Learning Assistants as constructors of feedback: How are they impacted?

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Abstract: Project and Practices in Physics (P-Cubed) is a flipped section of introductory, calculus-based physics, which is designed with a problem-based learning approach where students work in groups on complex physics problems. Learning Assistants (LAs) are critical to the course, where they each function as a primary instructor for four to eight students by asking questions and prompting discussion during class. LAs in P-Cubed also write individualized weekly feedback to each of their students, which is meant to offer suggestions to the student for how to improve their work in class and provide the student with a justification for their in-class grade. We conducted semi-structured interviews with LAs to examine the ways that they construct feedback and how this impacts their own experiences as students taking classes. In this paper, we examine and discuss the reflections of one such LA as a case study for the impact feedback can have.

I. INTRODUCTION

It is not a new idea that physics Learning Assistants (LAs) are impacted significantly by their experience in the LA Program. The experience can be transformative with respect to their identities as physicists [1], how they teach physics [2], and even their metacognitive development [3].

At Michigan State University, LAs are employed to work in the environment of Projects and Practices in Physics (P-Cubed), a flipped section of introductory, calculus-based physics, which is designed with a problem-based learning approach where students work in groups on complex physics problems [4]. The LAs work ten hours per week and fulfill three duties: (1) Each LA functions as a primary instructor for four to eight students by asking questions and prompting discussion during class. (2) LAs meet twice weekly to prepare for teaching and once weekly to debrief and reflect on how the week went. (3) LAs write personalized feedback for each of their students on a weekly basis. This last expectation for LAs is uncommon at other universities, for we could not find any published research mentioning such a requirement for LAs. The feedback LAs provide is intended to be formative by giving students guidance for improving their scientific practices within their in-class group work [5].

The intention behind individualized weekly feedback is to offer suggestions to the student for how to improve their practices and provide the student with a justification for their in-class grade, which comprises 20 percent of the total grade for the course. To this end, feedback is split up in two parts to address both how the group performed and how the student performed within the group. In each part, the LAs are to include something the student or group did well, something to work on for next week, and a strategy for how to work on it.

There is precedent from existing research [1–3] to look at how the LA experience as a whole impacts LAs, but reducing the grainsize to look at specific aspects of the LA experience is much more rare. This presents us with an opportunity to look at the LA experience and report out on it in a new way. This is especially interesting since the piece of the experience at which we are looking—feedback construction—is distinctly a part of being an LA in P-Cubed.

As mentioned earlier, the feedback in P-Cubed exists to help the students improve their scientific practices, and we postulate this impact extends in some way to the LAs who practice constructing the feedback. The undergraduate LAs hired for P-Cubed were all once students in the class, so we also intend to piece apart how *receiving* feedback plays into the impact of constructing it. With this mind, we pose three research questions: (1) How does constructing feedback affect decisions LAs make outside of P-Cubed? (2) How does receiving feedback as students affect LAs's approaches to constructing it? (3) How are the impacts of constructing and receiving feedback connected for LAs?

II. METHODS

We selected three LAs to each participate in a recorded, semi-structured interview, which was intended to probe at how the LA approaches feedback construction and how their experience as an LA and as a student in P-Cubed might have impacted other areas of their lives (e.g., study habits, working in groups in the workforce). We selected LAs to portray a broad range of approaches to feedback. Alvin is in his second semester of being an LA. He is a sophomore physics major. Bella is recent graduate who has been in the workforce for a couple months. She was an LA for three semesters, and she studied biochemistry. Carly is in her fourth semester of being a P-Cubed LA, and she is a junior majoring in biosystems engineering. All the LAs we interviewed are White.

We constructed [6] a pilot interview protocol meant to dig into three things: (1) We wanted to learn about each LA as a student in other classes, so that they could reflect on experiences they have had in contexts outside of P-Cubed—contexts in which feedback construction may have made an impact. (2) We wanted to learn about how each LA interacted with the feedback when they were a student in P-Cubed, because we thought that experience would play a big role in how the LA interacts with feedback construction. (3) We wanted to find out how each LA approaches feedback construction itself, because that experience is central to the impact feedback construction has.

