

An Interactive, Instant Polling Exercise to Allay Student Anxiety in Science Courses

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ABSTRACT

Many high school and undergraduate students enter science courses feeling intimidated by course content and unsure of their abilities. Teachers are frequently challenged in mixed-level and interdisciplinary courses to ascertain and honor students' levels and areas of experience. In these cases, the application of critical pedagogy techniques can create a culture of caring and thereby allay student anxiety and increase student motivation and success. Here I describe a simple instant polling exercise that employs critical pedagogy to stimulate dialogue about students' experiences with course content. This exercise is especially useful for mixed-level and interdisciplinary science courses, and can be easily adapted for small or large classes.

Key Words: critical pedagogy; histogram; interdisciplinary; internal safety; mixed-level classroom.

○ Introduction

Critical pedagogy theory suggests that students' sense of self has a persistent effect on their development, success, and connection to school (Leonardi & Meyer, 2016). Students' experiences of school hinge upon the point where *who they are* interacts with *where they are*, or the intersection of identity and school culture (Leonardi & Saenz, 2014). Thus, achieving "internal safety" (*sensu* Leonardi & Saenz, 2014) requires teachers to attend to students' sense of self, as well as to the social contexts in which they learn (Leonardi & Meyer, 2016). Leonardi and Meyer (2016) write, "Central to *internal safety* is the need for school environments to be places where students feel affirmed, where they are supported through their process of becoming" (p. 176). Increasingly, effective teachers are described as those who develop safe and trusting relationships with students, and those

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who foster a sense of community and caring in their classrooms (Palmer, 2007; Wentzel, 2009). Students in emotionally safe and trusting learning environments are more motivated to learn and to build positive social relationships (Wentzel, 2009).

Critical pedagogy theory and techniques can be applied in any classroom in which real or apparent dominance relationships exist, including science classrooms. Many students enter science courses feeling intimidated by the content and unsure of their abilities, particularly in highly technical (e.g., microbiology, genetics) or quantitative (e.g., ecosystem ecology, biogeochemistry) courses (Betz, 1978). Students may compare themselves to other students and conclude that they fall short. These distortions are rarely checked publicly, that is, via classroom dialogue, and thus students may never become aware that others in the course also lack science training. Further, without such dialogue, teachers are challenged in mixed-level and interdisciplinary courses to ascertain and honor students' levels of training and experience. Establishing a "culture of conversation" (Leonardi, 2014) in science classrooms is an important first step in crossing boundaries (hooks, 1994) and surfacing students' perceptions of how they define themselves "through and against others" (Luhmann, 1998). Such dialogue encourages students to publicly honor their own experience and "historical location" (Sleeter & Delgado Bernal, 2004) with respect to course content.

Teachers can use the exercise described here on the first day of any high school or undergraduate science course to achieve the following outcomes. (I have even used this exercise in interdisciplinary master's and doctoral environmental studies courses.)

1. Publicly check students' assumptions about their understanding and experience compared to others in the course;

2. Create a safe, trusting learning environment in which students feel comfortable taking risks by sharing their lived experiences with respect to course content;
3. Give voice to all students equitably, regardless of their history with course content;
4. Allay students' anxiety and shame if they perceive they do not measure up to others;
5. Allow the teacher to ascertain students' understanding of and experience with course content prior to beginning content delivery;
6. Teach students basic data generation, graphing, and interpretation skills via the collective creation of a frequency histogram.

○ Collective Creation of a Frequency Histogram

Before students arrive in the classroom, the teacher prepares five questions pertaining to the course content about which to poll students (Table 1); the teacher may write these questions on flip chart paper, or may prepare five PowerPoint slides with one question per slide. After preparing the questions, the teacher draws five large histograms on flip chart paper and tapes them to the walls around the classroom, leaving enough room in front of each histogram for the entire class to gather around. The x-axis of each histogram is labeled "Experience level" on a scale of 1 (none) to 5 (extensive), and the y-axis is labeled "Frequency." (I use "1" instead of "0" for "no experience" to avoid potential judgments associated with "being a zero.") The top of each histogram is labeled with the question being asked, for example, "Question 1: What is your level of experience with the field of ecology?" (Figure 1).

