

External Evaluation

Year 4 Summary Report for NRT-HDR: Intersecting computational and data science to address grand challenges in plant biology

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Year 4 Summary

During Year 4 of grant activities, the external evaluators at the University of Northern Iowa Center for Social and Behavioral Research (CSBR) consulted with the IMPACTS leadership team on their internal evaluation activities and monitored internal processes. The project leadership team has shown a high level of engagement and enthusiasm and has used their evaluation activities as an integral part of their programming and planning. As has been the practice in previous years, an inventory of all internal evaluation activities has been created and is maintained by the project coordinator and has been shared with the external evaluators. Assessments have been conducted regularly for courses and activities, and have been constructed with consultation from the external evaluators. The leadership team has also held regular check-ins with the evaluators via virtual meetings to receive feedback on specific elements of evaluation assessments, which have also led to meaningful conversations about the strengths of the program as well as potential areas for improvement. The current logic model is included below as Figure 1 and is scheduled to be updated with project leadership in August 2022. In addition, annual in-depth interviews were held with the leadership team for the 2021-2022 year (Shiu, Kumar, Long,) in June 2022 to gather insights about successes, challenges, and any changes implemented or planned for the coming year.

Overall, despite the continuing challenges of the pandemic, project activities are going well and the program is on track to meet its goals for project outcomes. The leadership team continues to use the recursive design of their evaluation assessments, which has served as a guide to ongoing improvement while navigating unanticipated issues and challenges. Assessments have been used to solicit course feedback at key points in the semester for the three program-specific courses offered: Foundations in Computational and Plant Sciences (Fall 2021); Frontiers in Computational and Plant Sciences (Spring 2022); and Forum in Computational and Plant Sciences (Fall 2021; Spring 2022). Feedback from each of these has allowed for adaptive planning to incorporate student suggestions regarding the pace and content of the course, as well as the direction of the Forum courses. Using course feedback and instructor reflections from mid-course assessments and semester-end surveys, the courses build upon one another and incorporate program-specific content as well as the professional development skills that the program seeks to support. Over the past years, the students have shown initiative in the Forum class by identifying issues they are most interested in, and have shown creativity and ambition in developing products that serve their goals as well as align with the greater goals of the program.

