*Keith Mewis, UNIVERSITY OF BRITISH COLUMBIA, keithmewis@gmail.com*
*Jaclyn Dee, UNIVERSITY OF BRITISH COLUMBIA, jaclyn.dee@botany.ubc.ca*
*Vivienne Lam, UNIVERSITY OF BRITISH COLUMBIA, vivienne.lam@hotmail.com*
*Shannon Obradovich, UNIVERSITY OF BRITISH COLUMBIA, s.obradovich@oceans.ubc.ca*
*Alice Cassidy, IN VIEW EDUCATIONAL DEVELOPMENT, alicecas@telus.net*

# A New Self-Assessment Teaching Assistant Survey for Growth and Development

## ABSTRACT

During their time as Teaching Assistants (TAs), graduate students develop a variety of skills, knowledge, and attitudes (SKAs) based on teaching and related facilitation experiences. As TAs move on to future opportunities, their prior experiences form a foundation upon which additional teaching experience builds. Presently, there are few tools to gauge pedagogical growth during graduate student involvement as TAs in a specific post-secondary course, or as a consequence of their participation in a specialized TA training or teaching program. We identified key factors that underlie TA development and designed a new survey based on these for TAs to self-assess SKAs that they bring with them from prior experience, and those that they develop or enhance during their time as a TA. We designed a survey to test how TA experience with non-traditional roles in a First-year Seminar in Science course, SCIE113, affects SKAs that can be used in future teaching endeavours. We administered the survey to 18 current and past SCIE 113 TAs as of December 2015 (representing the complete population). The results showed that TAs with similar levels of experience shared similar skills, knowledge, and attitudes. Those TAs with the most experience had greater abilities in roles previously identified as non-traditional TA roles. Others working with graduate students can use or adapt the survey questions to investigate and stimulate the growth and development of TAs in their course or program.

## KEYWORDS

teaching assistant training, survey, self-assessment, reflective practice, mentorship

## INTRODUCTION

Graduate teaching assistants (TAs) play an important and influential role in undergraduate student learning. Sundberg, Armstrong, and Wischusen (2005) reported that in 34 large research schools in the United States, 91% of the biology laboratory courses were taught by TAs. Accordingly, it has been noted that the TA's effect on the classroom environment appears to influence undergraduate retention in the sciences (O'Neal & Wright, 2007). However, TAs often enter the classroom without adequate pedagogical training (Golde & Dore 2001). Eighty-four percent of counseling psychology programs employ graduate TAs (Prieto & Scheel, 2008), yet only 62% of the TAs had received professional development in teaching and for an average of less than three days (Prieto & Scheel, 2008). This is particularly problematic as TAs with pedagogical training (e.g., an undergraduate education degree) are perceived as more effective by their students than those with prior TA experience alone

(Shannon, Twale, & Moore, 1998). TAs with training also generally appear to score higher on their perception of their learning and teaching (DeChenne, Lesseig, Anderson, Lee, & Barthel 2012).

There is a recognized need for TA training in post-secondary institutions (Love Stowell, Churchill, Hund, Kelsey, Redmond, Seiter, & Barger, 2015) and improved evaluation of that training (Boman, 2013). Fortunately, there is an encouraging movement in many institutions, including ours (The University of British Columbia, UBC) to help TAs facilitate student learning. The BioTAP Program provides workshops over two terms, including teaching topics as well as a variety of related topics such as inclusivity and diversity (Fay, Suarez-Gonzales, Pollock, Chowrira, & Kalas, 2015; also see Rushin, De Saix, Lumsden, Streubel, Summers & Bernson,1997). This and other training programs, including Certificates (Kenny, Watson, & Watton, 2014) and Instructional Skills Workshops (Day, 2005) focus on practice-based skills development.

What are the long-lasting benefits of these TA training programs, and how do we measure them? Evaluations of TA training programs generally measure short-term gains achieved over the course of a training program (e.g., Young & Bippus, 2008; DeChenne et al., 2012 & Boman, 2013). DeChenne et al (2012) developed a survey to measure TA perception of teaching topics that would be helpful in TA training, suggesting it could be applied to develop training priorities for TA professional development programs. These surveys often use self-efficacy to measure improvement in a number of teaching skills. For example, Prieto and Altmaier (1994) showed that prior training, which correlated with previous experience, had a positive effect on TA perception of self-efficacy in a variety of teaching behaviours. Self-reporting can be a reliable method of assessing teaching behaviors (Reddy, Dudek, Fabiano, & Peters, 2015). DeChenne et al (2012) also looked at self-efficacy and noted its correlation with both experience and training programs. Perceived improvement of teaching self-efficacy has also been correlated with improvement in assessments from outside observers (Boman, 2008). Measures from outside observers show that TA training increases the use and effectiveness of teaching behaviours by TAs during training workshops (Boman, 2013).