To initiate the exercise with students, the teacher provides five small (ca. 1" x 2") sticky notes to each student and explains the exercise. Then, students are instructed to write a small number "1" in the top right corner of their first sticky note pertaining to Question 1, after which the teacher displays Question 1 to students. The teacher instructs students to write their ranking (1 = none, 5 = extensive) in

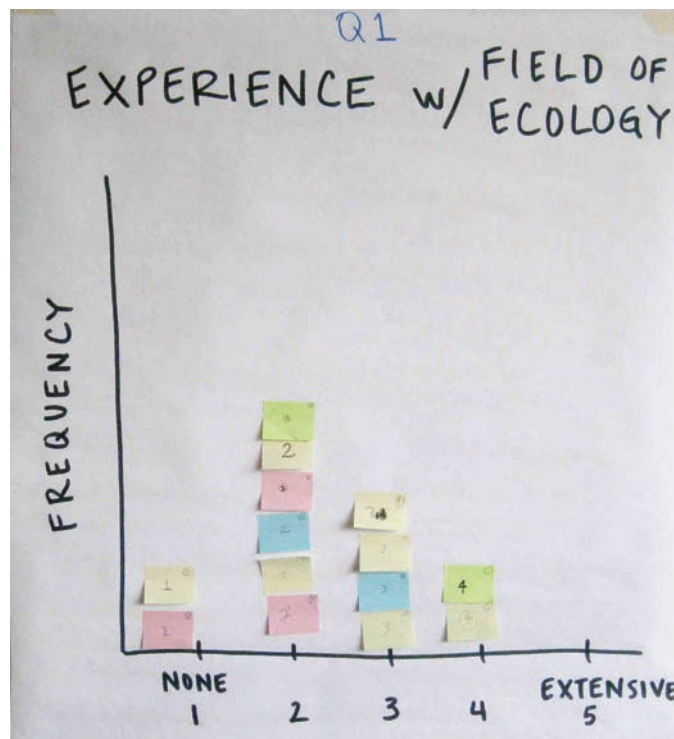


Figure 1. Example histogram from an upper-level ecology course. Teachers should customize their question prompts to their specific course content. Photo by R.K.T.

the center of the sticky note in response to the question. The teacher slowly goes through all five questions in this manner, with students writing the question number in the upper right corner of their sticky note, as well as their rank response to each question in the center of the appropriate sticky note. After all students have noted their responses on all five sticky notes, the teacher instructs students to take their sticky notes to the histograms and collectively build a frequency histogram for each question using their sticky notes (i.e., one sticky note is one datum for each question). The teacher may need to instruct the students to stack their sticky notes vertically along the y-axis, so each x-axis category has a histogram bar above it representing all the data (sticky notes) in that numerical category (Figure 1).

Once all frequency histograms are constructed, the teacher and students gather around each frequency histogram for discussion. (Note: Physically approaching the histograms works best with ≤ 20 students. For larger classes, teachers may wish to use an electronic, instant polling equivalent such as clickers and display the histograms electronically.) To frame the discussion, the teacher identifies the x- and y-axes, explains what they represent, and then points out the data frequency distribution, for example, bell curve, skewed left (low), skewed right (high). Then, the teacher asks for a student representative of each tail of the distribution to share why they chose their ranking. For example, if the frequency distribution of Question 1 (e.g., "What is your level of experience with the field of ecology?") has two data (two sticky notes) in category 4, the teacher asks for one student who replied "4" to share why they ranked their level of ecology experience as such. Similarly, if two data comprise the 1 bar of the histogram, the teacher asks for one (or more than one, to further normalize the experience) of

Table 1. Example questions that teachers may prepare for instant polling. Teachers should adapt questions to the course content as appropriate; the following questions were developed for an upper-level ecology course. 1 = none, 5 = extensive.

Question 1:	What is your level of experience with the field of ecology?
Question 2:	What is your level of experience working with quantitative data?
Question 3:	What is your level of experience designing a research experiment?
Question 4:	What is your level of experience writing a research report?
Question 5:	What is your level of experience giving a research presentation?

those students to tell the group why they chose 1. The teacher may also prompt a representative student to explain why they chose 2 or 3. This discussion gives students opportunities to share their personal and professional stories pertaining to course content, for example, working on interesting field or laboratory projects, hunting or fishing with a grandparent, maintaining a garden, etc. It is important that the teacher facilitate this discussion without judging or shaming; this is an opportunity for the teacher to encourage students representing all levels, and to reassure the students with 1 rankings that they can succeed and learn in the course without much prior experience in the subject matter. Further, inviting students from all rankings to share their responses allows those with minimal experience to identify one another, and to identify students with more experience, for support throughout the term.

○ Application

The exercise described here is especially useful for interdisciplinary science courses and courses that draw students from many varied backgrounds and areas of interest, for example, ecology, environmental studies, and sustainability studies. Given current global climate and biodiversity crises and the move toward interdisciplinary curricula, such courses are increasingly common and popular. For example, I use this exercise on the first day of my soil ecology course, which attracts students with backgrounds in environmental sustainability, agroecology, food justice, plant ecology, microbiology, and environmental education. My students regularly comment that the exercise is fun and interesting, and puts their minds at ease by surfacing the myriad levels and types of students' experiences. By publicly sharing their experiences in a non-shaming dialogue, students feel greater internal safety and are encouraged that I will use the diversity of their experiences to enhance student learning, rather than to perpetuate "power over" dynamics. Subsequently, students are more confident in what they can contribute to the course, which increases their motivation to learn, willingness to take risks, and authentic expression throughout the term.

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