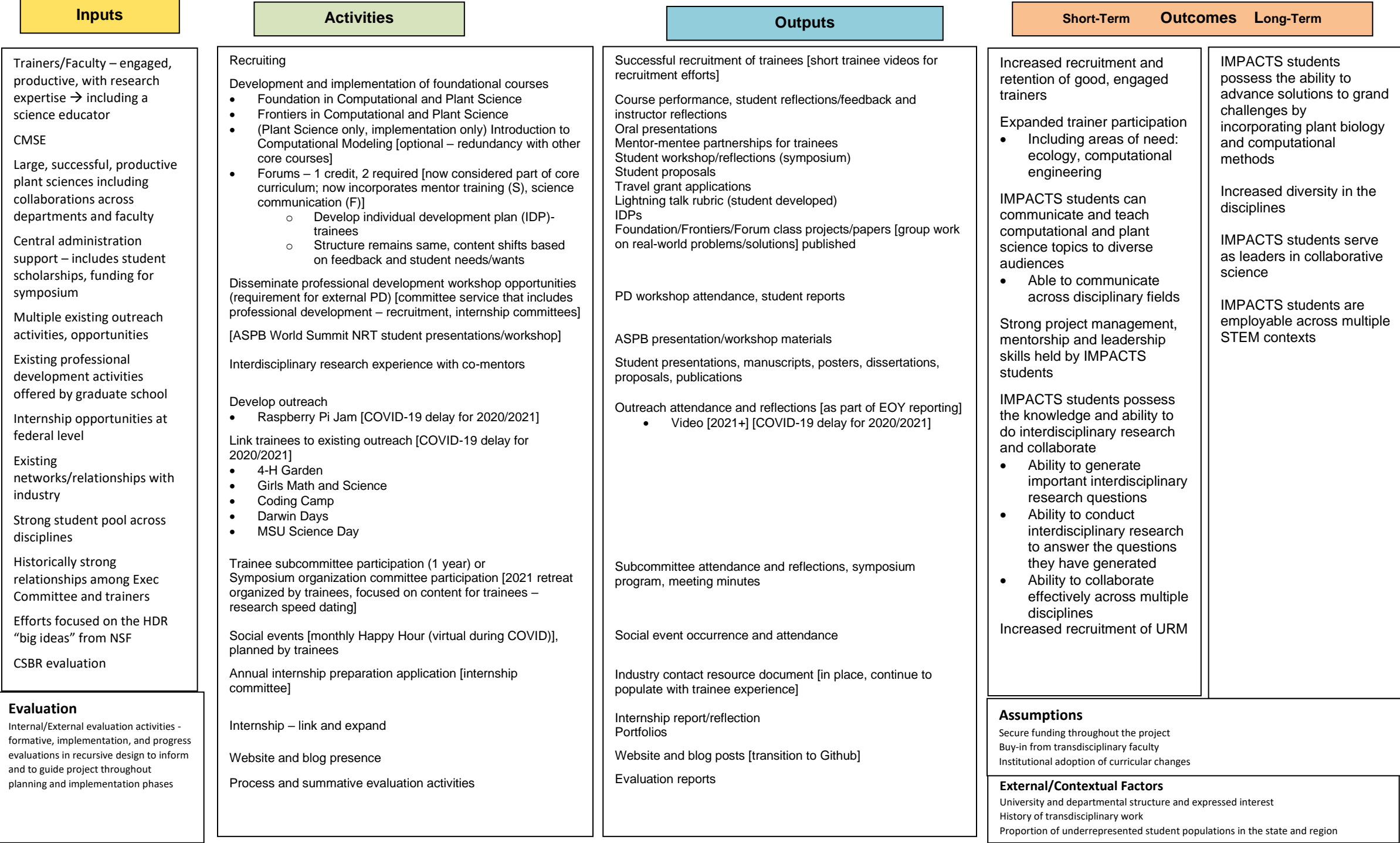
This year, the integration and recursive positive impact was especially evident as graduate students in the Forum and Frontiers classes were engaged in a challenge that was connected to the undergraduate Intro Biology course wherein the Forum students were focused on STEM lesson design and STEM learning and Frontiers graduate students were enlisted to develop tools to support the expanded utility of a large phenology dataset that has been populated with image data annually for several years by students in the Intro Biology course. The integration of

the goals of the three courses has provided the means to elevate all of them by generating a substantive lesson-design challenge to the graduate students in Forum leading to a product that can be included on their CV and in Frontiers as they resolved plant science problems provided using computational approaches. This “cross-pollination” spanning IMPACTS and non-IMPACTS courses (i.e., Intro to Biology) was fully realized during this past year demonstrating the significant innovative training outcomes emerging from the NRT project components.

The project leadership continues to foster engagement of the trainers and trainees despite challenges of the pandemic. Significant milestones have also been achieved. The certificate in computational plant science was approved during the past year and provides a clear, tangible demonstration of the project’s success thus far and sustainability beyond the funded time frame. The leadership team of Shiu, Long and Kumar is providing strong leadership in the steering and oversight of the project with Jyothi Kumar playing a significant role in the management of the day-to-day tasks and activities of the program. PC Kumar’s responsibilities include significant teaching responsibilities (in tandem with faculty trainers) for the program-specific courses, support for trainees, and continued involvement in the NRT Program Coordinators group that is comprised of PCs from NRT projects across the country. Faculty trainers are also engaged and continue to make substantive contributions to the success of the program.

The broader impacts of the program continue to expand through faculty and student activities. Virtual training for a cooperative program with university students in Mexico has been implemented during Year 4. The IMPACTS trainees also continue to engage with one another beyond program-required courses and adapt to a hybrid and in-person environment. Some of the transitions back to in-person classes and activities have been more challenging than expected and leadership continues to gather important formative information from trainees about how best to move forward as the pandemic continues. The majority of the outreach and internship plans moved to a virtual mode during Year 4 and the leadership team continues to adapt their strategies as needed to maintain as much value and consistency as possible in both programming and support of student trainees.