The first two interviews were with Alvin and Bella. The protocols used were very similar, the only difference being some questions were rephrased to give Bella the opportunity to speak about her experience in the workforce. The protocol was modified significantly for Carly's interview, with

potential follow-up questions listed and pauses built in based on preliminary analysis and reflections on the first two interviews. The goal of the modifications was to develop a more comprehensive view of Carly's experience with feedback construction than we were able to develop for Alvin or Bella. These interviews are the first three among a larger ongoing investigation, for we intend to interview additional LAs in the future to broaden the insight we make from our interviews with Alvin, Bella, and Carly.

In our analysis, we focus heavily on Carly's interview. The reason for this is hers has the richest data. This reality is owed partially to her willingness to reflect deeply on her multi-year LA experience, but also to the iterative development of the interview protocol, as described above. Carly, as the third participant, was given the best opportunity to express how the feedback impacted her, and more importantly she was prompted explicitly to think about and discuss ideas related to this impact—Alvin and Bella were not asked to discuss their experiences in the same way. However, Alvin and Bella did reveal enough to make us believe that there exist themes traceable between LAs, and perhaps the feedback has impacted Alvin and Bella in personally meaningful and lasting ways, even though they do not articulate the impact in the same way that Carly does.

We decide to align our research here as an explanatory case study [7], due to the limited theoretical background on the impact of individualized written feedback on its writer, and because the boundaries between the feedback's impact and the impact of the rest of Carly's LA experience are not always clearly evident. Carly was chosen as a critical case in investigating what effects giving feedback would have on an LA and how those effects occur. We specifically use logic models [7] to construct a theory of how Carly's experiences with feedback interact with one another.

III. RESULTS AND DISCUSSION

Alvin clarifies the feedback's impact on his own life when he is asked to reflect on what feedback construction means to him:

> "Me thoroughly contemplating what advice to give somebody, is also me...really thinking about good things to do...when I am in a group in the future and I have a similar situation... So if I tell a student of mine that this is a good way to improve when you have this sort of situation in your group, then, me having thought about that, and how to write feedback, will help me in the future when I am in a similar situation in a different group" – Alvin

Alvin's quote demonstrates a theme that showed in Carly's interview, too, which is that feedback construction helps LAs think about their own group work outside of P-Cubed and respond in thoughtful ways when difficulties arise. We explore this phenomenon in more detail in the following case study of Carly. Her perspective on feedback is built out of a multitude of experiences, and she is able to articulate this perspective clearly. As we will demonstrate, her own experience mirrors Alvin's reflection in the quote above, which suggests that the impact the feedback has had on Carly is not anomalous.

A. How constructing feedback affects decisions Carly makes in other contexts

Carly's take on how feedback construction plays into other areas of her life echoes Alvin's:

> "Writing feedback, it's easy to look at a group of people working together and be very objective about how everyone is behaving within that group. But then when you're in a group—to then be able to step back and reflect on your own group and how you're acting in that group—I think that's what...I've taken away...If I'm in a group and I'm getting frustrated, then it's like, 'Okay, what would I tell someone to be doing in this situation?'" – Carly

She highlights a strategy of relating her difficulties with group work to the same sorts of issues that might come up for a group in P-Cubed. She also makes an important point that writing feedback is not an isolated exercise—it involves observing behavior in class as it plays out. To understand how Carly enacts this strategy in real life, we asked her to give an example, and we believe the recollection she produced speaks richly to what the feedback's impact can look like for an LA. As part of a group, she came across a dilemma (which we will refer to as The Dilemma), and she believes her reaction derives from her experience constructing feedback. We retell how The Dilemma played out and use evidence from what Carly says to show that the feedback impacted her response in the ways that she claims. First, it is helpful to know how Carly sets it up:

> "I'm in a design group right now. Three of us get along really well. One guy is very inconsistent as to when he's there, but he puts a lot of work in, but it makes it challenging because we'll have done something and he will have missed all of it for no apparent reason... He'll come to the next meeting and be like, 'Oh, look at everything that I've done'. And we're like, 'Well we calculated that already, and we assumed these numbers, and you assumed these [other] numbers...so this is what we're gonna go with.' But, you have to be very tactful in how you say that." – Carly

Carly's dilemma is that one member of her group went off and did a lot of unnecessary work, and now the group needs to figure out a way to tactfully bring him back into the fold. Carly admits, *"I tend to...kind of be the leader of the group"*, and the decision is hers to make. Carly ended up making the decision for the group to sit down for a couple hours, step through the calculations everyone had done, and come to a

consensus together about what approach the group should use moving forward. The result was beneficial to the group—the group adopted some ideas that the fourth group member had found while doing his own calculations, and maybe more importantly, he was brought back into the group without feeling devalued.

