Biology Teaching Assistant Project 2.0: Advancing Research, Synthesizing Evidence

Final Outcomes Report
September 2021

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1. Background of the Project - BioTAP 1.0

The Biology Teaching Assistant Project (BioTAP; led by PI Schussler) was established in 2013 with one year of NSF RCN-UBE Incubator funding and a goal to create a collaborative research network focused on improving teaching preparation for biology graduate teaching assistants (GTAs). Although there are networks focused broadly on professional development for graduate students (e.g. CIRTL), there are few organizations whose sole focus is to network with graduate student teaching professional development (TPD) practitioners (those who design and deliver TPD to graduate students) to advocate for and improve the efficacy of these programs.

This first version of BioTAP (BioTAP 1.0) made significant progress toward its objectives by: (1) Identifying a draft list of instructional skills specific to the needs of biology GTAs, (2) Identifying and analyzing current national practices in biology GTA TPD, and (3) Initiating relationships with GTA TPD practitioners. However, the successful completion of these goals led to the recognition of additional needs for Biology GTA TPD, specifically, the need for network members to conduct research on biology GTA TPD to build evidence for best practices. That need led to the submission of an NSF RCN-UBE five-year proposal that is the focus of this outcomes report.

2. The Current Project - BioTAP 2.0

The goal of the second iteration of BioTAP (BioTAP 2.0) was to advance the field of disciplinary-based education research specific to the strand of effective implementation of Biology GTA TPD through the enhancement of empirical data on GTA TPD practices. In addition to continuing to grow the network of those interested in improving Biology GTA TPD, BioTAP 2.0 also conducted a program with two-day workshops and online follow-up sessions that would develop the capacity of TPD practitioners to conduct their own research projects on GTA TPD. These workshops (called Research Development Sessions), paired with online supplemental sessions (called Virtual Learning Communities), were proposed to foster research collaborations among institutions, increasing the probability that this research could be generalized and synthesized to identify TPD best practices at a national level. This program was called the "BioTAP Scholars Program."

2.1. Focus and Objectives of BioTAP 2.0

- OBJECTIVE 1: Expand and support collaborations with all biology GTA TPD stakeholders (researchers, educators, administrators, graduate students).
- OBJECTIVE 2: Create and implement Research Development Sessions and Virtual Learning Communities to foster collaborative research on biology GTA TPD.
- OBJECTIVE 3: Synthesize, disseminate, and advocate for research to identify empirically based best practices in biology GTA TPD.

Overall, our hope was to build a network focused on conducting, synthesizing, and disseminating research to identify best practices for biology GTA TPD to increase the national effectiveness of TPD. The ultimate result of the program would be improved quality of undergraduate instruction and better preparation of future faculty. In working toward this goal, **we believe that BioTAP has established itself as the premier network for professional development and advocacy for TPD practitioners and improvement of TPD practices.**

3. Structure of the Report and Overview

The BioTAP network grew to over 250 participants over the 6 years of the project, as assessed by membership on the listserv. Of this group, 66 network members applied for and were admitted to the BioTAP Scholars program over a 4-year period. This report starts with an overview of the network broadly, and then presents the outcomes specific to the BioTAP Scholars program.

Initially, BioTAP envisioned a BioTAP Scholars outcome in which they would present the results of their projects to each other. This vision was expanded in 2017 to host a virtual conference where anyone could present the results of research they were doing on GTA TPD. The third section of the report summarizes the outcomes of three years of this annual virtual conference.

One of the final tasks of the network was to consider the ways in which BioTAP can continue its work into the future. A sustainability task force worked independently from the PIs in spring 2021 to make suggestions to the PI team about how to continue the work of the network. The summary of this group's work is included in this report.

The report ends with a timeline of the activities of the network over the six years of the project, and a reflection on what we accomplished and learned as part of this project. Appendices include the summary of the Evaluator's assessment of the project, and a list of the publications and presentations generated by the PIs of the project.

In addition to this report, much of the work of the network is stored as part of the project website which we converted this summer from an institutional-affiliated web site to an independent hosted page. This location contains the list of the BioTAP Scholars and their projects, the BioTAP position statement about the importance of GTA TPD, a video about the BioTAP Scholars program, as well as resources related to GTA TPD research (and more).

Throughout the report, summaries are provided for each area of BioTAP activity, and hot links are provided that link to folders with additional documentation and information.

4. BioTAP 2.0 Outcomes

4.1. Network Participants

Although many of the BioTAP activities were directly associated with the BioTAP Scholars program, there was a broader community of individuals interested in GTA TPD and research on GTA TPD who engaged with the network through the listserv, website, and / or the virtual conference. Therefore, to assess the broader network membership, we monitored the growth of the listserv during the duration of the project. **There were 81 participants on the BioTAP listserv at the end of BioTAP 1.0, and there were over 250 by the end of the BioTAP 2.0 funding, representing a tripling of participation over the length of the grant.**

To collect information on network members, and assess their satisfaction with the BioTAP network, we conducted member surveys in 2017 and 2021 through the use of Qualtrics survey software. Co-PI Gardner and External Evaluator Lemons took the lead on these surveys. The raw data and individual survey summaries can be found here, with an overall summary below.

