthy lifestyles. These included safety concepts, healthy eating and nutrition, and physical activity. Activities included Water and Boating Safety, Garden Project, Fitness Challenge, Otterthon Relay Race, and Field and Court Games. The students were encouraged to participate, be active, and have fun with their classmates. They learned about the importance of being physically active, having good nutrition habits, and overall what it means to be healthy.

Research Methods Course

The research methods course was delivered during the summer session for six weeks. Twelve students were enrolled in the course. During the first two weeks of class, the health sciences students learned about the outdoor education program and became familiar with the curriculum and content that they would be teaching to the children. From there, the class was divided into four groups of three students each to come up with a research question that they wanted to investigate during the program. As part of the course, one of the first assignments that the students completed was a proposal that detailed the specifics of the research project. They were required to provide a research question, hypothesis, methods (participants, data collection, data analysis), and the type of research design that they were interested in carrying out. Based on what they learned at the beginning of the course about the types of research designs, they created a study and a question to match the design. Once the students completed the assignment on the design of their study, the instructor met with each group to review it. The instructor provided feedback on ways to improve the study and the students worked to incorporate the changes to make the design stronger. This back and forth process happened until the instructor felt the design was well thought out and could answer the research question.

Prior to going into the field, the students had a solid research study that addressed a specific research question. The research questions the students focused on were specific to the one-week outdoor education experience. Two

of the student projects focused on assessing the amount and level of physical activity that the participants accumulated while in the outdoor education program. They compared physical activity levels such as sedentary, light, moderate, and vigorous between classes, curriculum components, age, and gender. Another group assessed the science learning that occurred during the camp. They performed pre- and post-assessment to determine science knowledge that was gained through the experience. They had a control group that did not perform the outdoor education program for a comparison. The last group examined the participants' perceptions of learning in the outdoor education environment. They conducted surveys of all participants at the end of camp and then interviewed a subset of children to gather their feedback on the outdoor experience.

During weeks three and four of the course, the health sciences students were in the field implementing the curriculum and collecting data. At the end of the course (weeks five and six), the students returned to the classroom to analyze their data. The students learned about the different types of statistical analysis (correlational, independent t-test, ANOVA) that could be performed based on their design and research question. The hands-on application of real data to teach the statistical analysis portion of this course was viewed positively by both the students and the instructor. They worked on creating a final paper and presentation that represented the results of their study. The course concluded with a presentation from each group to the YMCA senior leadership, board members, classroom teachers and administrators, and faculty.

Conclusion

This approach was a way to demonstrate how to teach research methods to undergraduate health sciences students through a community-based initiative in an urban school district. The health sciences students felt that a project-based approach was an effective way to learn the content of the course. The course objectives were met through demonstration of performance on course quizzes and through designing and carrying out a research study, analyzing the data, and writing and presenting the results of the project. As we continue to offer this course, we will use this approach to create measures that assess student perceptions of learning for both the health sciences students and the elementary school children. The active learning and student-centered pedagogical strategy created a culture of ownership over the research project and excited students about the course material. In many science lecture and laboratory courses, active learning can be an effective method to improve student learning and understanding and to improve student attitudes about a subject. Incorporating a team-based research project that uses the outdoor environment into a research methods course can help prepare students for future research experiences and their professional careers.

About the Author

Dr. Kevin Finn is an Associate Professor and Chair of Health Sciences at Merrimack College. His area of expertise is curriculum and teaching in the health professions with a focus around increasing physical activity in children. Kevin is a licensed athletic trainer in Massachusetts and a certified strength and conditioning specialist.

References

American Association for the Advancement of Science. 1993. Benchmarks for Science Literacy: Project 2061. Washington DC: AAAS.

Association of American Colleges and Universities. 2007. College Learning for the New Global Century. Washington DC: AACU.