Next, we intend to unpack the forces that played into Carly's thought process in the way she described it. The way she outlines her ability to *"step back and reflect"* when speaking generally about The Dilemma in her first quote shows that she traces her tactful response to writing feedback and helping P-Cubed students in class—this is represented with the relationship $b \Rightarrow c$ in Fig. 1. After recounting how the group responded to The Dilemma, Carly relates it back:

> "As an LA I would never want to see someone's work just completely dismissed. If they...roll through a bunch of stuff, [and] someone [else] was just like, 'What are you doing?...We're doing it this way'... I would...have to find something...and validate both sides." – Carly

Carly relates the tact of her approach to how she might address a group of students in P-Cubed. The Dilemma is relevant to her work in P-Cubed, for in both cases she wants students to feel that their work is valued. It would be unrealistic to say feedback construction is the only aspect of the LA experience Carly considered when formulating a respond to The Dilemma, so it is no surprise that Carly includes her in-class work in this discussion. This quote is valuable in demonstrating that Carly sees connections between her LA experience and how she conducts herself in other classes. As we will show next, the way she approaches her LA duties is also strongly connected to the feedback she received when she was a student in P-Cubed.

B. How receiving feedback as a student affects Carly's approach to constructing it

Carly was student in P-Cubed two years ago, and its impression on her was indelible. In sorting out what influenced her reaction to The Dilemma, we were hoping to separate her LA experience from her student experience, but consistently Carly would bring up one when discussing the other. It would be unfair at this point to say that for her they are not intertwined. One way to see the connection is by comparing her description of what the feedback should look like with what it looked like when she was a student. When Carly constructs feedback, she has a format in mind:

> "The basic format [is]: highlight a positive, highlight something to work on, explain why this will be beneficial to them, and maybe end on a positive if it works into your feedback." – Carly

She mentions three pieces: A highlight of what went well, a highlight of what to improve, and some reasoning. At other points in the interview, Carly explains that the reasoning is a
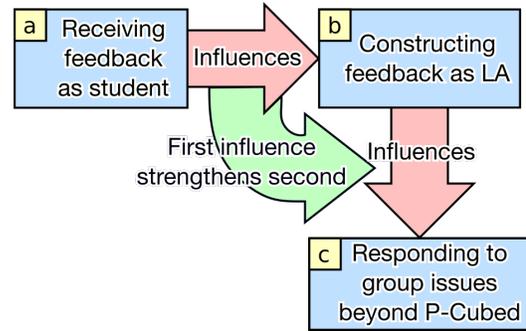

FIG. 1. This shows direct and indirect influences of Carly's experiences with feedback in P-Cubed, as referenced in sections of the discussion. The relationship $b \Rightarrow c$ is the focus of section A. Section B focuses on the relationship $a \Rightarrow b$. Section C demonstrates the relationship between the two influences, and argues that the first influence strengthens the second. The influences and connections themselves are detailed in the discussion.

justification for how the group will benefit from the improvement, and she sometimes includes an outline of steps that can be taken to achieve the improvement. When she talks about helpful feedback she received as a student, it matches up with the format she described:

> "There was one week where the positive was essentially like, 'You do a good job of facilitating discussion within the group and asking people to pause and clarify what they're saying'...but then the follow-up was, 'Sometimes though, you save questions for me as the instructor when you could be asking these questions to your group, because then that also can prompt discussion.'... For me then it was like, '...Okay, I can see this thing that I've been doing well with, and this is a way for me to continue to improve that. I've been facilitating discussion but now, like, I didn't realize that I had been saving questions just for the instructor, like I can now present those to my group as well.'" – Carly

All the pieces are there: a positive, a suggestion for improvement, and a justification. The pieces of feedback she found valuable as a student are the same pieces she tries to emulate in her own feedback. Further, all P-Cubed LAs are formally trained on how to give feedback, and the format from the training has a slightly different structure—Carly seems to have appropriated it to more closely match the feedback she received when she was a student. Seeing the parallels between the feedback she received and how she arranges feedback in her mind today, we believe that Carly's experience receiving feedback shapes how she structures it today, which is represented with the relationship $a \Rightarrow b$ in Fig. 1. For Carly, there is still one more layer to the couplings described between her many feedback experiences, which we will outline in the next section.