4.1.1. 2017 Network Survey Results

For the 2017 BioTAP network survey, we had 61 respondents. Non-tenure track faculty members comprised the largest group of respondents (36%), and of the total survey respondents, 76% were interested in conducting research in GTA TPD. The majority of respondents were involved with implementing GTA TPD programs (75%). However, 71% said that they are not currently conducting research on GTA TPD and 30% have another research agenda unrelated to their GTA TPD program. For respondents who had conducted GTA research (24%), the majority of their research focused on what GTAs know and believe, as well as how GTAs feel, about biology teaching and learning. Respondents said they were likely to engage with the listserve and regular emails (92%) and to share ideas and resources (73%) during the BioTAP Scholars program. When asked about engagement in the BioTAP network, the majority of respondents indicated that they would regularly (92%) or periodically (58%) visit the website for resources and share resources and ideas related to GTA TPD (73%).

4.1.2. 2021 Network Survey Results

For the 2021 BioTAP network survey, we had 41 respondents; of these, 26 were BioTAP Scholars. Respondents included grad students, postdocs, staff, teaching-intensive (20%) and tenure-track faculty (20% assistant professors). Most respondents worked at R1 institutions (77%). Most (66%) said they joined BioTAP to learn about GTA TPD as follows: research (20%), learn about research (18%), exchange ideas about research (16%), and share ideas with others (13%). **Overall, respondents indicated that they had a positive experience with the BioTAP network, with all but one indicating that the BioTAP network either met (40%) or exceeded (58%) their expectations by providing them with a community that offers support and help on issues surrounding GTA TPD implementation and research, as well as collaborations.**

For BioTAP products, respondents indicated that they benefited from the virtual conference (93%), BioTAP website (85%), listserv emails (76%), and information provided about the BioTAP Scholars program (66%). From these resources, respondents stated that they

provided them with networking opportunities, new job opportunities, relevant journal articles, and a supportive community. From the website, the resources participants said they used were research methods articles (90%), GTA TPD research articles (88%), BioTAP virtual conference information and recordings (80%), and BioTAP Scholar profiles (65%). The majority of respondents stated that the BioTAP network increased their:
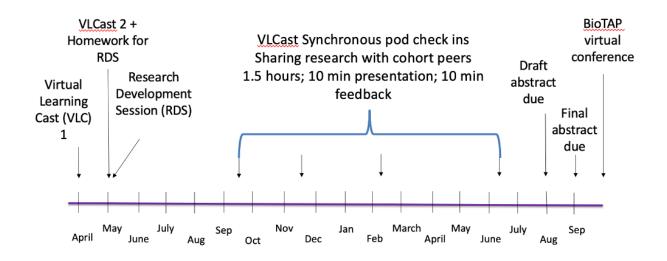
- awareness of research on GTA TPD (95%),
- knowledge of how to conduct research on GTA TPD (95%),
- knowledge of how to implement GTA TPD (93%),
- credibility as a GTA TPD practitioner (80%),
- credibility as a GTA TPD researcher (78%),
- visibility for GTA TPD at their institution and/or nationally (73%),
- quality of GTA TPD at their institution (63%),
- opportunities to advocate for GTA TPD at your institution and/or nationally (63%), research collaborations (58%), and
- GTA TPD program collaborations (53%).

In the future, respondents stated they would like to see continued regular meetings where they can share ideas, cultivate collaborations to help sustain the network, maintain the listserv and website, and seek additional funding. One individual went as far as to recommend starting a BioTAP professional society.

4.2. BioTAP Scholars

The BioTAP Scholars program was one of the central activities of the BioTAP project. We supported 66 Scholars in four cohorts over four years to conduct research on GTA TPD through this program. The program had a combination of face-to-face and online programming, and all of the materials used to enact this program are located here.

Starting in November 2016, we recruited participants to apply to be a BioTAP Scholar each academic year. Applications were due in January, and selections were made by the PI team in late February or early March. We had over 80 applicants total to the program over 4 years. These applicants were primarily staff, tenure or non-tenure track faculty members, that primarily worked at R1 institutions in the United States. Over four years, we selected 16 individuals for Cohort 1 of the BioTAP Scholars, 18 individuals for Cohort 2, 16 for Cohort 3, and 16 for Cohort 4. Each group did two virtual sessions (one synchronous and one asynchronous) in the spring, and then met as a group in late May or June to complete the 2-day-long Research Development Session (RDS). These were held in person in Madison, Wisconsin (Cohort 1; in conjunction with the ABLE conference) and in Columbus, Ohio (Cohorts 2 and 3). Due to COVID restrictions, Cohort 4's RDS was held online. After each RDS, there were four virtual online sessions with smaller groups (pods) who reported on research progress and received advice from the PIs and their podmates. Final abstracts of their research projects were due in August of the year after their RDS session. To see the variety of project topics the Scholars enacted, you can visit this webpage https://www.biotap.org/biotap-scholars. A visual timeline of a typical Scholars cohort is shown below:

