

## **ED 12X: In the Classroom Reflection #2**

The major goal that I have taken away from my studies at Tufts is in thinking about how to elicit and really hear my students' thinking. As I have worked on practicing this in my internship, an associated struggle that I have often encountered is one of not being sure how to build on the student's prior knowledge, their thinking, to get towards the traditional physics content. I chose this particular lesson, the introduction of 'work', to discuss with our ED12X class in hopes that it would jump start conversation around how others in the class go about facilitating and building off of students' prior knowledge. I had planned the lesson knowing that that my students would come in with many different ideas about what work is given its usage in everyday language. I had put in a lot of thought into how I was going to elicit their prior knowledge about 'work' and also how to progress from there to the physics definition of work. I wanted my fellow classmates' feedback about how the lesson went overall and to get their suggestions on other ways to transition from student ideas to "the content".

My thoughts about lesson's goals initially were for my students to discuss the different aspects of what they know the term "work" to mean, for them to generate and realize that there are multiple meanings for the term "work". I hoped that the dialogue would then help my students feel more okay with the narrowly defined definition of work in physics.

### The Activity:

Unlike other unit introductions where I had the students elaborate on anything that would come to mind when they thought of a particular word, normally the title of the unit, for example, "List or draw as many things as you can that come to mind when you hear the word "Energy", this time, I decided to provide specific images to try to get more detailed insights into their ideas

about the topic of 'work'. I gave each student four pictures to analyze. I wanted them to start individually so that each would activate their schemas and be more likely to engage and participate in the discussions. For each picture, students had to first write down if there was “work” being done in each picture and give an explanation as to why they thought so. Image A is of a person pushing a wall, image B is of a person lifting a box, image C is of a person pushing another person in a rolling chair, and Image D is of a person holding a bike above his head. See Appendix A for the associated images. After having several minutes to contemplate and write down their own rationale, the students then turned to talk to one to two other students at their table and wrote to see if they agreed or disagreed with each other. They had to note down if they had similar definitions of work or if they had different definitions.

I then went around the room and wrote down the various thoughts as to which images portrayed 'work' and what different characterizations of work came out of each group. Afterwards, seeing the entire list that was generated by the class, I explicitly showed the class that they had come up with many meanings to the term 'work'. I then stated that in physics, 'work' is used very specifically and that physics would only say that in two of the images would there be work done. I had them re-discuss with their groups which two images they thought would depict work in the physics sense and why.

#### Student Thought and Action:

For two of my classes, the students seemed engaged and participated in the activity. The tables that had disagreements had great conversation. One of the students turned to me in my A block and said to me, “It depends on what your definition of work is!” This comment hit the point so well that I used it to launch the class discussion afterwards.



The majority of groups in A and B block chose the correct two images (B: the person lifting a box and C: where a person was being pushed in the office chair by another person) that depicted work in a physics context. They also for the most part, came up with the physics definition of work, saying that there was something moving. B Block also said acceleration, which I felt like was in the right direction so I allowed it at the time.

In E Block, however, all the groups chose different pairs of images. I was quite surprised, especially after having the prior experiences with A and B blocks. Talking to my students in E block more, I learned that they were seeing many different patterns. Two of the images had objects that were not moving, two images had moving objects, two images had objects being lifted (force applied vertically), and another two images where the objects were being pushed to the side (force applied horizontally). I found it interesting that they noticed so many patterns. In ED12X, we talked about how I could more explicitly ask them to think about what would make something a good physics argument. Now looking back at their conclusions, I feel like even without me explicitly asking them what would make a good physics argument, my E block came up with four strong contenders for the definition of work that would make sense in a physics context. My students trying to make sense and use the images to draw conclusions. That is exciting!

A particular remarkable part of the video clip I showed in ED12X was when a student exclaims, "I don't get what you mean by work!" In my initial review of the video, before discussing in ED12X, my thought was that this was one of those moments where students really wanted me just to tell them the answer. They found it frustrating that I was making them do this activity and not just providing them with the "correct" answer that I was looking for as a teacher. It seemed like from all these years of school, my students want and have learned to wait for the

answer from teachers. They are not used to engaging in, coming up with, and arguing for their own rationales and explanations. Feedback from the discussion in ED12X, however, made me rethink my assumptions about this situation. It might have been less about resistance and instead, just trying to figure out what game I was asking them to play because they could sense an ulterior motive. I had assumed that part of eliciting and hearing student thinking is not to say much so that the ideas would come from the students and that I would not be influencing their thoughts. Yet, what I learned from our discussion is that if I am more transparent about what and why I am asking them to do what they are doing, it would remove their preoccupation with wondering about what the game is, and instead, actually participate in the activity. Next time, I will be more upfront that the goal is to as a class, tease out all of the definitions of work so that we can then think about what is useful to think about in a physics context.

While in a way the above change can be seen as a subtle procedural change, after reflecting on the feedback, I appreciate that it really is a strong reminder to continuously challenge and improve what I think the goals of my lessons should be. My lessons should challenge students to not only bring in prior knowledge, but to go beyond to critically engage with and build upon their ideas to gain to deeper understandings of physics . As much as I strive for lesson goals that are of this level of meaningfulness, I definitely need more practice and it was helpful to have my classmates look over a lesson and help it become a more meaningful lesson. I hope to continue to utilize my Tufts' network to strengthen my lessons and propel my students to continuously engage in critical thinking.

**Appendix A: Class Handouts, Work lesson activity**

**A: Pushing a wall**



**B: Lifting a box**



**C: Pushing a chair across the floor**



**D: Holding a bicycle over your head for 10 minutes**



<p><b>A: Pushing a wall</b></p> <p>1. Do you think this is an example of work? Why?</p>         <p>2. Does your team think this is an example of work? Why or why not? What are the different arguments?</p>	<p><b>B:</b></p> <p>1. Do you think this is an example of work? Why?</p>         <p>2. Does your team think this is an example of work? Why or why not? What are the different arguments?</p>
<p><b>C:</b></p> <p>1. Do you think this is an example of work? Why?</p>         <p>2. Does your team think this is an example of work? Why or why not? What are the different arguments?</p>	<p><b>D:</b></p> <p>1. Do you think this is an example of work? Why?</p>         <p>2. Does your team think this is an example of work? Why or why not? What are the different arguments?</p>