Project-based science instruction for general-education undergraduates and seventh graders: Practices, proficiency, and pitfalls

Walter S. Borowski  
*Eastern Kentucky University*, w.borowski@eku.edu

Malcolm P. Frisbie  
*Eastern Kentucky University*

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**Recommended Citation**  
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graders: Practices, proficiency, and pitfalls

Walter S. Borowski¹ and Malcolm P. Frisbie²

¹Department of Geosciences and ²Department of Biological Sciences

Eastern Kentucky University, Richmond, Kentucky

For three semesters we conducted a general-education course designed for both undergraduates
and seventh-graders in which students investigated contaminant sources and water quality of a
local stream. The middle school students attend a local, county school that draws its students
from disadvantaged areas of the town of Richmond, Kentucky. Undergraduates were general-
education honors students with little predilection toward science. The instructors guided
undergraduates through the project, and our honors students then mentored the middle-schoolers
in their scientific endeavors.

Both sets of students serially investigated the chemical and biological properties of a typical
upland stream (Tates Creek, Madison County, Kentucky) impacted by anthropogenic activities
as dictated by land use. Students measured water properties such as temperature, conductivity,
 pH, and oxygen content then sampled stream waters to quantify dissolved nutrient concentration,
fecal microbes (Escherichia coli), and stream macroinvertebrates. Nutrients (ammonium, NH₄⁺;
nitrate, NO₃⁻; phosphate, PO₄³⁻) were measured by colorimetry and E. coli were counted using
rapid-assay, IDEXX methods. Students also assessed water quality by classifying and counting
macroinvertebrates, and using an established water quality index. Students then summarized
their findings with group presentations. Middle-schoolers researched aspects of anthropogenic
contamination and stream ecology to present their work as poster projects at an event on the
campus of Eastern Kentucky University. Undergraduates gave group presentations in class
following the format of an oral presentation at a scientific conference.

Courses with embedded projects are challenging from logistical, fiscal, and pedagogical
standpoints. Assessment of overall course effectiveness continues, but several aspects emerge.
The course seemed most effective for middle-schoolers where teachers saw students actively
engage in all aspects of the project, even those students who are generally disinterested in
science. Results from undergraduates were mixed. Honors students enjoyed mentoring the
seventh graders, but did not fully grasp the impact and nuances of project findings.

Earth Educators Rendezvous Conference, Madison, Wisconsin

July 2016