Figure 1. IMPACTS NRT – Michigan State Logic Model (5/20/21)



Key Themes of Internal Evaluation Assessments

Throughout the year, student trainees participated in several surveys and reflections to provide feedback on the three courses and associated activities offered throughout the year. Students in the Fall Foundations course were also invited to take part in a virtual focus group to share their perspectives about their experiences. Overall, student feedback was positive about the classes provided in the 2021-2022 school year, and students were able to identify a number of strengths for each course. They also provided constructive feedback for areas that could be improved and this feedback was shared with course instructors. As has been true throughout the project, feedback from the leadership team during end-of-year in-depth interviews suggests that this student input was integral to deciding on course adaptations to better enhance student progress, and the feedback will be used to adjust class content and/or structure going forward. The internal evaluation report provides detailed findings but several key outcomes from these assessments are summarized here:

Fall Foundations Course

- Student perceptions were positive overall about structure, materials, and instruction and the students enjoyed being part of the course and liked working within groups.
- Collectively, the students appreciated workbooks and course material being available even after course completion and did not find communication between the MSU and UNAM students to be problematic.
- Some students expressed dissatisfaction with the virtual learning platform and there was some awareness of lack of content knowledge among some of the computational students as well as some discontent about differential level of coding skills at the outset across students. UNAM students noted they would prefer having more time for foundational concepts.

Spring Forum Course

- Students viewed the course as useful for their future career plans in teaching, mentoring and communication in both academic and industry positions.
- Students expressed an appreciation for the opportunity to get to know one another in weekly updates and discussions.
- Students expressed a desire for more structure and direction with specific goals.
- Students were split in their desire for virtual versus in-person class mode.

Spring Frontiers Course

- Most students viewed the course as useful for their future career plans while a few thought specific modules (e.g., image analysis) was not as useful.
- Students perceived the collaboration, problem-solving, group work and networking as positives.
- Students expressed a desire for more training in coding and data analysis.
- Students noted some technical difficulties with the virtual platform but were generally supportive of the virtual format.

Annual IDs with Leadership

Background & Methods

During June 2022, the IMPACTS leadership team (PI Shiu, Co-PI Long, PC Kumar) were invited to participate in brief, in-depth interviews. Mary Losch conducted half-hour interviews. Interviews were audio-recorded and transcribed. The notes and observations were entered electronically following the interviews to facilitate recall of the event. A semi-structured interview guide was developed by the evaluation team to gather information regarding perceptions about project progress, challenges, leadership dynamics, and team communication.

Inductive thematic analysis was used to identify major themes in the data that emerged from the content of the interviews. The evaluator involved in the interviews carefully reviewed the transcripts and notes to refamiliarize themselves with the interview responses and identified key themes that emerged. Below, is a summary of key topics and themes from this analysis, which include: (1) accomplishments and positives, (2) challenges, (3) project implementation, (4) leadership dynamics, (5) communication, and (6) plans for sustainability.

Accomplishments & Positives

There was agreement that the team collaboration, focus and energy are strong despite the continuing pandemic challenges. All three noted the important milestone of gaining approval for the IMPACTS curriculum to be codified into a certificate program which helps ensure the viability and sustainability of the curricular part of the training component into the future. The ability to resume at least some in-person events was also viewed as a positive with large numbers of trainees participating in project activities – some seeing one another in-person for the first time - but lingering issues with in-person engagement of the students in some classes was also seen as a continuing challenge (see below). Courses were viewed as going very well with publications with students and a partnership with a university in Mexico to teach python programming (in the Foundation class) with jointly participating students from the IMPACTS program – was also viewed as an important achievement.

All three leaders also noted the importance of the recursive integration of the courses (outlined in the summary above) and their increasing positive impact on layered training to advance learning in the program. The value of ongoing internal evaluation and use of the findings for formative improvements was also noted as a strength.

Challenges

All of the leaders noted the continuing challenges of the pandemic especially in engagement and facilitation of communication and learning goals. Although the year brought some ability to meet in person, the ongoing pandemic strains have not been completely resolved. Engagement remains elusive with some trainees not fully ready to attend classes in-person yet and that lack of face-to-face interaction has been limiting to fully facilitating the interdisciplinary promise of the project. There also seems to be some paradoxical dimensions of the pandemic dynamic wherein some of the students are expressing continued concerns about isolation and disengagement while many are still expressing some preference for virtual or hybrid classes or events.

Other challenges noted by one of the leaders was the continued work to have students and faculty truly engage in the interdisciplinary and transdisciplinary space – which requires additional effort and suffers from lack of structural support within the traditional departmental silos. There are still no clear answers to how best to ensure depth of training in the core discipline along with the needed breadth in the adjacent discipline(s) to support true team science that will yield more expansive achievement across

disciplines. One other challenge noted was the limited engagement of the advisory board and the desire to work toward better utilizing that group in the coming year.