VLCast 2 + Homework for RDS

Virtual Learning Cast (VLC) 1

Research Development Session (RDS)

VLCast Synchronous pod check ins
Sharing research with cohort peers
1.5 hours; 10 min presentation; 10 min feedback

Draft abstract due

Final abstract due

BioTAP virtual conference

April May June July Aug Sep Oct Nov Dec Jan Feb March April May June July Aug Sep

4.2.1 Building a Database of GTA TPD Literature

In order to inform our participants on the extant research literature on best practices in GTA TPD, we felt it was important to create a usable database of the scholarship for our participants. As such we gathered and compiled a sortable spreadsheet of the current research on best practices in GTA TPD aligned with the outcomes framework created by the BioTAP 1.0 project (Reeves et al., 2016). This database is a "living" sheet and is updated frequently. The sheet is coded and sortable by Reeves et al. (2016) outcomes. Scholars used this database to familiarize themselves with the extant literature prior to the RDS and to access literature for their own study design and scholarly communication at conferences or through manuscripts.

4.2.2. Program Assessment

To assess the impact of this program, we used the five levels of evaluation framework (Adapted from: Colbeck, 2003; Guskey, 2000; Kirkpatrick, 1994, and Connolly, et al., 2006) to gather data on the characteristics of the participants, their satisfaction with the program, their learning, the way they applied what they learned, and its impact on them. The data supporting the summary below, as well as the list of data sources, can be found here.

Participants were primarily from R1 universities (N=49), with 12 from US Master's-granting or Baccalaureate institutions and 4 from non-US institutions. This likely reflects the fact that GTAs are mainly employed in teaching roles at R1 institutions. Almost half of the BioTAP Scholars were faculty members at their institutions (N=13 tenure track and N=16 non-tenure track), with the rest being staff (N=18), graduate students (N=11), or postdocs (N=8) (note that some BioTAP Scholars had multiple roles, so our numbers may add up to more than 66). All but 4 of the BioTAP Scholars were involved in GTA TPD programs in some capacity. NOTE: The following assessment data only includes BioTAP Scholars' Cohorts 1-3 as the fourth Cohort was finishing their research as we were compiling this report.
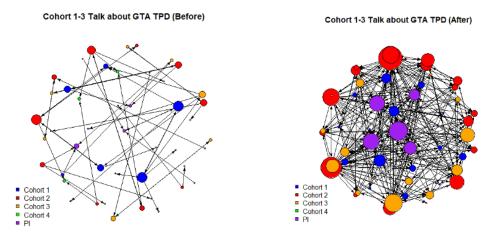
When asked about **satisfaction with the program** it was almost always uniformly high. By program component, participants were typically most satisfied with the RDS, followed by the post-RDS pod meetings, slightly less satisfied with the pre-RDS online meetings (although these still scored high in satisfaction). Project Evaluator Dr. Lemons confirmed that satisfaction

with the RDS part of the program was almost unanimously favorable - she visited RDS implementation twice and conducted her own satisfaction surveys each year. **The program met or exceeded the participant expectations each year, and each aspect of the RDS experience was rated highly. They felt they gained knowledge, received valuable feedback, and formed a community.** Requests for improvements almost always focused on how to do the presentations of research ideas at the end of the RDS, and the need for more time at the RDS. Participants generally left the RDS feeling prepared to conduct their research. Satisfaction for the online RDS in 2020 was still uniformly high despite acknowledged zoom exhaustion and distractions due to home environment. Overall, Evaluator Lemons found that the small-group work with peers was seen as one of the strengths of the RDS.

To assess **learning and self-efficacy related to their research projects**, we had participants record their confidence levels regarding completing various aspects of research pre-RDS, post-RDS and then post-program. Likert averages for Cohorts 1-3 showed distinct gains in confidence from pre-RDS to post-program for many different areas of research (e.g. developing research questions, finding instruments to use, designing a project). Cohort 1 seemed to gain more confidence early in the program compared to later in the program, and we attribute this to alterations we made to the post-RDS aspect of the program for Cohorts 2 and 3. We also asked the Scholars to self-report the two most important things they learned over the course of the program about research. Most Scholars discussed learning about the instruments that are available to conduct GTA TPD and general IRB and data collection approaches. Secondary gains were learning to formulate a research question and becoming more aware of the existing literature on GTA TPD.

To assess **implementation of research projects (application)**, we looked at the progression of research that each Scholar underwent over the time of the program. We looked to see whether Scholars completed each stage of research including: completing their IRB application, collecting their data, analyzing their data, and completing their project. For Cohorts 1-3, five participants did not get their IRB approved for their project. Twenty eight participants completed data collection, 13 were in some stage of data analysis, and 15 completed their projects. **Many BioTAP Scholars encountered significant barriers that limited their project completion. The most commonly-cited barrier was finding the time to complete the research amidst their other duties.** The next most common barrier was challenges in study design, which often occurred when Scholars had problems obtaining the sample size they desired. Some experienced institutional issues such as IRB complications or permission to access GTA participants. Many got bogged down in data analysis, and this was often seen for qualitative data, which was new to many Scholars. Despite these barriers, they also mentioned institutional supports such as people or funding, some mentioned the BioTAP PIs as supporters, the peer feedback they received from their pods, and having regular deadlines.

