TEACHING DATA LITERACY IN HIGH SCHOOL BIOLOGY

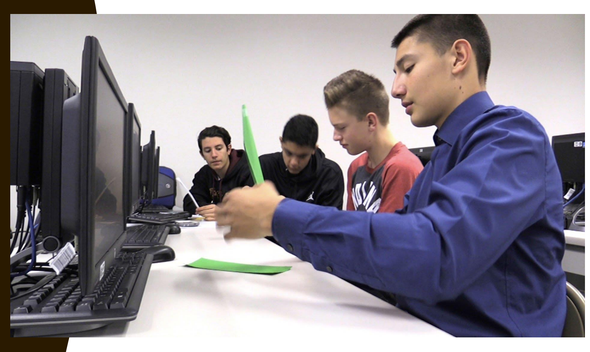

Figure 1: Students preparing graphs.

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Figure 2: Student groups analyzing data.

Background

Although the high school biology curriculum is designed to teach the most important biological concepts, there is a concern that students are not learning the data literacy skills they need for the 21st century workforce. To prepare students for the challenges they face in future college and careers, the science curriculum should include lessons in data literacy. Students should be able to make the right kinds of graphs to display different types of data, analyze data using basic statistics and argue claims using evidence from data. It is difficult to find time to teach these skills, so this project investigated ways to incorporate the teaching of these important skills into the existing biology curriculum

Teaching students a body of scientific facts is not enough for the challenges they will face in the 21st century workforce[1]. The ability to read, interpret, and analyze scientific and technical text are fundamental practices of science and engineering[2].In addition, students must be able to use data to help make decisions, justify claims, solve problems and challenge conclusions[3].

Methodology

This investigation was conducted with two honors biology classes at Casteel High School in Queen Creek, Arizona (*N*=54).

The project incorporated the teaching of data literacy skills within an existing high school biology curriculum. As students learned about concepts in evolution and ecology, their lessons also included practicing skills in graphing, basic statistics and data analysis. The lessons were designed to incorporate data collected by student experiments or the use of data sets from real-world scientific problems.

Students were assessed with interviews and a survey of attitudes and confidence levels before and after treatment. In addition, students completed two pre and post tests of data literacy skills.

Units of Instruction

Unit 1: Student designed experiments in ecology
Data Literacy Skill: choosing and making the right kind of graph

Unit 2: Evolutionary theory lesson on variation of genetic traits in a population
Data Literacy Skill: making and interpreting box-and-whisker plots

Unit 3: Ecology lesson on protist diversity in fresh water ponds
Data Literacy Skill: analyzing data using basic statistics

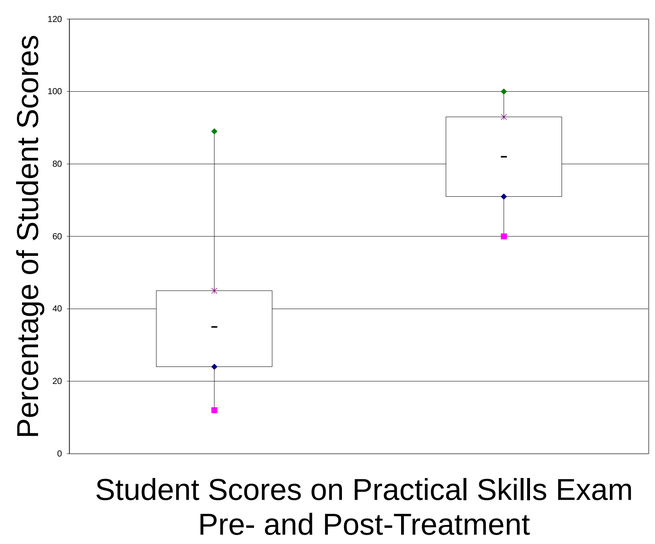
Unit 4: Ecology lesson on effect of climate change on penguin populations in Antarctica
Data Literacy Skill: arguing claims based on evidence

Focus Questions

This project was designed to answer these questions:

- *How does incorporating data literacy into biology content lessons improve data literacy skills ?*
- *How can the use of real data help students learn data literacy skills?*
- *How does the teaching of data literacy skills improve student engagement and confidence levels in organizing and analyzing data?*

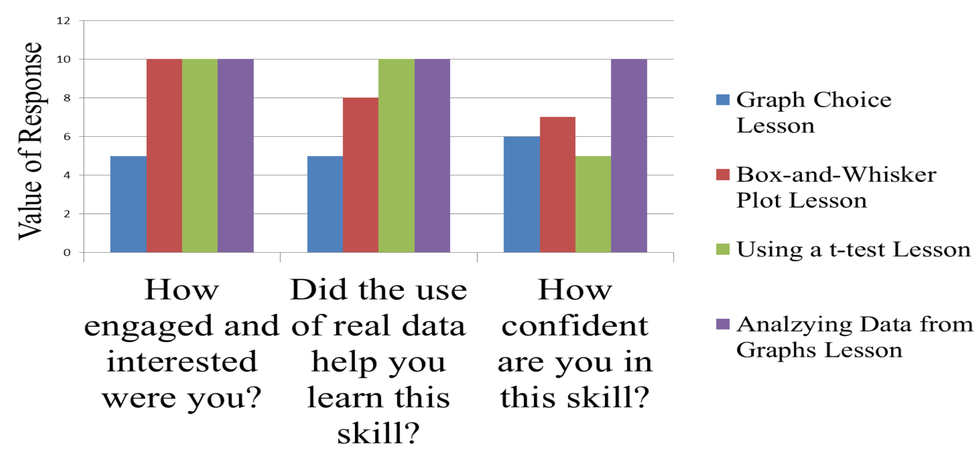
Practical Skills Test Results



Student Scores on Practical Skills Exam
Pre- and Post-Treatment

Mean scores on the Practical Skills Test increased from 38% to 82%.
Student confidence levels showed a substantial improvement in using box-and-whisker plots and analyzing data from graphs.

Confidence Levels Survey Results



Conclusions:

Data literacy skills can be successfully incorporated into an existing high school biology curriculum. Student skills significantly improved by incorporating instruction into lessons in ecology and evolutionary theory. Students reported greater confidence in their ability levels. They also said that the use of real data helped them learn the skills easier and lessons were more engaging and interesting.

"I know I could have learned this skill by just following the instructions, but using real data made me want to learn it. Any real data is better. It makes it more interesting"

"I now understand why it is so important to practice this skill. I know I will use it from now on."

Text References

(1) Harris, J., (2012), Data is Useless Without the Skills to Analyze it, *Harvard Business Review*
(2) NGSS Lead States (2013), *Next Generation Science Standards: For States, By States*
(3) Common Core Standards (2010), Reading Standards for Literacy in Science and Technical Subjects 6-12, *Common Core State Standards Initiative*

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Figure References:
(1) Chandler Unified School District, www.youtube.com
(2) www.azednews.com

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