Project Implementation

There were no major concerns about implementation beyond the continuing constraints of the pandemic. All leaders perceived the timeline to be on track with no serious issues.

Leadership & Communication

Engagement of leadership was deemed high and there was a notable level of respect and admiration expressed for all of the members of the leadership team. Overall, communication – both frequency and quality -- was deemed strong by all members of the leadership team.

Sustainability

The curriculum certificate approval during the past year has been a very positive milestone for sustainability. The online python course is also a component that will provide sustainable value into the future as well. Questions and challenges posed by the leaders included how much various departments would support faculty effort for the continued interdisciplinary teaching and training.

Plans for Year 5

Overall, the internal evaluation data and the findings from the IDIs and observations suggest that the IMPACTS project is progressing well. The challenges of the continuing pandemic are not easily addressed but despite those constraints, progress has been steady. The leadership has good insights into the challenges and has worked to resolve issues and overcome the challenges where possible.

The IMPACTS program is on track for the stated goals of the program, and activities are planned to continue as scheduled for Year 5. The leadership team and committees will continue to meet on a regular basis. The external evaluation team will continue to consult with leadership on a regular basis (at least quarterly) to review evaluation activities and findings, and will continue to provide feedback on specific issues if and when needed. It is hoped that the external evaluator will be able to make a site visit during August 2022 to attend and observe the annual meeting if conditions and schedules allow.

The internal evaluation report includes the following:

I. Report of Findings from Mid-semester Survey & Focus Group to Elicit Trainee Feedback on HRT 841: Foundations in Computational Plant Science, Fall Semester 2021 Date: 2021-11-2 and 2021-12-15	4
II. Report of Findings from the Survey to Elicit Trainee Feedback on PLB 843: Forum in Computational Plant Science, Spring 2022 Date: 2022-12-08	10
III. Report of Findings from the Survey to Elicit Trainee Feedback on PLB 843: Forum in STEM Teaching and Learning, Spring 2022 Date: 2022-2-21	12
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I. Report of Findings from Mid-semester Survey & Focus Group to Elicit Trainee Feedback on HRT 841: Foundations in Computational Plant Science, Fall Semester 2021 Date: 2021-11-2 and 2021-12-15

Survey and Focus Group Objectives:

- To obtain feedback about the Foundations course (PLB 843)
- To document the experiences of MSU and UNAM students. Students in this course are from different disciplines - engineering and biology. They are from different learning backgrounds coming into the class with those prior experiences. They are located in 2 countries while taking the course virtually and working on projects in the discord space.
- Here we are using the pre-class survey questions and responses (administered by Dan and Bob) to guide the following set of questions.
- A virtual focus group session will take place during exam week in December based on the responses we get for this survey which will be administered to the whole class.

Key Findings

- Students enjoyed being part of the course and liked working within groups
- Collectively the students appreciated workbooks and course material being available even after course completion

Method

A survey was designed by Kumar and Long and shared via email to the PLB843 class list on 2021-11-2. Students were asked to complete the survey and the feedback was collected, analyzed and shared as a report. Survey results guided some of the questions in the virtual Focus Group which was organized on 2021-12-15.

Questions Posed to students:

Questions (MSU students):

1. What was your overall experience with the course?
2. Communications/strategies:
 - a. Was language a barrier in your group discussions? If so, how did you manage that?
 - b. Were there any challenges other than language you encountered while working in an intercultural team
 - c. Could you give an example during your group work where your colleagues were explaining concepts and you were finding it very hard to understand them. What was the challenge and how did you respond? Describe any strategies you used to adjust/improve your communication with your colleagues
3. If there are 1-2 things you could change about this course what would that look like?

Questions (UNAM students):

1. What was your overall experience with the course? Was the structure and the bilingual Notebooks/lessons helpful?
2. Communications/strategies:
 - a. Was language a barrier in your group discussions? If so, how did you manage that?
 - b. Were there any challenges other than language you encountered while working in an intercultural team
3. If there are 1-2 things you could change about this course what would that look like?
4. Were there instances where you had to make adjustments in the way you communicate with colleagues who are unfamiliar with the topics you were discussing? What are some examples of how you overcame some challenges in your group projects?