The **impact** of the project was perhaps more than we expected for a relatively brief program. **In the follow-up survey, almost all of the respondents reported personal or professional gains for themselves (98%) and increased dialogue about GTA TPD at their institution (67%),** although this did not always translate to changes in GTA TPD (28%). The following quotes come from Scholar insights described in their final project abstracts. One Scholar stated, "*Overall, my work with BioTAP did improve GTA TPD at my university. This fall I ran a training on inclusive teaching (by zoom) for new TAs for the first time. I first had the idea to*

do this as part of my BioTAP project and am glad I requested to be involved with GTA TPD in this way. It went really well and [I] think it will become a regular portion of the new biology GTA training." The personal and professional benefits mostly centered around what they learned as a result of the program, in addition to the expansion of their professional network and building of new collaborations. For example, one Scholar said, "*Through the BioTAP Scholars' RDS and the follow-up POD Check-ins, I now understand the basics of quantitative and qualitative research in this area of study, how to conduct a confidential survey and how to submit an IRB form. I learned that writing a question that your survey participants will read the exact way you intended is very difficult, that as soon as you get an answer to one question, you open up many more new questions.*" Another Scholar said "*Despite having done research in some format for almost 20 years, I can pinpoint the RDS as the first time I actually learned a systematic, clear and concise process for formulating a question and outlining a project. It was invaluable.*" **About half also mentioned on the survey that they were being seen as a GTA TPD expert or institutional change agent as a result of their participation.** "*BioTAP was a catalyst, in my opinion, for how TPD is now implemented at our institution. The reason has everything to do with the fact that being a BioTAP scholar gave me a credibility I did not have previously.*" The increase in collaboration was captured through social network analyses showing pre-program and post-program connections between BioTAP Scholars and PI's across the four cohorts increasing dramatically, as shown below for Scholars talking about GTA TPD with each other before and after the program.

This increase in networking was supported by Scholars' comments such as, "*I definitely formed a new network and am appreciative of being in touch with others who do research looking at biology GTAs. I collaborated with one BioTAP scholar from the first cohort, and am still in the works of possibly working with another BioTAP scholar too (both from different universities). I am also interested in working with others as well. Seeing some of the BioTAP scholars at conferences has helped to build my professional network and staying in touch with others (who I may not see in conferences) has still helped because it helps me stay connected to the community.*" Another said, "*Overall, I am very happy that I found this community of like-minded researchers. During my time as a PhD student in Science Education I felt like an outlier when it came to research interest. There were very few colleagues interested in studying TAs, which left*

me feeling on my own in a lot of ways. I feel encouraged and supported in my interest in TAs now, as well as more knowledgeable of the methods, resources, and needs for further study of such important agents of higher education."

In August 2021, we asked BioTAP Scholars to report on the scholarly outcomes of their participation in the program. We had 37 of the 66 Scholars enter data into a spreadsheet. Of those 37, two indicated that they had published the results of their BioTAP Scholars project. Fourteen (38% of respondents) said they were working on a manuscript reporting the results of their BioTAP Scholar research. Thirteen Scholars presented the work of their BioTAP Scholars project at a conference, and 14 presented those results at their institution. We were also interested in the extent to which their participation in the project had inspired continued participation in research on GTA TPD beyond their BioTAP Scholars project. Eight of the 37 (22%) indicated that they published an article that was inspired or influenced by their participation in the program. Twenty seven percent are working on a manuscript that they consider to be inspired or influenced by their BioTAP participation, and 16% presented work at a conference that was inspired or influenced by their participation. **Significantly, 29 of the 37 (78%) said that they were continuing research on GTA TPD at their institution. Eight mentioned submitting applications for funding related to GTA TPD, and seven mentioned modifications to their GTA TPD programs since participating in the program.**

Overall, this indicates that Scholars clearly learned from the program and enjoyed their experience. They documented professional gains and increased awareness and discussion about GTA TPD at their institution. They left the program with a broader network from whom to discuss ideas and research. Importantly, although few BioTAP Scholars published the work they did for the program, many are pursuing publication and many are continuing research in this area. **This indicates that the program was successful in building capacity for research on GTA TPD, but that it also impacted the participants professionally in ways that we did not anticipate in terms of professional promotions and collaborative networks.**

4.3. Virtual Conference

Over the time of the grant funding we held three BioTAP Virtual Conferences and are currently planning the fourth in Fall 2021 with the assistance of network membership. It is our intention for this aspect of BioTAP to continue as a way to maintain visibility for and dialogue about GTA TPD programs and research on GTA TPD programs. The reports for each of the three virtual conferences, including participation, sessions, and post-surveys can be found here. The BioTAP website has links to the conference recordings.