Although some training programs assess teaching efficacy pre- and post-workshop, they do not measure whether the SKAs gained in these programs persist long-term or are transferred to the classroom (Boman, 2013). Reassessing TAs four months after their training, Dimitrov, Meadows, Kustra, Ackerson, Prada, Baker, and Potter (2014) found that the length of training program influenced TA development. Longer training programs resulted in a greater increase in self-efficacy, overall confidence, TA preparedness for teaching, and student-focused teaching than shorter training programs. These TAs were more engaged, shared teaching techniques with peers and faculty, and planned to enter academia.

There is a lack of research assessing the long-term influence of TA training on TA self-efficacy and SKAs when encountering real world teaching scenarios, such as extended class management (Luo, Bellows, & Grady, 2000), student relationship (Allen & Rueter, 1990), and curriculum development (Cassidy, Dee, Lam, Welsh & Fox, 2014). Existing published surveys may be limited in the length, specificity, and range of expertise/skills that a TA might develop during their employment in a course. A survey that addresses these concerns would be helpful for continual self-assessment of and reflection on one's own teaching practices, one that also allows for improvement of university training programs. We developed a model to consider ongoing TA development, and created and tested an evidence-based survey for graduate students to self-assess skills, knowledge, and attitudes in relation to factors such as prior training and in-class experience.

Our key goals are 1) to present a model of skills, knowledge, and attitudes (SKAs) that TAs bring with them from prior experience, develop or enhance during their time as a TA, and take with them to other settings, and 2) to design a new survey for TAs to self-assess SKAs at any point in their work in order to examine their own teaching practices.

### A model and a new survey

To represent TA growth and development of TAs, we designed a model (Figure 1). Our model considers the level of experience that TAs bring with them into a course, what they develop during their time in the course, and what they take with them when they leave that course. We contemplate whether experience in teaching and facilitation improves confidence in specific pedagogical skill sets, as suggested by DeChenne et al. (2012). To test this, we designed a new survey, administering it to graduate students who were about to, were currently, or had been TAs in SCIE 113 as of December 2015. Survey questions relate to experience with and views towards each of nine roles previously documented by Cassidy et al. (2014), including what techniques and strategies TAs use from their prior and current training and experiences as TAs, facilitators, and/or teachers.

Figure 1. Model of pedagogical growth in a teaching assistant (TA) prior to and following participation in a given course. Here we consider the pedagogical development (as skills, knowledge, and attitudes) before and after TAship. Some TAs may undergo repeated TAships within a given course (shown as a curved arrow) in which newly gained skills can be applied in subsequent TAships (shown as double-ended arrow).
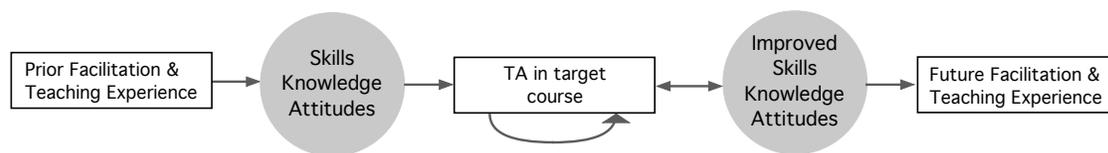


The survey is intended for TAs to self-assess and monitor their progress in development of pedagogical skills in practice, but also to allow them to recognize development of professional skills for those that will take positions outside academia (Rose, 2012). Instructors can also use the survey to identify and enhance their teaching partnerships with TAs. Coordinators and mentors can use the survey to identify areas of TA training that could be improved upon.

## METHODS

### Survey design

We designed survey questions that reflect key attributes of experienced instructors to allow TAs to self-assess their skills, knowledge, and attitudes. We then assigned each question to a specific TA role as previously identified by and elaborated upon by Cassidy et al. (2014) for this course. These include the most common or traditional roles in much TA work: Facilitator, Marker, Liaison, Mentee, and Student Mentor, as well as roles that, though they may be part of some TA work in other settings, we identified as being less common: Instructor, Mentor for Faculty, Course Developer and Collaborator, and Scholar (Cassidy et al., 2014). Neither the model nor the survey includes respondents' learning experience as undergraduates themselves. The addition of this notion, with the idea that what students

experience as learners could influence their work as TAs, certainly could be considered by others or added to the survey in the future.

We invited feedback on the first draft of our survey from an instructor and from a researcher involved with the course. After building in their comments, we then had 11 TA volunteers not involved with SCIE 113 complete the survey. We incorporated their feedback to adjust ambiguous survey questions and to trim the survey to make it easier to administer and for students to complete.

