

# TA Beliefs in a SCALE-UP Style Classroom

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**Abstract.** In Spring 2010, the Oregon State University physics department instituted a SCALE-UP (Student-Centered Active Learning Environment for Undergraduate Programs) style studio classroom in the introductory, calculus-based physics series. In our initial implementation, comprised of two hours lecture, two hours of studio, and two hours lab work, the studio session was lead by a faculty member and either 2 GTAs or 1 GTA and 1 LA. We plan to move to a model where senior GTAs can lead studio sections after co-teaching with the faculty member. It is critical that we know how to prepare and support the instructional team in facilitating student learning in this setting. We examine GTA and LA pedagogical beliefs through reflective journaling, interviews, and personal experience of the authors. In particular, we examine how these beliefs changed over their first quarter of instruction, as well as the resources used to adapt to the new classroom environment.

## INTRODUCTION AND BACKGROUND

In Spring 2010, the Oregon State University physics department instituted a SCALE-UP (Student-Centered Active Learning Environment for Undergraduate Programs) style studio classroom in the introductory, calculus-based physics series. SCALE-UP style classrooms have been instituted at a number of schools across the country, often with significant success[1]. However, as with any classroom, the efficacy of SCALE-UP is limited by the skill of the instructional team, which frequently includes not just the leading professor but also several teaching assistants (TAs). Often these TAs serve as a student's primary contact, acting as a middleman between the students and the professor. In such a role, the TAs frequently have far more interaction time with the students and can greatly influence a student's learning. It has been shown by that TA beliefs affect the way a TA teaches a reformed curriculum, impacting student learning[2]. Thus, for classes that employ TAs, the beliefs and practices of the TAs are at least as important as those of the professor. According to Guskey's model of teacher change, which we here apply to TAs as well, change in teacher beliefs most often occurs not after going through a professional development program, but rather when they see actual changes in student learning in their own classrooms[3].

Here we deal with two primary methods of effecting changes in TA beliefs, namely reflective journaling and teacher preparation. These two methods were chosen due to prior experience in their use when the Paradigms in Physics model was developed at Oregon State[4]. This was also continued with prior reforms instituted in the introductory, calculus-based physics series[5]. The value of reflective practices such as journaling has been well noted, with reflective practices being strongly linked to both improved skill and decreased time to improve

skill[6, 7].

In this first implementation of SCALE-UP at Oregon State, we seek to investigate the experiences of the four graduate teaching assistants (GTAs) and a single undergraduate learning assistant (LA), modeled after the program at the University of Colorado[8]. This information will be helpful in three ways. First, it will aid us in understanding what changes need to be made when first implementing the SCALE-UP environment. Secondly, it will aid us in better preparing the GTAs and LAs in future terms. Finally, it will provide general information on teacher orientation and possibly the role of the SCALE-UP environment and our preparation methods in contributing positively to that.

## The SCALE-UP classroom

Key features of our implementation of the SCALE-UP design are eight circular tables which each seat up to nine students. These nine students are then subdivided into three groups of three students each. By using circular tables, students are encouraged to discuss with both the other two group members as well as the other groups at the table. Each table contained three laptops, one per group, and had one Hitachi StarBoard serving the dual roles of projection and smart board space for group work. Students also made frequent use of large, portable white boards where the entire group could work simultaneously. Students were then given a variety of tasks to complete, some more conceptual, some more mathematically rigorous. The GTAs and LA circulated among the tables, generally at a ratio of approximately one GTA or LA per four tables, or roughly 36 students. The professor and an external researcher doing observations would also aid in helping students, however, the professor also

had to attend to details such as timing, technology issues, capturing students' work, and management of the whole classroom, rather than concentrating solely on aiding the students.

## **GTA/LA Preparation**

Prior to working in the SCALE-UP environment, GTAs had three training environments. The first was a TA orientation session. This was completed by all GTAs prior to entering the graduate school as a part of the departmental orientation. This focuses primarily on duties, responsibilities, and an introduction to being a teaching assistant for those who have not done so before. The second was a TA seminar, held for all GTAs' first fall term. This was very similar in focus to the TA orientation, though with slightly more emphasis on a few teaching strategies. The final source was a teaching seminar held in the winter term prior to the institution of the SCALE-UP environment. This seminar focused exclusively on the SCALE-UP environment and focused on strategies, possible problems, the technology of the room, as well as pedagogy and curricular materials.

The LA's preparation was significantly different. As an undergraduate student, he has not been required to take any of the graduate classes listed above. Instead, the LA has already completed the same class for which he is now the LA. This was done in the fall term of 2009. Since the SCALE-UP environment was not instituted until the Spring 2010 quarter, the LA received a more traditional, lecture focused class, though with significant peer instruction built in to the curriculum.