We held the conference each fall using the zoom platform even before COVID-19 made us all intimately familiar with the platform. We chose a single afternoon session that lasted between 4 and 4.5 hours. The conference typically averaged 11 presenters including 1-2 keynote speakers. We offered short talks lasting about 15 minutes and lightning talks lasting 2 minutes. Posters were offered at the 2020 conference, but no one opted for this session type. Anywhere from 3-6 BioTAP Scholars presented sessions at each conference, with some of their work being a direct result of their BioTAP Scholar project and some being new research they have conducted since their program completion.

An average of 100 people from 70 different institutions (including international) pre-registered for each conference, however, only about 60% of those individuals attended.

Because the conference link was sent to listservs, and pre-registration was not required, about 35 people at each conference attended, but had not pre-registered. **Thus, we averaged 91 people at each conference.** Most of the attendees were faculty from research-intensive institutions, although the trend over time has been a decrease in percent of research-intensive participants. Tenure-line faculty participation has also decreased over time relative to other academic position types. Typically, about 25% of the attendees lead GTA TPD programs or conduct research on GTA TPD, although those averages were much higher in 2020 (44% and 42%, respectively). Total average time of attendance at each conference ranged from 98 minutes (2020) to 137 minutes (2018).

       Post-conference surveys suggest that participants came to the sessions to get ideas for GTA TPD or research on GTA TPD. Participants liked the ease of attending a virtual conference, and almost always said they were satisfied or partially satisfied with the experience. Most said they would attend a face to face BioTAP conference if it were offered. The main feedback was that participants wanted more ways to discuss ideas with each other. Finally, the conference was a significant source of new network members, with many attendees not being BioTAP listserv members; 30 people in 2018 requested to be added to the listserv after the conference.

4.4. Sustainability Task Force

       In the spring of 2021, with the end of the grant funding in sight, the BioTAP PIs asked for volunteers from the network (via listserv recruitment) to form a Sustainability Task Force (STF). Nineteen network members, 17 of whom were BioTAP Scholars, answered this call. The members were organized into three sub-groups (each with a designated leader) to represent the three main facets of BioTAP activities: BioTAP Scholars, Virtual Conference, and Networking. These groups convened in late March 2021 for an initial charge from the PIs. PI Ridgway organized and coordinated the groups, but the PIs remained separate from the deliberations of the STF to allow this group autonomy to steer the future of BioTAP.

       The charge to the groups broadly was to: 1) generate ideas to sustain BioTAP, without the constraints of the grant mandates, 2) identify the affordance and challenges of the current BioTAP functioning and address needed changes, and 3) synthesize the discussion of each sub-group into a summary and recommendations for the future of BioTAP. Over the next two months, the sub-groups met three times in their small groups to consider the overall charge and the specific questions posed by the PIs. At the end of May 2021, the groups came back together to report on their discussions to the other groups and then synthesize ideas. A survey was sent to each STF participant one week later to capture their final thoughts on the future of BioTAP.

       The BioTAP Scholars sub-group asserted the value of the program and brainstormed ways to continue gathering individuals together to form a community of scholars to enact TPD improvements or GTA TPD research. They suggested several models for how to continue these programs and decided to pursue NSF grant funding for one of their ideas. The Virtual Conference sub-group also asserted the importance of continuing the conference, and also pursuing opportunities for in-person conferences as well. They suggested some formatting changes to increase networking at the conference, and suggested how to continue implementing the conference, including potentially charging registration. Members of this group will be helping to organize the BioTAP 2021 Virtual Conference. The Networking sub-group

focused on the value niche of the BioTAP network and how to re-shape the mission and vision to serve the proposed future members of the network. They suggested collaborating with established professional societies to enact programming and then thinking about how to establish a governance structure for the BioTAP network, with PI participation and a focus on network growth. A more extended STF final report as well as the summary reports from each of the STF sub-groups, and the charge to the committee powerpoint is shown here.

These recommendations were presented to the final Steering Committee meeting of the project and the group worked to shape them into a plan for the future. We will be forming a Governance Task Force comprised of 6 members (invited by the PIs) and one PI who will work to establish the organizational structure of the new BioTAP. We have started to invite BioTAP network members to chair three new committees: the conference committee, the research and practice committee, and the communication and networking committee. Once chairs are established, we will open up self-nominations for committee membership to the community and beyond. We are also considering a call for members of a TPD program repository task force to think of ways to database information on TPD programs for others to search and use. Our hope is to have all of these committees in place for the November virtual conference.