Our survey (Appendix 1), based on the literature (Appendix 2), shares common points with some other surveys. We drew upon the work of Tollerud (1990), modified by Boman (2013). We used an ethics protocol for human subjects approved by the Behavioral Research Ethics Board at UBC (BREB #H10-01749).

The survey consists of three types of questions. The first requires TAs to assess a statement on a Likert scale of 1-5, where '1' indicates 'strongly disagree' and '5' indicates 'strongly agree.' The second measures the frequency of certain TA activities on a scale of 1–5, where '1' indicates that the respondent never engaged in that activity and '5' indicates that the respondent always engaged in that activity. The third requires respondents to provide concrete evidence to support their self-assessments or elaborate on their responses. For example, Q11 asks TAs how extensive the variety of techniques they use to promote active learning, and follows up by prompting them to list examples of active learning strategies that they have employed.

A total of 18 TAs were involved with SCIE 113 since inception in September 2010 through December 2015 when this study took place. All were invited to complete the survey, and all did so. The population of TAs encompasses three major categories: graduate students who have yet to TA SCIE 113 but have been hired to do so, those who have TAed 1-6 times and are expected to TA again in the future, and those who TAed at least one time but are no longer involved with the course. This range of TA experience allowed us to assess the pedagogical contributions of their various roles and to provide an example of the breadth of answers expected from a group of graduate students with variable teaching backgrounds and experience.

### Principal component analysis (PCA) of responses

For all responses that could be quantified (Q6 – Q15, Q17 – Q24, Q26, Q28 – Q32), principal component analysis (PCA) was applied to group respondents based on their answers (Figure 2) (Jolliffe, 2002). Based on these questions, we inferred which areas of skills, attitudes, and knowledge shifted as TAs become more experienced. An experience score (XP) was determined for each respondent based on their answer to questions 1, 3-5, 25, and 27. Scores were calculated as follows: three points for each term they had previously TAed SCIE 113, one point for each term they had TAed another course, two points for each instance of TA or instructor training they had participated in, two points for having written a teaching philosophy statement, and four points for having participated in a conference or paper related to the scholarship of teaching and learning. Respondents were classified into three groups corresponding to low (XP < 10), medium ($10 \leq$ XP < 20), and high (XP $\geq$ 20) experience levels.

**Figure 2. Principal component analysis of all respondents' quantitative answers showed respondents with medium and high experience levels tended to cluster together and away from low experience respondents, showing a convergence of SKAs as TAs gained experience.**
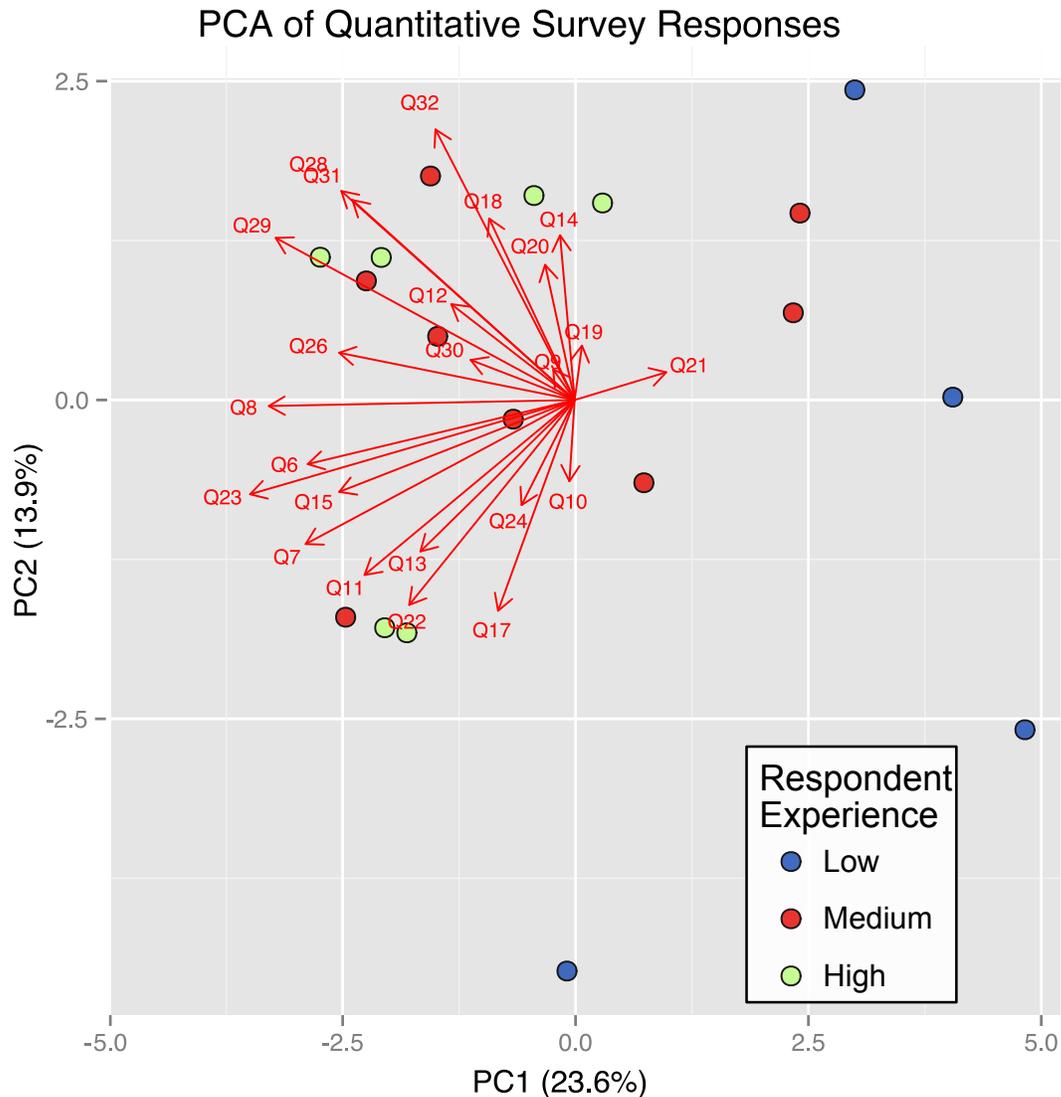