Recurring themes (From MSU students):

Overall experience: The students liked the structure and format of the course with learning coding skills and applying the content in research projects.

The students who were novices to coding shared their challenges of difficulty in keeping up but agreed that overall, it was a good experience.

The students noted that the “real” learning happened during the research project that they worked together especially given reality of our new, hybrid world.

Collectively the students appreciated workbooks, written materials more helpful than videos.

Important to have code present while learning. Challenge that a (computational student) shared was they “did not take away much from the plant bio side (comp student) - still very confused about plant bio. Felt information at the beginning was ‘all over the place’. Having prior biology knowledge was helpful to make sense of the plant bio presented.”

Communication strategies: Overall communication was not a problem, but students share that sometimes they had to repeat or explain something more. The students did not particularly think the language was a barrier. They did not think of their UNAM colleagues as people from another country and appreciated being in class with other native Spanish speakers. They did find that the instructor translator was helpful and inclusive.

Technical/logistical issues: HPCC platform used for data analysis at MSU was difficult to get students signed up for. The Discord platform for class instruction served its purpose intended, but not ideal. E.g., disconnect among team members about mode of communication (chat vs talk). Not as inclusive since there were audio challenges with discord written text to communicate took significant time.

Challenges with groups: Difficult at beginning, esp due to difference in coding skills; In project, they did not feel able to offer much input because the skills of teammates exceeded their abilities and some of them felt underprepared to contribute.

Recurring themes (From UNAM students):

Overall experience: The UNAM students shared that they enjoyed the course and appreciated the materials in advance to practice before class. They liked the opportunity to apply the coding skills they learnt for problem-solving and coding exercises. They liked that these resources would be available online (for later reference) even after the course completion. They appreciated offloading 'theoretical' parts to homework.

The students appreciated the hybrid format and consider this a great opportunity since they do not have resources to come to MSU.

Technical/logistical issues: The students expressed that they would like more time for activities. They like the lecture as homework since the in-class time is not enough time to finish all the assigned activities. They enjoyed interacting with groups; it helped diversify their skills within teams (between bio and programmers). A critique they shared was that it would have been useful to know early on that MSU had tools to allow access to a graphical interface for writing commands.

Overall, the students shared that this is one of the best courses. They expected to learn python, but ended up learning much more.

Positive experience with groups: The students felt that more time on foundational concepts would be helpful. They also shared that working on the project was more effective as it was goal oriented. Assignments that required collaboration were the best use of groups. A balance of groups with differences in skills with prior prep would be better.

Suggestions: The students suggest allocating more time on foundational concepts. Also they suggested providing a notebook with the most common mistakes to help identify the roadblocks during coding.

Instructor reflections:

Positive themes:

Organization: The instructors recognized that flexibility was a big factor in the success of the course especially considering having both MSU and UNAM participate in group projects. They also finalized the curriculum into an online resource which is available [here](https://plantsandpython.github.io/PlantsAndPython/00_Opening_page.html) https://plantsandpython.github.io/PlantsAndPython/00_Opening_page.html.

The class project that students work in groups to demonstrate what they have learned since the beginning was considered the highlight of the course.

Engagement: The instructors recognize that the course relies on self-motivation and is stated to the students from the beginning. One of the instructors' observations mentioned that the encouraging messages were very helpful to keep the students' interest. Additionally, they mention that focusing on the class project, rather than test based assessment, fulfills a learning objective of teaching students to draw upon their own strengths and contribute to a team and to work with others across disciplines and cultures.

Challenges:

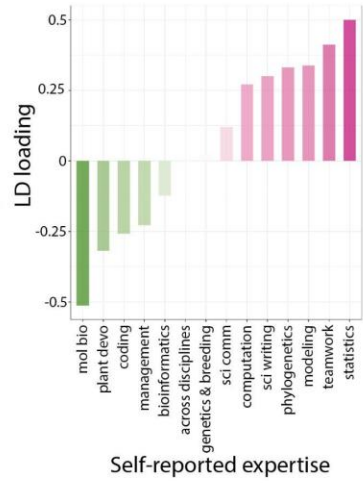
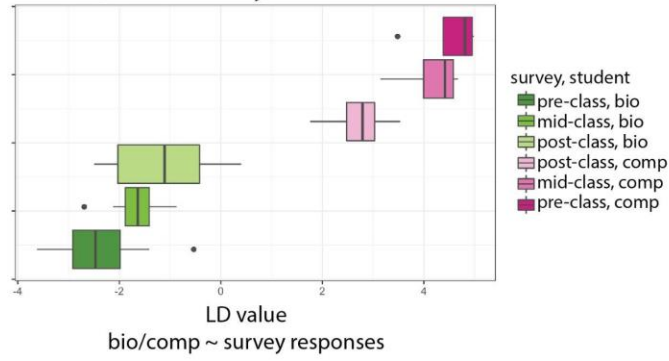
Organization: Technical difficulties of small bandwidth for some students and the firewalls on discord. The work around solution for this was by interacting more through the text channels.