5.Timeline of BioTAP Activities

Funding started August 2015 and ended September 2021 (one no-cost extension)

2015-2016
- Named the workshops and online programs the BioTAP Scholars program
- Drafted ideas for the in-person workshop (Research Development Session; RDS) and virtual online sessions (Virtual Learning Casts; VLCasts)
- Planned the structure / sequence of the BioTAP Scholars program
- Planned and enacted the first in-person BioTAP Steering Committee meeting

2016-2017
- Drafted and deployed the BioTAP Scholars application in November 2016
- Completed the VLCast 1 video and VLCast 2 homework set
- Selected Cohort 1 of the BioTAP Scholars program in February 2017
- Reorganized annotated bibliography of Biology GTA TPD research
- Planned and enacted the first RDS for Cohort 1 in June 2017
- Conducted pre- and post-assessments of the RDS
- Presented an ABLE mini-workshop on BioTAP Scholars in June 2017
- Created a promotional video for the BioTAP Scholars program

2017-2018
- Conducted a survey of the BioTAP network (fall 2017)
- Started using zoom for post-RDS VLCast sessions; conducted sessions as small-group (pod) check-in meetings
- Created initial BioTAP website

- Created and sent administrator letters for BioTAP Scholars; also created and enclosed a BioTAP position statement on GTA TPD
- Revised and posted application for BioTAP Scholars Cohort 2 in November 2017
- Selected Cohort 2 of the BioTAP Scholars in February 2018
- Drafted post-program assessment for BioTAP Scholars
- Revised homework and RDS agenda and enacted second RDS in June 2018
- Conducted pre- and post-assessments of the RDS
- Provided feedback to Scholar projects in July 2018
- Decided on abstracts as format for final BioTAP Scholar reports
- Started planning first virtual conference
- Created a twitter site for BioTAP
- Held an online Steering Committee meeting

2018-2019
- Posted resources on conducting research on GTA TPD on BioTAP website, including resources from CIRTL at UGA
- Received final abstracts from Cohort 1 of the BioTAP Scholars
- Completed post-program assessment of Cohort 1
- Planned and enacted the first BioTAP Virtual Conference in October 2018
- Revised and posted BioTAP Scholars Application for Cohort 3
- Selected Cohort 3
- Enacted the RDS for Cohort 3
- Conducted pre- and post-assessments of the RDS
- Created a listserv for BioTAP Scholars
- Hosted "BioTAP Happy Hours" for Scholars to gather at conferences

2019-2020
- Planned and enacted the second annual BioTAP Virtual Conference in November 2019
- Received final abstracts from Cohort 2 of the BioTAP Scholars October 2019
- Completed post-program assessment of Cohort 2
- Posted BioTAP Scholars application for Cohort 4
- Selected Cohort 4 of the BioTAP Scholars program
- Hosted an online RDS meeting for Cohort 4
- Conducted pre- and post-assessments of the RDS
- Submitted supplemental funding request - declined because of travel restrictions
- Hosted online Steering Committee update meeting with 6 new members drawn from BioTAP Scholars
- Published book chapter on Theory of Change for BioTAP

2020-2021
- Received final abstracts from Cohort 3 of the BioTAP Scholars September 2020
- Completed post-program assessment of Cohort 3
- Planned and enacted the third annual BioTAP Virtual Conference in October 2020

- Planned for and enacted a Sustainability Task Force series of meetings with 19 network volunteers; initial meeting in March 2021 and final report meeting May 2021
- Writing final outcomes report
- Conducting final network survey
- Published article on BioTAP Scholars program in Course Source
- Hosted last Steering Committee meeting (online) - August 2021
- Received final abstracts from Cohort 4 of the BioTAP Scholars September 2021
- Completed post-program assessment of Cohort 4
- Planning 2021 Fourth Annual BioTAP Virtual Conference with assistance for Sustainability Task Force members

6. Conclusion

Overall, BioTAP was highly successful in fulfilling the objectives that it defined in the grant proposal, but also in expanding the activities beyond the initial scope we proposed (expansions included the virtual conference and sustainability task force). Our original assertion in proposing this project was that TPD providers work in isolation and need a network, and we feel confident that BioTAP proved the merit of that statement. People from throughout the US and beyond have joined the network, indicating a broad group of isolated individuals passionate about GTA TPD. We also set out to build capacity in research and we feel proud that 25% of our network engaged in an intensive program to conduct research on GTA TPD. **Many of these Scholars continue to be engaged in research on GTA TPD or improve the GTA TPD programs at their institutions, and they can now do this with collaborative peers that they may not have had prior to the program.** The program also highlighted their skill set to their institutions and many indicated benefiting professionally from their affiliation with BioTAP.

As PIs of the project, we learned a tremendous amount about how to build and sustain a community, and how that can be done even in a virtual environment. We feel that the materials we built for the BioTAP Scholars program can be used as a template for any professional development effort, remembering that building relationships is a key component of success.

Summary of Accomplishments by Objective

- OBJECTIVE 1: Expand and support collaborations with all biology GTA TPD stakeholders (researchers, educators, administrators, graduate students).

The BioTAP Scholars program (composed of individuals ranging from graduate students to administrators) was found to be a highly effective means of increasing collaboration among and across cohort members. Pre-post assessments of collaboration show significant increases in discussion among members about GTA TPD programs and research on GTA TPD. We were unable to conduct collaborative network diagrams for the listserv network, but note that we gained 170 individuals on our listserv over 6 years.

- **OBJECTIVE 2**: Create and implement Research Development Sessions and Virtual Learning Communities to foster collaborative research on biology GTA TPD.