Burrowes, P.A. 2003. "A Student-Centered Approach to Teaching General Biology That Really Works: Lord's Constructivist Model Put to a Test." The American Biology Teacher 65 (1): 491–502.

Campisi, J., and K. Finn. 2011. "Does Active Learning Improve Students' Knowledge of and Attitudes Toward Research Methods?" Journal of College Science Teaching 40 (4): 38–45.

Clark, M.C., H.T. Nguyen, C. Bray, and R.E. Levine. 2008. "Team-Based Learning in an Undergraduate Nursing Course." Journal of Nursing Education 47 (3): 111–117.

Hake, R.R. 1998. "Interactive-Engagement Versus Traditional Methods: A Six-Thousand-Student Survey of Mechanics Test Data for Introductory Physics Courses." American Journal of Physics 66 (1): 64–78.

Finn, K., and J. Campisi. 2015. "Implementing and Evaluating a Peer-Led Team Learning Approach in Undergraduate Anatomy and Physiology." Journal of College Science Teaching 44 (6): 323–328.

FitzPatrick, K.A., K.E. Finn, , and J. Campisi. 2011. "Effect of Personal Response Systems on Student Perception and Academic Performance in Courses in a Health Sciences Curriculum." Advances in Physiology Education 35 (2): 280–289.

FitzPatrick, K.A., and J. Campisi. 2009. "A Multiyear Approach to Student-Driven Investigations in Exercise Physiology." Advances in Physiology Education 33 (4): 349–55.

Macheski, G.E., J. Buhrmann, K.S. Lowney, and M.E.L. Bush. 2008. "Overcoming Student Disengagement and Anxiety in Theory, Methods, and Statistics Courses by Building a Community of Learners." Teaching Sociology 36 (1): 42–48.

Manning K., P. Zachar, G.E. Ray, and S. LoBello. 2006. "Research Methods Courses and the Scientist and Practitioner Interests of Psychology Majors." Teaching Psychology 33 (1): 194–196.

Mierson, S. 1998. "A Problem-Based Learning Course in Physiology for Undergraduate and Graduate Basic Science Students." Advances in Physiology Education 20 (1): 16–21.

National Research Council. 1999. Transforming Undergraduate Education in Science, Math, Engineering, and Technology. Executive Summary. Washington, DC: National Academy of Science Press.

———. 2003. Evaluating and Improving Undergraduate Teaching in Science, Technology, Engineering and Mathematics. Washington, DC: The National Academies Press.

———. 2003. Bio 2010. Transforming Undergraduate Education for Future Research Biologists. Washington, DC: The National Academies Press

National Science Foundation. 1996. Shaping the Future: New Expectations for Undergraduate Education in Science, Mathematics, Engineering, and Technology. Washington, DC: NSF Directorate for Education and Human Resources; NSF 96-139.

Niaz, M., D. Aguilera, A. Maza, and G. Liendo. 2002. "Arguments, Contradictions, Resistances, and Conceptual Change in Students' Understanding of Atomic Structure." Science Education 86 (2): 505–525.

Prince, M. 2004. "Does Active Learning Work? A Review of the Research." Journal of Engineering Education 93 (3): 223–231.

Rash, E. 2005. "A Service Learning Research Methods Course." Journal of Nursing Education 44 (10): 477–478.

Sizemore O.J., and G.W. Lewandowski. 2009. "Learning Might Not Equal Liking: Research Methods Course Changes Knowledge But Not Attitudes." Teaching Psychology 36 (1): 90–95.

Towns, M.H., and E.R. Grant. 1997. "Cooperative Learning Activities in Physical Chemistry." Journal of Research and Science Teaching 34 (2): 819–835.

National Research Council. 2003. Evaluating and Improving Undergraduate Teaching in Science, Technology, Engineering and Mathematics. Washington, DC: The National Academies Press.

National Research Council. 2003. Bio 2010. Transforming Undergraduate Education for Future Research Biologists. Washington, DC: The National Academies Press