Students and instructors were usually exhausted with other life and pandemic related problems in the real world.

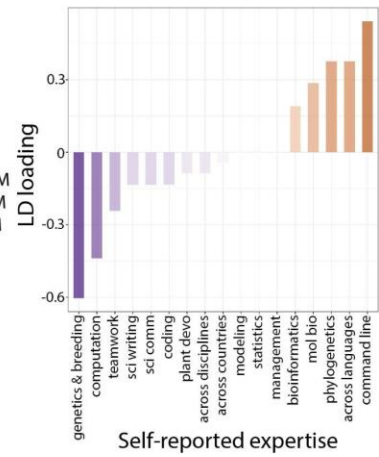
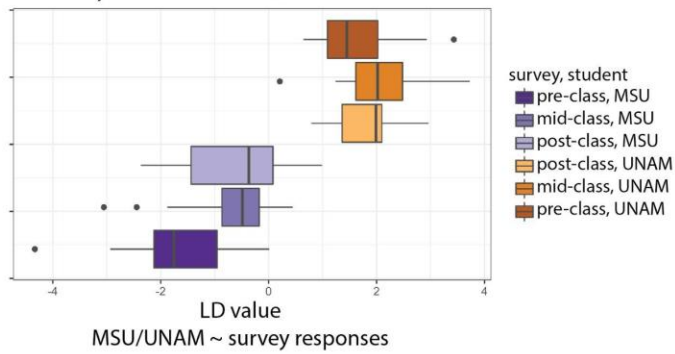
Engagement: Although there were issues with daylight savings time changes and students taking time off for personal and work related reasons, the instructors mention that they did the best they could in a bad situation and innovated along the way to produce something positive. They recognize that a traditional classroom setting and a “test” culture would have been disastrous and switching to a complete virtual classroom was a positive move and helped with flexibility.

Instructors’ survey results: The instructors analyzed the results using Linear Discriminant Analysis (LDA) for the fall 2021 class students’ survey. They categorized ‘type of student (bio/computational)’ as (1) before the class, (2) after Plants&Python, and (3) after the class project. Bio students indicate negative LD1 values and comp students as positive (Figure below). Based on the results of Linear Discriminant Analysis (LDA) the factors most responsible for separating students by discipline (2020) or by country (2021) were analyzed, as indicated in the loadings. In 2020, students from biology and computational backgrounds reported different expertise, but as the course proceeded, their self-reported expertise became more similar. In 2021, students from different countries also reported different expertise, even though they came from similar academic backgrounds. As the 2021 course proceeded, US students self-reported expertise more like Mexican students, and Mexican students reported expertise even further in the direction that distinguished them from US students.

2020, MSU only



2021, MSU + UNAM



II. Report of Findings from Survey to Elicit Trainee Feedback on PLB 843: Forum in Computational Plant Science, Spring 2022 Date: 2022-12-08

This report serves to summarize findings from an end-of-course survey administered to students enrolled in Forum, Fall 2021.

Survey Objectives: Obtain trainee feedback and perceptions about the efficacy of fall 2021 Forum. Trainee feedback is an important consideration in the design and administration of IMPACTS courses and serves to inform modifications to course content, delivery, and the structure of the IMPACTS curriculum.

Method: Survey questions were constructed in the previous iteration by J. Kumar and T. Long (IMPACTS internal evaluation team) was administered using Google Forms. Survey questions included:

In your opinion,

1. Was this course useful to you with respect to your professional goals and interests? Please explain.
2. Please comment on course strengths.
3. Please identify area(s) where you think the course could be improved.
4. How did the shift online impact your participation or performance in the course? Please describe any affordances or challenges you encountered.