We successfully ran four cohorts of the BioTAP Scholars and mentored 66 individuals through research on GTA TPD through this program. The RDS and VLCast materials were refined each year and are provided on the BioTAP website for others to use as a template for training programs. Part of the STF task force is working on a grant submission to use the BioTAP Scholars model as the basis for new ideas in training. Our assessment data indicates the success of our program to increase knowledge, build community, and advance research capacity.

- **OBJECTIVE 3**: Synthesize, disseminate, and advocate for research to identify empirically based best practices in biology GTA TPD.

The PIs spent a great deal of time early in the project compiling the literature on Biology GTA TPD and creating an annotated, sortable database of this research. CoPI Gardner led an effort to identify which GTA TPD research outcomes have been investigated most in the literature, and which our BioTAP Scholars were researching. This helped us to highlight areas that need additional research in the area of GTA TPD.

The BioTAP Scholars generated 2 articles and 14 conference presentations related to their proposed GTA TPD research, showing the potential to increase dissemination of new research through this program. We had originally envisioned synthesizing the work of the BioTAP Scholars to disseminate broader conclusions about what practices might work best for GTA TPD, but the variation in institutional context and lag time in publishing of the Scholar results made that goal difficult. However, the number of Scholars continuing to work in research on GTA TPD shows the promise of this program to increase empirical data on these programs as time progresses.

In terms of advocacy, we found that the administrator letters and position statements we sent to administrators of BioTAP Scholars were anecdotally effective in raising awareness of GTA TPD and Scholars at their institution who were working on those issues. Many administrators replied to the PIs about this letter, and Scholars reported increased focus on GTA TPD at their institutions, as well as recognition of their role in those changes. The Virtual Conference was also a significant activity to broaden the network and advocate for research on GTA TPD. In this respect, the website is also a significant tool for both information about BioTAP and advocacy for Biology GTA TPD.

APPENDICES

Appendix 1:
Evaluation Report, submitted by Paula Lemons, University of Georgia
Did BioTAP meet its objectives?

BioTAP met its objectives. First, the PI team expanded and supported collaborations with biology GTA TPD stakeholders, including researchers, educators, and graduate students. The best evidence for the expansion of BioTAP's relationship with GTA Stakeholders comes from the success of the Scholars program, which is discussed below, and the growth of the network. The network grew from 81 to 250 members over the life of the project. A network satisfaction survey conducted in 2021, which is described above, shows that members highly value the network because it improves their awareness and knowledge of GTA TPD research and practice and their credibility as GTA TPD practitioners and researchers. Network members also value the collaborations they have created through BioTAP.

Second, the PI team created and implemented Research Development Sessions and Virtual Learning Communities. These were carried out with 66 BioTAP 2.0 Scholars in four cohorts. This program is described in detail above and was assessed through surveys for all four cohorts and interviews with a subset of participants for Cohorts 2 and 4. A summary of the data can be found here. The summary attests to the high-quality nature and impact of the program.

Third, the PI team synthesized, disseminated, and advocated for research to identify empirically based best practices in biology GTA TPD. In 2015, the team published a conceptual framework for GTA TPD evaluation and research (Reeves et al., 2015). They used this conceptual framework to organize their work with Scholars. Notably, they provided Scholars with literature from different categories of the conceptual framework and additional papers on GTA TPD. Note that most network participants point to the knowledge and awareness they have gained about research on GTA TPD (95% of survey respondents) and knowledge of how to conduct research on GTA TPD (95% of survey respondents). Additionally, as described in this report, the PI team and their collaborators published two articles and one book chapter and made twelve conference presentations. They also are preparing an additional manuscript that will address the work of this project.

Did BioTAP generate the expected products?

The PI team generated the expected products, including website, RDS development sessions, VLCasts, abstracts from Scholars, and publications about their work.

How is BioTAP perceived by key stakeholders?
BioTAP stakeholders hold a strongly positive perception of BioTAP. They are mostly GTA TPD practitioners and researchers who gain awareness, knowledge, credibility, visibility, and opportunities for collaboration from the network. The evidence for this conclusion comes from an evaluator-conducted survey of network members.

What challenges were encountered and how were they addressed?

The PI team encountered one major challenge and two minor challenges. The major challenge was COVID-19, which forced a last-minute shift in spring 2020 to hold the Research Development Sessions online. The team did an admirable job with this shift and received [favorable feedback from participants](#). All of the positive outcomes that members of Cohorts 1-3 expressed were also expressed by members of Cohort 4. Cohort 4 members did provide valuable feedback for ways to improve the virtual version of the Research Development Session that the PI team can draw on for future work.

Two minor challenges were that the PI team planned to implement one or two more cohorts of the Scholars program. However, they discovered that each cohort required more of their capacity than expected (e.g., time to prepare the Research Development sessions and time to mentor Scholars after the Research Development Sessions). Thus, they elected to focus on four cohorts, which was a wise decision. A second minor challenge was that it was difficult to generate collaborative research projects among Scholars. For the most part the Scholars focused on solo projects due to their limited research experience, limited time to devote to research (i.e., due to their heavy responsibilities as GTA TPD practitioners), and contextual constraints (i.e., universities/colleges had different contextual issues that afforded or limited research). The PIs elected to be content with this outcome because the overall project objectives were still met and the Scholars were still able to execute research projects.