## One-way ANOVA tests of aptitude for traditional and non-traditional TA roles

We separated the survey questions into each of the nine TA roles identified by Cassidy et al. (2014). Responses pertaining to what we describe as either traditional or non-traditional TA roles were grouped together to assess aptitude in these two categories. A one-way ANOVA test was applied to these categories, comparing low, medium, and high experienced TA groups. Due to our limited sample sizes, the distribution of the data could not be inferred. The ANOVA test was chosen for this comparison due to its resiliency in assessing datasets of unknown distributions.
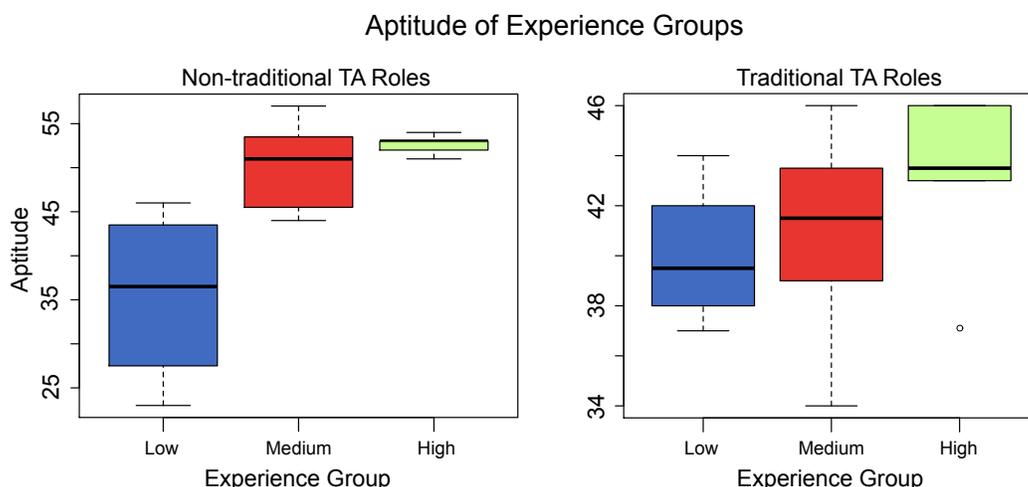
RESULTS AND DISCUSSION

### Respondents cluster according to experience level

PCA showed medium and high experience level TAs are more similar to each other than to low experience level TAs based on survey responses (Figure 2). This patterning suggests a convergence of skills, knowledge, and attitudes as TAs gain experience as defined by our criteria. This finding can be used to identify specific areas that separate more experienced (high and medium) TAs from less experienced (low) TAs in order to focus TA training on particular areas. As an example, we see Q7 ("I have led portions of a class in collaboration with an instructor") and Q22 ("I discuss issues related to TA roles with fellow TAs") to be strongly correlated with TA experience, suggesting that additional focus on these areas may be most effective for improvement. While this survey presents only a snapshot of TA skills, knowledge, and attitudes, follow-up administrations of this survey throughout a TA's career could be used to determine how these areas improve as individual TAs gain experience.