In addition to the environments listed above, the GTAs and the LA all met with the professor for a TA meeting every week during the course. During this time, the GTAs, LA, and the professor would discuss the curricular materials to be presented at the next studio session. This meeting also presented a place for the GTAs and LA to discuss any challenges they had faced during the previous studio session, or during the course in general.

## **METHODOLOGY**

### **Journaling**

To begin to look at GTA and LA beliefs, we requested that the GTAs and the LA write a weekly journal about the week's studio session. This not only aided us as researchers, but also served the dual purpose of encouraging self-reflective practices in the GTAs and the LA. To aid and guide in these reflections, four questions were listed as starting points, though TAs were encouraged

to not be constrained by these questions. These prompts were:

1. Describe a part of today's class that you consider a "good teaching moment." What did you or the students do that made it go well?
2. Describe a part of today's class that you would do differently. What would you change and why? What might have helped it go better?
3. What are your goals for interacting with students today? How well do you think you and your students achieved them? What goals might you set for the next class?
4. What was your role in class today? (i.e. troubleshooter, manager, observer/listener, some mix of several roles, etc)?

These questions were created for the purpose of having the GTAs and LA reflect on what worked and what didn't, as well as what could be done to make improvements in the course. These journals were written and kept on our group's online research wiki. This allowed for journals to be read promptly, and by all the GTAs and the LA, and some issues to be addressed by the group as the term progressed. Teacher identity in the TAs was high which, combined with the journaling being voluntary, served to ensure authentic journaling.

### **Interviews**

In addition to the journaling, interviews were conducted at the end of the term to further examine GTA and LA beliefs. These interviews were videotaped interviews lasting approximately 40-minutes in duration with the three GTAs. Some sample questions include:

1. How would you describe the style of teaching you used in the SCALE-UP environment?
2. How has your idea of a TA's role changed since working in the SCALE-UP environment?
3. What did you find to be the most challenging part of teaching in the SCALE-UP environment? Why?
4. What additional teaching resources would have been helpful in overcoming these challenges?

The questions were developed to probe three main areas of inquiry. The first was to explore GTA and LA beliefs and practice, while the second was how these beliefs changed over the course of the first quarter of implementation of SCALE-UP. The third was to establish what resources the GTAs and LA used to adapt to the new environment, and what additional resources would be useful in adapting more efficiently.

## RESULTS

### Journals

To analyze the journals, we used the standard qualitative analysis technique of blending a-priori with emergent coding. Some of the a-priori codes include time management (managing the amount of time spent with a given group), teaching moment (an example of a good teaching moment), and interactions (discussion about asking questions versus telling the answers). Some of the emergent codes that developed were participation (how to get the whole group to participate rather than just one or two), materials (discussion on the curricular materials with either criticism or praise), and class management (which focused on how to organize the whole class for wrap-ups, demos, or other class wide issues). These codes were then used to categorize comments in the twenty-two journal entries generated by the GTAs and the LA.

The first pattern that was noticed was the decrease in frequency of specific goals being mentioned over the course of the term. The GTAs and the LA mentioned specific goals seven times in the first half of the term, but only twice during the second half. Conversely, the GTAs and LA wrote more often about the nature of their interactions with the students as the course progressed. These comments were characterized by the GTA or LA commenting on the style of interaction, primarily asking open-ended questions and drawing the students out. These interaction concerns were detailed three times during the first half and six times during the second.

Another interesting trend developed in the discussion of time management. This was characterized by the GTAs and LA trying to balance the depth and quality of student interactions versus the need to interact with twelve separate groups, and generally more than once during an activity. Unlike the previous examples, this pattern was characterized by a spike in the middle weeks, mentioned five times in the four middle weeks, with no mention in either the first or last three weeks of the term. However, whether this indicates that the issue was resolved or if there were more pressing issues is difficult to judge solely from the journal entries and requires additional methods of analysis.

Lastly, one concern was fairly constant throughout the term. This was efforts to get all three members of a group to participate, instead of just a student or two. This remained relatively constant, with one GTA or the LA mentioning it per week, with only a few exceptions. However, these exceptions may have simply been due to greater concerns in the given week rather than actual resolution of the concern.

### Interviews

Similarly to the journals, a number of a-priori codes combined with emergent codes were used to analyze the response of the GTAs and LA to the interview questions. The a-priori codes began with the same list as the journal questions, and then added more to cover the expanded scope of the interviews. These include codes such as light bulb (the moment when a student has a realization about a physical concept), new material (where the students did not know the material that was expected), and spark (where the TA is to give the starting push or extra help to have the students complete the task on their own).