C. How the impacts of constructing and receiving feedback are connected for Carly

Carly's reflections indicate that the practice of constructing feedback influenced how she chose to respond to The Dilemma, as outlined in Section A. Also, her experience receiving feedback as a P-Cubed student influenced the way she goes about constructing it (Section B). In this section we will discuss the similarities in how she describes these two impacts, which make us think that the significance of receiving feedback is twofold: (1) It helped Carly develop her practice of constructing feedback ($a \Rightarrow b$ in Fig. 1), which we outlined above. (2) The ways she describes the two influences are so in line with each other that we believe that the first influence ($a \Rightarrow b$ in Fig. 1) played a role in facilitating the second ($b \Rightarrow c$ in Fig. 1). Perhaps the process of pulling from her experience as a P-Cubed student to develop strategies as an LA is a practice that Carly was able to refine and reuse to pull from her experience constructing feedback to develop a strategy to solve The Dilemma. This relationship between the practices is represented with the curved arrow in Fig. 1.

The connection between the two impacts is best displayed by starting with a piece of Carly's first quote:

> "To step back and reflect on your own group and how you're acting in that group—I think that's what...I've taken away... If I'm in a group and I'm getting frustrated, then it's like, 'Okay, what would I tell someone to be doing in this situation?'" – Carly

We compare Carly's explanation of how she reflects on feedback construction with a separate quote on how she decides on what to say to her students as their LA:

> "Part of [constructing feedback] is drawing on, 'Okay, what was I feeling in class at that point, what was I struggling with?' ...having been a student prior to being an LA for this class is really helpful... I think it just gives you a better understanding of the students themselves." – Carly

In both quotes, Carly is pulling from her past experience to recall how to solve a group-related issue, applying a learned lesson to the situation at hand. In the first quote, she imagines herself inspecting the group, constructing advice to help them overcome The Dilemma. In the second quote, she imagines herself as the struggling student, remembering what feedback she heard in the past that helped her overcome a similar difficulty. The reflection processes in each quote imitate each other down to the questions Carly asks herself, which exhibits that they are in some way the same process practiced twice.

IV. CONCLUSIONS AND FUTURE WORK

We now circle back to our three research questions listed at the end of the introduction. Our findings in relation to those questions are as follows: (1) Constructing feedback helps Carly think critically and make better decisions when faced with group-related difficulties in contexts outside of P-Cubed. (2) Receiving feedback as a P-Cubed student was an experience that shaped how Carly thinks about and constructs feedback today. (3) The process of pulling from old feedback to help her think about how to construct it [finding (2)] is a process that Carly has practiced and refined in pulling from constructing feedback to help her respond to dilemmas outside the context of P-Cubed [finding (1)]—the third finding is the connection itself.

This research highlights the positive impact, in the context of P-Cubed, of hiring LAs who have experienced the exact class they will be teaching—Carly alludes to this herself: *"having been a student prior to being an LA...is really helpful... I think it just gives you a better understanding of the students themselves."* This may seem like an obvious conclusion but this matching of LAs with their prior experiences is not always the case at institutions running physics LA programs. The degree of this positive impact could be investigated further by interviewing LAs who have taught in P-Cubed but not taken it. Currently this would describe one student. Alternatively, this finding could highlight the need to investigate further how important it is for LAs to have had prior experience in the same learning environment, especially when it is a transformed classroom with a lot of innovations.

We acknowledge that we only fully represent one LA's perspective in this paper, but the insight we were able to make into how Carly has interacted with the feedback as a P-Cubed student and as an LA makes us optimistic for the investigation that will build from this work. We expect to conduct and analyze more interviews with LAs. A preliminary analysis has been completed on one such interview, and we believe that it will showcase interesting features of the feedback's impact in the same rich, personal way that Carly's interview did.

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