

# Development of Preservice Teachers' Sense of Agency

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**Abstract.** High school physics teachers face myriad restrictions and challenges that may make it difficult to teach using research-based methods. Whereas greater learning gains are found with active learning, this generally requires more time than rote lecturing. National standards which call for wide content coverage make such approaches prohibitive. This and other pressures may lead new teachers to feel that they have little control over what and how they teach. We think that it is important to build in teachers a sense of agency for their teaching, and we report on a curriculum for preservice teachers that aims to accomplish this.

## 1 Introduction

Many people think that the ability to teach is an artistic trait that you are either born with or not. However, physics education research has found that students tend to learn more in interactive engagement classrooms than in traditional lectures, regardless of charisma or other personality traits of their instructor (*e.g.*, [1]). This finding demonstrates that there is a science behind teaching. The degree to which teaching is an art and the degree to which it is a science is one in which teachers and researchers alike have not reached a consensus. On the one hand, especially in consideration of the exhausting course load that high school teachers in many countries face, there are sentiments that it would be best to have teaching physics purely as a science, with minimal innovation by the teacher. With this model, the teacher would faithfully utilize curriculum developed by education researchers without a need for taking the time to interpret or understand of the rationale behind the curriculum. There are others, however, who feel that this is not a productive stance to take. Some physics education researchers, for example, maintain that we should aim to refine teacher intuition, rather than repress it (*e.g.*, [2]).

One reason why it is ill-advised to request teachers to faithfully carry out reformed curriculum without reflection is that students do not always respond as curriculum developers expect. An example of this is described in detail by Harlow [3] who looks at two teachers utilizing a lesson from *Physics and Everyday Thinking (PET)*. In studying magnetism, the worksheet has students draw a sketch of what they think is different inside of a nail that has been magnetized by rubbing it with a magnet from one that is not magnetized. The worksheet then has students cut the nail in half and predict what their picture would imply should happen if each end of each half is held up to a magnet. After doing the experiment, students are told to revise their models if necessary. The curriculum developers expect students to think (incorrectly) that north poles accumulate at one end of the magnetized nail and south poles at the other end, as shown in Fig. 1. When cut in half, the developers predict students to (incorrectly) say that each end of the negative half of the nail will be attracted to the north end of the magnet. When students find that, in fact, one end of the half is attracted but the other end is repelled, students can revise their model to the correct one, that there are magnetic dipoles throughout the nail that are all aligned when the nail is magnetized. In both the classroom of Ms. Shay and the classroom of Ms. Carter, there was a group of students who did not have this specific incorrect explanation of what a magnetized nail



Fig. 1 Expected student models for unmagnetized (left) and (incorrect) magnetized (right) nails.

looks like. Rather, they thought that the magnetic property comes about because magnetic dust had accumulated on the nail when it was rubbed by the magnet. Ms. Shay, staying true to the worksheet, had the students proceed to cut the nail regardless. The lesson did not succeed, because the results did not challenge the students' model. Ms. Carter, on the other hand, deviated from the worksheet productively. Namely, she had the students "wipe off" the magnetic dust. Seeing that the nail was still magnetic, the students revised their model.

## 2 Instilling in teachers a sense of agency

To respond as Ms. Carter did in this anecdote, we posit that a teacher must both have knowledge about the intentions of the curriculum [4] and a sense of agency. A sense of agency not only provides teachers the "permission" needed to make productive in-the-moment changes to the curriculum, but also to use reformed curriculum in general, especially when it might be inconvenient to do so. High school physics teachers graduating from Tokyo Gakugei University have reported feeling pressure to teach in the traditional style used by other teachers at their school instead of with the reformed curriculum they learned as preservice teachers. In many countries, the class time necessary to cover the wide breadth of topics put forth by national standards makes the use of reformed curriculum prohibitive, as interactive engagement typically require more time. A teacher without a sense of agency may feel that he or she does not have the freedom to utilize reformed curriculum.

In this talk, we will present findings from a course intended to build in preservice teachers a sense of agency overall while instructing them in a specific reformed physics curriculum. At both Tokyo Gakugei University (TGU) and the University of Vienna (UV), preservice high school physics teachers were instructed in the use of Open Source Tutorials, guided worksheets developed by the University of Maryland College Park which students complete in groups of four. At UV, a Vertiefungsseminar course featured a different tutorial each week throughout the summer semester of 2018. Preservice teachers acted as tutorial facilitators first in class for their classmates and then outside of class for local high school students. Weekly homework assignments had them predict the intentions of that week's tutorial, and they checked their predictions in the following class when they received the instructor's guide. At TGU, graduate student preservice teachers met weekly to discuss possible improvements to the worksheets for use with undergraduate students. Preliminary observations indicate that this course where students analyze and/or improve reformed curriculum increases preservice teachers' sense of agency, as measured by a survey we designed as well as anecdotal observations.

## References

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