The clearest response was on the challenges the SCALE-UP style presents. All of the GTAs stated that time management, how much time they spent with a group, was a large challenge. This implies that time management is still a concern, however, other matters took precedence in the journaling. The other major challenge cited by the GTAs and the LA was student buy-in, namely how to involve those students that don't buy in to the activities.

Another question with near unanimous response regarded additional teaching resources that would help the GTAs and the LA in resolving issues they encountered. To this, all but one of the GTAs and LA responded that more practice in the space with the students would be the most helpful. The lone dissenter requested instead either videos of how other GTAs at other schools worked in the space, or else would like to observe the other TAs as they work.

The GTAs also generally agreed on the style of teaching that they used. This style was characterized by the GTA or the LA asking the students open-ended questions that relied on the student justifying their logic and assumptions and avoided the traditional method of simply dispensing answers as necessary, however, the GTAs all changed in different ways to get to that point. One GTA had to listen to the students more as the term progressed, while another needed to question the students more instead of answering questions. One GTA felt he had to inform the students of their correctness more often, as he felt that the students were not realizing correct solutions from incorrect ones.

The interviews also revealed that the most useful training the GTAs received was the teaching seminar held in the winter term prior to the SCALE-UP class that concentrated on SCALE-UP techniques. This stands in stark contrast to the TA orientation they received, which was largely classified as "useless." The fall term TA seminar generally received mixed opinions, as it was useful for those who had not been a TA before, but was less useful for those with experience TAing.

Similarly, the GTAs and the LA all had differing reasons why the SCALE-UP classroom was personally sat-

isfying, though all circled around a central theme. The LA and one of the GTAs found that the most satisfying thing was seeing the "light bulb" moment when a student understands a concept, while another GTA found the amount of control he had over the students' learning most rewarding. The third enjoyed seeing students being able to debate one another using scientific reasoning and arguments. While diverse reasons, all stem from the personal and direct interactions between the TAs and the students that are often lacking in traditional lecture settings. Further, this finding is in line with Guskey's theory of teacher change[3].

### The LA

As an undergraduate student, the LA faces several challenges that GTAs do not. One of these is having to interact with students outside of the classroom, often because the students and the LA were friends prior to the course. When these interactions turn towards the class the LA instructs, especially if the students are not pleased with how the course is progressing, the LA may frequently find himself forced to defend the class, the professor, or the classroom expectations in general.

One such incident occurred after a midterm exam, on which one of the LA's friends had done rather poorly. After the friend complained about the short amount of time provided for the exam, the LA, rather than attacking the statement, instead turned it around and asked how the friend would prepare differently for the next exam, or what the professor could do to help him. This led to a very interesting conversation on pedagogy between the student and the LA. Overall, from the LA's experience, the most effective solution is to present the rational arguments behind why the professor has done this or that, but also to recognize when the other students are simply venting and disengage when that occurs.

Another LA specific issue is content knowledge. While GTAs have frequently seen the course material several times before, for the LA much of the material is still fairly new, having only seen it once before. The LA did find that his content knowledge increased significantly over the course of the term for several reasons. One reason was "a form of positive academic peer pressure: everyone else knew the ideas well, so I [the LA] should as well." This "peer pressure" was then further aided by the fact that the LA had several willing tutors who knew the material very well and were willing to help him out, namely the GTAs and the professor. This motivation, combined with the availability of help in understanding the material lent itself to quickly bringing the LA to the level of content knowledge required.

## CONCLUSIONS

From the journals and the interviews, two major challenges that GTAs and the LA face quickly emerge. The first is time management, staying with a group long enough to be helpful, but not so long that other groups are neglected. The second is student buy-in, which, while a factor that TAs can affect, is an issue beyond the scope of this paper. The GTAs felt that the best way to deal with the first challenge was through practice. This is reflected in how they categorized the various forms of professional development to which they had been exposed. The most general, the TA orientation, was seen as useless due to its vague nature and lack of examples. The TA seminar had mixed opinions, generally seen as having too few examples, if more than the TA orientation. The teaching seminar, conducted in the SCALE-UP classroom and focused on that environment, was regarded as the best as it demonstrated classroom norms and gave many examples and discussions on the teaching style that was to be employed. GTA and LA buy-in to the course reform was not an issue in this course, due primarily to the fact that the GTAs and LA all volunteered for the course.

Future work will continue to track the pedagogical beliefs of the GTAs as they complete additional terms in the room. Further, as new GTAs and LAs enter the environment, changes in the pedagogical beliefs will be analyzed as we institute changes in the professional development prior to instructing the course.

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