Appendix 2:
Publications and Presentations (of the project PI team)

Over the six years of the project, the PI team and their collaborators had three publications (two articles and 1 book chapter) and twelve conference presentations. Those publications are shown at this [Link](#). In addition, the PIs are working on one additional publication that will summarize the progression of BioTAP Scholars through their research projects, barriers and affordances for their research, and collaborative outcomes of the program.

Publications

Miller, KR, JS Ridgway, G Marbach-Ad, EE Schussler, GE Gardner. In press. The BioTAP Professional Development Model: Expanding Empirical Research on Graduate Student Teaching Professional Development. *CourseSource*.

Gardner, G, J Ridgway, EE Schussler, KR Miller, G Marbach-Ad. 2021. Scaling up institutional change through research coordination networks: A case study of graduate student teaching professional development. *In* White, K., Beach, A., Finkelstein, N., Henderson, C., Simkins, S., Slakey, L., Stains, M., Weaver, G., & Whitehead, L. (Eds.). *Transforming Institutions: Accelerating Systemic Change in Higher Education*. Pressbooks.

Reeves, TD, G Marbach-Ad, KR Miller, J Ridgway, GE Gardner, EE Schussler, and EW Wischusen. 2016. A Conceptual Framework for Graduate Teaching Assistant Professional Development Evaluation and Research. *CBE Life Sciences Education* 15: 1-9.

Presentations

Gardner, G., Ridgway, J. Marbach-Ad, G., Miller, K., Schussler, E. 2021. BioTAP: Barriers and Supports to Conducting Science Education Research on Graduate Student Teaching Development Practices. Paper presented at the 94th NARST Annual International Conference. Virtual presentation due to COVID-19.

Schussler, EE, G Gardner, G Marbach-Ad, K Miller, J Ridgway. 2019. The Biology Teaching Assistant Project: Theory of Change for a Network. ASCN Transforming Institutions Conference, Pittsburgh, PA.

Gardner G, E Schussler, K Miller, G Marbach-Ad, J Ridgway, J Reid*, M Chen*. 2018. Current Literature on Biology Graduate Teaching Assistant Teaching Professional Development (GTA TPD): Mapping a Research Agenda. Poster at the National Meeting of the Society for the Advancement of Biology Education Research (SABER), Minneapolis, MN.

Marbach-Ad, G, J Ridgway, G Gardner, K Miller, E Schussler. 2018. Biology Teaching Assistant Project (BioTAP 2.0): A Network to Build a Capacity for Collaborative Research on Biology Graduate Teaching Assistant Teaching Professional Development (GTA TPD). Poster presented at the Network of STEM Education Centers annual meeting (NSEC). Ohio, Columbus.

Marbach-Ad, G, G Gardner, K Miller, J Ridgway, E Schussler. 2018. Network initiative to develop research skills in professional developers working with biology teaching assistants. Stand-alone paper presented to the 91th National Association for Research in Science Teaching (NARST) annual meeting, Atlanta, GA.

Reid, J, M Chen, P Carroll, GE Gardner, E Schussler, G Marbach-Ad, K Miller, J Ridgway. 2017. A critical review of the literature on biology graduate teaching assistant professional development. Biology Education Research Symposium at the National Association of Biology Teachers (NABT) Professional Development Conference. St. Louis, Missouri.

Marbach-Ad, G, E Schussler, G Gardner, K Miller, J Ridgway. 2017. A Network for Research on Biology Graduate Teaching Assistant Teaching Professional Development. AAC&U Transforming STEM Higher Education Conference, San Francisco, CA.

Schussler, E, G Gardner, G Marbach-Ad, K Miller, J Ridgway. 2017. Networking for Change: Assessing the Capacity for Research on Graduate Student Teaching Professional Development. National Meeting of the Society for the Advancement of Biology Education Research, Minneapolis, MN.

Miller, K, G Gardner, G Marbach-Ad, J Ridgway, E Schussler. 2017. BioTAP 2.0 (Biology Teaching Assistant Project): Engaging individuals in scholarly research about biology graduate teaching assistant teaching professional development (GTA TPD) programs. 39th Annual ABLE Meeting at University of Wisconsin – Madison.

Gardner, G, E Schussler, G Marbach-Ad, K Miller, J Ridgway. 2017. The Biology Teaching Assistant Project 2.0: Advancing research, synthesizing evidence. Paper presented at the annual meeting of the Tennessee STEM Education Research Conference hosted by Tennessee STEM Education Center (TSEC), Murfreesboro, TN.

Schussler, E, J Ridgway, G Gardner, K Miller, G Marbach-Ad. 2015. Networking to promote the assessment of GTA professional development. National Meeting of the Society for the Advancement of Biology Education Research, Minneapolis, MN.

Marbach-Ad, G, EE Schussler, K Miller, M Ferzli, and QD Read*. 2015. Professional Development for Biology Graduate Teaching Assistants: Status, Challenges and Needs. National Association for Research in Science Teaching [NARST] annual meeting, Chicago, IL.