### Experience as a factor in traditional and non-traditional TA roles

We compared the three groups with a one-way ANOVA test to understand how experience might relate to TA aptitude in both traditional and non-traditional TA roles. Both medium and high experienced TAs showed a statistically significant increase ($p = 0.001$) in aptitude for non-traditional roles (Figure 3), but did not show a statistically significant increase in aptitude for traditional TA roles. This difference suggests that experience as defined by our criteria is a useful marker for assessing efficacy of TAs in SCIE 113. A clear delineation of expected roles of TAs prior to teaching can make incoming TAs aware of areas they can be anticipate to expand in and additional skills they can develop. Such awareness and reflection on teaching practices has been shown to improve teaching capabilities by breaking habitual frameworks (Brookfield, 2002). The questions asked in this survey make respondents aware of areas that can improve teaching practices, such as the development of a teaching philosophy (Q25), the use of active learning techniques (Q11), or the existence of multiple techniques for student learning assessment (Q16). As these are not part of the traditional TA roles, we see this as an indication that TA work in SCIE 113 and possibly other settings provides an opportunity for improvement of teaching efficacy.

**Figure 3. Medium and high experience respondents showed a statistically significant increase in aptitude over low experience respondents in non-traditional roles in SCIE 113, but not for traditional TA roles.**



 Mewis, K., Dee, J., Lam, V., Obradovich, S., & Cassidy. A. (2018). A new self-assessment teaching assistant survey for growth and development. *Teaching & Learning Inquiry, 6*(1). http://dx.doi.org/10.20343/teachlearninqu.6.1.8

### Open-ended question responses confirm TA growth in some roles

Our analyses of responses to the open-ended questions near the end of the survey revealed a number of common learning experiences from TAing SCIE 113. Fourteen of the 18 respondents noted growth in one or more areas. For example, the opportunity to observe and have discussions with a variety of teaching faculty was a highlight. Comments included, "It's great practice! I got try a lot of different techniques and learn from six instructors. Seeing so many different people teach is very helpful," and "The best experiences while TAing this course were the discussions with faculty about their teaching experiences and how they tackle a teaching problem."

Respondents noted that TAing SCIE 113 gave them an opportunity to apply and learn new instructional skills: "I gained experience teaching communication and working with a very engaged teaching team," and

> *It has allowed me to learn and employ a variety of skills, both those that I learned in the ISW workshops and those I have learned from working with five different instructors in the course. It has given me confidence in working with students.*

Involvement in SCIE 113 also appears to have enabled TAs to improve their discussion facilitation skills ("As a facilitator, all of the discussion that we do has helped me recognize how beneficial it can be as a learning tool and has taught me new ways of engaging students who might be hesitant to participate," and "Helped me to improve my group facilitation techniques.") and encouraged TAs to approach their roles as instructors with a more developed teaching philosophy ("I have had a chance to critically reflect on what I believe makes a good teacher, and how one enacts that role, and tried to do so myself" and "I feel more empowered to bring my own philosophy into teaching").

The act of filling out the survey presented a number of benefits for 12 TAs, providing an opportunity for self-reflection ("It has helped me to realize the variety of skills that I have gained and all the tools I have in my teaching, facilitating [and other roles] toolboxes," and "It made me reflect on my own confidence in teaching.") One respondent noted NA, and five respondents did not feel they gained significant insight from filling out the survey. Of those, two had TAed for four terms, one had TAed twice, one had TAed once, and one had not yet TAed the course. The respondent who had TAed the course once indicated that the survey did not provide any new insights because they belonged to the Faculty of Education where they already spent a lot of time thinking about teaching and learning (most TAs for SCIE 113 are in the Faculty of Science).

TAs also became more aware of scholarship in teaching and learning. One noted, "I will work more on how to search for peer-reviewed literature about teaching and learning," and another "I think there are more or less opportunities to incorporate teaching and learning scholarship/techniques into TAing depending on the course." TAs also noted the areas in which they could still improve: "It made me reflect on what I needed to improve upon, and what worked for me. I've done a fair number of TAing stints and each course required a slightly different skillset."

We present a few responses unique to individuals about the value of TAing in SCIE 113. One TA felt that it prepared them to fulfill roles outside of their academic research role, noting that "Exposure to pedagogy and academic pursuits beyond my field (Genomics), exposure to the creation and modification of course material, it has made me feel prepared to be an instructor instead of just a teaching assistant." Another TA became sensitive to one of the learning barriers that teachers may encounter: "I have gained an appreciation for the difficulties faced by foreign students."

