Hands–on Science and Motivation: Using Relevance and Authority Transference to Motivate Students

BASE BROOKLYN ACADEMY of SCIENCE AND THE ENVIRONMENT

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Introduction

How to motivate students effectively is one of the central concerns in education. This hurdle is especially salient within the high school community, where the sciences often arouse much anxiety in students. Traditional educational models that focus on lecture-driven courses, standard examination methods, and centralized instructor-based power hierarchies typically fail to grasp and engage students reliably.

Recently, much attention has been devoted to generating, sustaining, and elevating student motivation. We utilized two of these methods with sophomore science research students at B.A.S.E., an urban high school located in Brooklyn. This two-part model stresses (1) framing target content in conceptually relevant contexts based on students' daily experiences and (2) developing hands-on research projects that are contingent upon students' interests and feedback. Part two of this model encourages instructors to transfer some authority to their students, which presents them with the opportunity to invest creatively in science research.

We tested these methods by using student interest and feedback to develop three unique scientific studies under the umbrella of green space research. By treating the classroom as a discussion board, students' ideas shaped the scientific process. Based on their designs, students collected and analyzed the data, discussed the implications of the results, and generated possible alternative and future research designs.

Method

Using green space as a backdrop, we introduced three different variables to explore: stress, environmental appreciation, and health. We used the following instructional style to promote conceptual understanding and active participation in the students:

Phase 1- Divide students into groups of 4-5 members. Every study requires new group members.
Phase 2- Assign background articles on the topic variable. Articles are reviewed in class with student-led discussions to ensure topic understanding.
Phase 3- Students develop hypotheses about the relationship between the topic variable and green space. We stressed certain questions (*Why are we doing this research? Why does it matter?*) so that students would focus on communicating to the general public.
Phase 4- Students consider how to answer their hypotheses. Examples of designs and measures are incorporated into class to guide their methods.
Phase 5- The students and instructors coordinate a schedule for collecting data, where everyone is accountable for administering surveys, coding data, etc.
Phase 6- Students analyze the data with guided worksheets and in-class computer exercises.
Phase 7- We consider our results, what they mean, our methodological limitations, and future designs .
Phase 8- We establish a take-home message to communicate to others.

Study 1
Is There A Relationship Between Green Space And Self-perceived Stress?

Hypothesis – Those who are exposed to green space frequently will have lower stress levels than those who are not.
Method – Students administered a survey that they created to freshmen in their school. Example questions were provided from published, validated scales. Question items were generated in class and immediate feedback was provided. The final questions used were voted on by students.
Measures:
    Green Space Exposure Scale (How many trees can you see from your home?, Does your daily commute pass through parks or green space?, etc.)
   **Self-perceived Stress Scale** (Do you find it difficult to relax?, Do you find that you are easily agitated?, How often do you feel like you cannot keep up with your work?)
Results – We obtained significant correlations on the following items:
    Those who have more plants in their homes have lower stress levels ($r = -.41$, $p < .05$)
    Those who have more windows in their homes have lower stress levels ($r = -..33$, $p < .05$)
    Those whose daily commute passes through green space also enjoy green space ($r = .41$, $p < .01$)
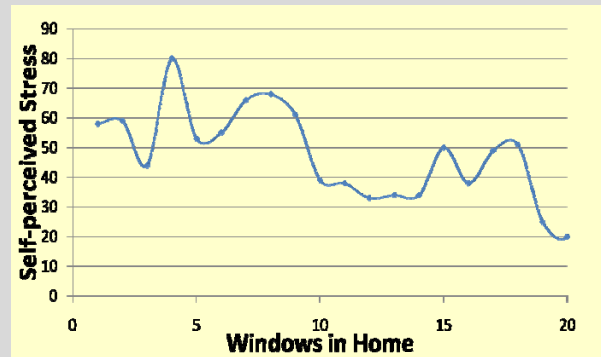
Study 2
Does Green Space Exposure Affect Environmental Appreciation?

Hypothesis – Those who are exposed to green space will appreciate the environment more than those who are not.
Method – The students wanted to make a causal claim, so we created an experimental (rather than correlational) design.
Green Space Manipulation:
    Experimental Condition – We exposed participants to a short (10 minute) video clip showing environmental scenes.
    Control Condition – We exposed participants to a short (10 minute) video clip showing technological images and urban scenes.
Measures – Students used their Green Space Exposure Scale and created an Environmental Appreciation Scale (Do you care about nature?, Do you think it is important to save the environment?, etc.).
Results – We obtained a marginally significant difference between participants exposed to green space ($M = 48.83$) and technology ($M = 42.21$) on environmental appreciation. We also found that the strongest predictors of environmental appreciation are how many windows one's home has and the degree to which one commutes through green space.

Study 3
Is There A Relationship Between Green Space and Health?

Hypothesis – Those who are exposed to green space frequently will have better health levels than those who are not.
Method – To promote spatial thinking skills, we utilized the MyWorld software. Students were given numerous exercises to help them create visual representations of green space and health through layered maps. They compared green space and health data on the maps, and then converted this spatial data into quantitative data.
Results – Although not significant, the data revealed the opposite trend; regions that had more green space had poorer health.
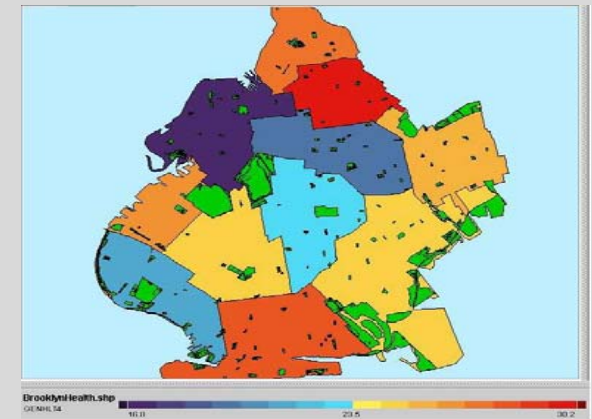
Discussion

Overall, we find that giving students the freedom to create their own questions and develop the means by which to answer them increases their motivation, enthusiasm, and interest. By decentralizing the traditional power relationship between instructor and student, we have observed that students are more receptive to critical feedback and more likely to invest creatively in the course.

Somewhat surprisingly, as students took the initiative to create their own projects, they also became more critical of each other's efforts. As a result, they had generated a social pressure to work productively and remain on task during class. Therefore, the students became accountable for each other, and this pressure helped reduce the image of the instructor as the sole source of feedback.

In sum, by transferring some authority to students and giving them the opportunity to practice hands-on research in their own relevant communities, they not only learn the material well but become stewards of science, research, appreciation, and communication.