### Survey results allow for personalized approach to TA improvement

Respondents' answers to these questions highlight the individuality of TA training. What may improve training for some TAs may not necessarily be important for others. This approach allows each individual's responses to situate them on the PCA plot, and identify areas that will help them to most rapidly improve. For example, respondent 6 (low center on Figure 2) could shift towards the more experienced group through improvement in Q28 ("I can provide examples of peer-reviewed literature on teaching and learning."), suggesting that providing additional academic resources or papers for them may be an effective method of improvement.

Twelve out of 18 respondents indicated that the survey was a useful tool to help them self-identify skills, knowledge, and attitudes that they can improve upon. Seven of those reported that completion of the survey gave them a greater awareness of, and also stimulated interest in, the scholarship of teaching and learning one of the unique aspects of TA development in SCIE 113 (Cassidy et al., 2014). This is noteworthy as there is a lack of knowledge in pedagogical practices or awareness of pedagogical literature in graduate student TAs (Fay et al. 2015).

The survey could also help instructors and coordinators identify weaknesses in their interactions and mentoring of each individual TA. We found that feedback from mentorship of TAs by experienced instructors is an effective way to improve TA pedagogical practices and improve the confidence in teaching. Dialogue between TAs and faculty members can encourage TAs to take on more active roles beyond those expected of typical TAs (such as those we describe as non-traditional roles). These opportunities ultimately allow TAs to practice these skills, knowledge, and attitudes attained from these non-traditional roles, which are essential in future post-secondary teaching.

### Future work with the survey

This analysis is based on the idea that more experienced TAs (as defined by our criteria in the methods section, based primarily on duration of teaching experience) have an expanded teaching skill set compared to starting TAs, which may not necessarily be the case. It would be interesting in the future to group TAs based on student learning metrics such as pre- and post-surveys, student based assessment of TA instruction, or TA assessment from faculty members. Furthermore, some of the questions in this survey cannot be directly addressed through specific training (Q32: "I feel confident that I could design a new course in my field") but are rather a combination of confidence and previous experience in course instruction and preparation of curriculum material.

The last two questions invited respondents to further explain their responses, allowing them to comment on the survey itself, and to pose any other comments. One TA wanted clarification on Q12 and Q16. Two respondents felt that they could not accurately answer some of the questions posed because the questions did not allow for a response that recognized that TA experience differed when working with different faculty. For example, one TA remarked:

> *My responses to some of the questions varied a lot depending on which instructor I was working with. For example, I have felt comfortable giving feedback to two of the four instructors with whom I have worked. I had to give a blanket answer but it isn't exactly an accurate reflection of what I experienced.*

Some survey questions do not account for the difference in TA experiences based on the instructors they worked with, so this could be added in the future, especially with a larger data set. Many

questions allow only a single response on the Likert scale, and this may not reflect a respondent's experience. Specifically, Q18 and Q19 ask TAs their comfort level in giving some form of criticism or feedback to the instructor that they were paired with. Two respondents indicated they could choose only one blanket response to the prompts but did not feel that it limited their ability to provide accurate answers. It is likely because they felt comfortable giving feedback to some of the instructors that they worked with but not others.

The utility of the survey as an opportunity for self-reflection on an individual's roles as a TA may be limited in some circumstances. For instance, some of the more experienced TAs or the one TA already steeped in the culture of teaching and learning did not self-identify aspects of their TA work that they wanted to improve on. Respondents who had not yet TAed the course prior to completing the survey did not feel that the survey was useful for changing their attitudes towards TAing (but that might prove to be true if those TAs could take the survey after having TAed). While this survey reflects the experiences of 18 respondents, that number represents the complete population of TAs from SCIE 113 as of December 2015.

### Future directions
Our sample was a snapshot of skills, knowledge, and attitudes at a single point in time. Administering this survey to TAs at multiple points as a TA in a particular course, or across their careers would reflect the changing attitudes as TAs gain more experience. We expect that regular self-assessment of teaching efficacy can improve TA confidence and help develop awareness of one's own teaching practices to help break down habitual frameworks (Brookfield, 2002). We are also curious to see if awareness of other opportunities not commonly addressed in teaching assistantships, such as academic career development and educational research may generate interest in these areas. If administered over the span of many terms of a course, this survey could generate feedback that could be used to modify the existing framework of a course in order to make it more accessible, useful, and engaging for TAs.

## CONCLUSION
Our survey findings support our model of TA growth and development, where the skills gained from prior facilitation or TA training can be expanded and improved upon, especially with the addition of some roles that are not typically handled by TAs in most courses. In SCIE 113, these roles included Instructor, Mentor for Faculty, Course Developer and Collaborator, and Scholar. Other or additional roles could be identified by colleagues who wish to add or adjust survey questions. Respondents indicated that the SCIE 113 experience can prepare them for future academic careers. It is important to document the growth and development of graduate student TAs, as they form a large and essential part of the post-secondary teaching team. Here we present tools for self-assessment by graduate TAs that can be used by and for TAs, coordinators, and mentors as part of ongoing training and reflection. The model and survey could also be used in multiple-section courses with different teams of faculty instructors and TAs, but they can be modified and adapted for any course or discipline to ensure continual, effective growth of TAs in a variety of roles and to prepare them for the immediate demands of post-secondary education careers.

## ACKNOWLEDGEMENTS

survey, providing valuable input that we used to create the final. Thanks to the 18 SCIE 113 TAs who completed the survey. Gülnur Birol provided tips on online surveys and the steps in the verification process. Undergraduate learning technology assistants Cassia Drozdzik and Yvonne Dixon helped us immensely. We thank everyone who taught SCIE 113 since inception; their comments about the value of TAs to the course was a great contribution.

*Keith Mewis is a graduate from the Genome Sciences and Technology Program at UBC, and has TAed SCIE 113 five times. He has also developed and taught his own Biochemistry course.*

*Jaclyn Dee, a PhD student in Botany at UBC, TAed SCIE 113 four times. Jaclyn has taught in a variety of contexts and settings across diverse communities.*

*Vivienne Lam, a session lecturer in Botany at UBC, TAed SCIE 113 six times. She has also taught several undergraduate cellular biology courses.*

*Shannon Obradovich, is a Ph.D. student in the Institute for the Oceans and Fisheries, and Coordinator, Writing Across the Curriculum+ Program at UBC. She TAed SCIE 113 three times.*

*Alice Cassidy, inaugural SCIE 113 Course Coordinator at UBC, also hired the TAs. She designed a related course, taught Zoology and Education, and is an educational development consultant.*

## REFERENCES

Alleman, E., Cochran, J., Doverspike, J., & Newman, I. (1984). Enriching mentoring relationships. *Personnel & Guidance Journal, 62*(6).

Allen, R. R., & Rueter, T. (1990). *Teaching Assistant Strategies: An Introduction to College Teaching.* Dubuque, IA: Kendall/Hunt.

Boman, J. (2008). Outcomes of a graduate teaching assistant training program (Doctoral dissertation). *The University of Western Ontario, Canada*.

Boman, J. (2013). Graduate student teaching development: Evaluating the effectiveness of training in relation to graduate student characteristics. *The Canadian Journal of Higher Education, 43*(1),100.

Brookfield, S. D. (2002). Using the lenses of critically reflective teaching in the community college classroom. *New Directions for Community Colleges*, 118,31–38.

Cassidy, A., Dee, J, Lam, V. KY, Welsh A and Fox, J. (2014). Teaching assistants thrive in a collaborative team: A TA development case study. *Transformative Dialogues: Teaching & Learning Journal*, 7(2),1–14.

Day, R. (2005). *The Instructional Skills Workshop: The Heart of an Educator Learning Community in British Columbia and Beyond*. Presented at the International Society for the Scholarship of Teaching and Learning Conference, Vancouver, B.C.

DeChenne, S. E., Lesseig, K., Anderson, S. M., Lee, S. L., & Barthel, C. (2012). Toward a Measure of Professional Development for Graduate Student Teaching Assistants. *Journal of Effective Teaching, 12*(1) 4–19.

Dimitrov, N., Meadows, K., Kustra, E. D. H., Ackerson, T., Prada, L., Baker, N., Potter, M. K. (2014). *Assessing Graduate Teaching Development Programs for Impact on Future Faculty*. Toronto: Higher Education Quality Council of Ontario.

Fay, N., Suarez-Gonzales, A., Pollock, C., Chowrira, S., & Kalas, P. (2015). *A Collaborative Approach to TA Professional Development in the Biology Program at The University of British Columbia*. Presented at the Society for the Advancement of Biology Education Research, Minneapolis, MN.

Gardner, G. E., & Jones, M. G. (2011). Pedagogical preparation of the science graduate teaching assistant: Challenges and implications. *Science Educator, 20*(2),31.

Golde, C. M., & Dore, T. M. (2001). *At Cross Purposes: What the Experiences of Today's Doctoral Students Reveal about Doctoral Education*. A report prepared for The Pew Charitable Trusts, Philadelphia, PA. www.phd-survey.org

Jolliffe, I.T. (2002). *Principal component analysis*. 2nd edition. New York: Springer

Jones, J. L. (1993). TA training: From the TA's point of view. *Innovative Higher Education*, *18*(2),147–161.

Kenny, N., Watson, G. P., & Watton, C. (2014). Exploring the context of Canadian graduate student teaching certificates in university teaching. *The Canadian Journal of Higher Education*, *44*(3),1.

Knotts, G., Henderson, L., Davidson, R. A., & Swain, J. D. (2009). The search for authentic practice across the disciplinary divide. *College Teaching*, *57*(4),188–196.

Lockwood, S. A., Miller, A. J., & Cromie, M. M. (2014). Preparing future biology faculty. *The American Biology Teacher*, *76*(1),17–21.

Love Stowell, S. M., Churchill, A. C., Hund, A. K., Kelsey, K. C., Redmond, M. D., Seiter, S. A., & Barger, N. N. (2015). Transforming graduate training in STEM education. *The Bulletin of the Ecological Society of America*, *96*(2),317–323.

Luft, J. A., Kurdziel, J. P., Roehrig, G. H., & Turner, J. (2004). Growing a garden without water: Graduate teaching assistants in introductory science laboratories at a doctoral/research university. *Journal of Research in Science Teaching*, *41*(3),211–233.

Luo, J., Bellows, L., & Grady, M. (2000). Classroom management issues for teaching assistants. *Research in Higher Education*, *41*(3),353–383.

Mathany, C., Spencer, J., & Weidner, N. (2015, September). *Inquire: A Graduate Certificate in the Scholarship of Teaching and Learning*. Presented at the Graduate Student University Teaching Conference, Guelph, Ontario.

McKeachie, W., & Svinicki, M. (2013). *McKeachie's teaching tips*. Boston: Cengage Learning.

Murray, H. G. (1983). Low-inference classroom teaching behaviors and student ratings of college teaching effectiveness. *Journal of Educational Psychology*, *75*(1),138.

Nyquist, J. D., Abbott, R. D., & Wulff, D. H. (1989). The challenge of TA training in the 1990s. *New Directions for Teaching and Learning*, *39*, 7–14.

O'Neal, C., & Wright. (2007). The impact of teaching assistants on student retention in the sciences: Lessons for TA training. *Journal of College Science Teaching*, *36*(5),24.

Prieto, L. R., & Altmaier, E. M. (1994). The relationship of prior training and previous teaching experience to self-efficacy among graduate teaching assistants. *Research in Higher Education*, *35*(4),481–497.

Prieto, L. R., & Scheel, K. R. (2008). Teaching assistant training in counseling psychology. *Counselling Psychology Quarterly*, *21*(1),49–59.

Reddy, L. A., Dudek, C. M., Fabiano, G. A., & Peters, S. (2015). Measuring teacher self-report on classroom practices: Construct validity and reliability of the classroom strategies scale–teacher form. *School Psychology Quarterly*, *30*(4), 513.

Rosales, J., Spracklin-Reid, D., & Caines, S. (2013). Effective use of graduate students as teaching assistants in undergraduate engineering education. *Proceedings of the Canadian Engineering Education Association*. École Polytechnique, Montréal, Canada

Rose, M. (2012). *Graduate Student Professional Development: A Survey with Recommendations*. The Canadian Association for Graduate Studies and the Social Sciences and Humanities Research Council of Canada.

Rushin, J. W., De Saix, J., Lumsden, A., Streubel, D. P., Summers, G., & Bernson, C. (1997). Graduate teaching assistant training: a basis for improvement of college biology teaching & faculty development? *The American Biology Teacher*, *59*(2), 86–90.

Seymour, E. (2005). *Partners in Innovation: Teaching Assistants in College Science Courses*. Lanham, Maryland: Rowman & Littlefield.

Shannon, D. M., Twale, D. J., & Moore, M. S. (1998). TA teaching effectiveness: The impact of training and teaching experience. *Journal of Higher Education*, (issue/volume), 440–466.

Staton, A. Q., & Darling, A. L. (1989). Socialization of teaching assistants. *New Directions for Teaching and Learning*, *39*,15–22.

Sundberg, M. D., Armstrong, J. E., & Wischusen, E. W. (2005). A reappraisal of the status of introductory biology laboratory education in US colleges & universities. *The American Biology Teacher*, *67*(9), 525–529.

Tollerud, T. R. (1990). *The Perceived Self-Efficacy of Teaching Skills of Advanced Doctoral Students and Graduates From Counselor Education Programs*. University of Iowa Ph.D. Thesis.

Weber, R. J., Gabbert, A., Kropp, J., & Pynes, P. (2007). Creating the Teaching Professor: Guiding Graduate Students to Become Effective Teachers. *Journal of Scholarship of Teaching and Learning*, *7*(1),45–63.

Young, S. L., & Bippus, A. M. (2008). Assessment of graduate teaching assistant (GTA) training: A case study of a training program and its impact on GTAs. *Communication Teacher*, *22*(4),116–129.