Key Findings: A majority of students agreed that this course achieved one or more of their professional development (PD) goals.

Summary of Findings:

Usefulness from professional goals and interests perspective

A majority of students agreed that Interdisciplinary discussion and crafting a presentation was helpful to organize their research. They appreciated the opportunity to present to a diverse group of people and learned from watching other peoples' presentation style as well. Some of the students shared that they felt a sense of community and a safe space to practice science communication. They also felt that it was a really friendly environment to give and receive feedback about how we can improve the way that we communicate our projects. One international student shared the importance of creating such forum environments/spaces to improve our communicative abilities especially for non-native (international) speakers. The students mentioned that the roundtables organized with industry partners were great from a career perspective.

Course strengths

A majority of students agreed that a strength of the course was the format of doing both lightning talks and longer talks, since both types of talks are common for presentations. Trainees had a clear consensus that the course was useful for their PD. Trainees' PD goals were perceived as largely consistent with the overarching goals of the course. Specifically, trainees reported that the course was consistent with their goals of gaining experience in presenting to an audience of diverse disciplines, leading discussions, and communicating with peers to understand research questions and topics.

Improvements to course

Regarding the format where the whole group participated in group discussions, instead of splitting up into separate groups. The students recommended continuing that format for the next iteration of the course. They also mentioned needing more instruction at the beginning about the format of the presentation.

Instructor reflections

Positive themes: Instructors agree that student presentations went well, and they were engaged throughout the course. Overall, the class engagement and interest in presentations was very high.

Challenges: The hybrid format was a challenge. The in-person students' participation was much higher and while the online students' participation was challenging. Generally, less participation from the online attendees. Sometimes the technical aspects led to this, while other times some students' experienced a zoom burnout.

III. Report of Findings from Survey to Elicit Trainee Feedback on PLB 843: Forum in STEM Teaching and Learning, Spring 2022 Date: 2022-2-21

Survey Objectives:

- To obtain feedback about the Forum course (PLB 843)

Key Findings

- Students enjoy the subject matter, think it's useful for their careers, and they feel welcomed to voice their opinions.
- About half of the students enjoy the online format while the other half expressed, they would participate more if the course were in person

Method

A survey was designed by Kumar and Jayakody* and shared via email to the PLB843 class list on 2022-2-21. Students were asked to complete the survey and the feedback was collected and shared by Jayakody. Survey results reflect the responses from 9 students out of the total class size of 16. Terminology: Evaluator's suggestion refers to suggestions made by Jayakody and/or Kumar. Jayakody's observation refers to observations Jayakody made using information outside of what was found in the surveys.

*Thilani Jayakody is a former IMPACTS trainee. In Fall 2021, she was awarded a fellowship as part of the Future Academic Scholars in Training (FAST) Program. FAST Fellows conduct independent projects with STEM education mentors on a topic of their choosing. For her project, Jayakody collaborated in the design and implementation of the 2021-22 evaluation of the IMPACTS curriculum. She presented her work in a symposium in May of 2022 with other FAST Fellows from across the university.

Questions Posed to Trainees:

In your opinion,

1. Is this course useful to you with respect to professional goals and interests? Please explain.
2. Please comment on course strengths.
3. Please identify area(s) where you think the course could be improved.
4. How does the remote learning format impact your participation or performance in the course? Please describe any affordances or challenges you encountered.
5. Please add any other comments you wish to make about the course.

Summary of Findings

Usefulness of course toward student's professional goals and interests

A majority of responders agreed that this course was useful to them with respect to their professional goals. Commonly, they felt teaching was an essential part of their current and

future careers. Some students intend on using these skills immediately in their current teaching and mentoring roles, while others mentioned how they could use these skills for their future careers. None of the students indicated that this course was not useful to them.

Student Observation: Based on the student's future career goals, the context to which they would apply the skills they learned in this course varied. More than half of the students are currently in or plan to soon be in teaching positions and found this material directly relevant for those positions. Some students mentioned how these teaching skills could apply to roles that weren't explicitly teaching, they mentioned how they could apply these skills to better communication and mentorship. Specifically, one student mentioned how this course would "help teach [them] how to be a better mentor in the private sector and ensure that [their] team members will learn and be efficient".

Course strengths

The responders really enjoy the opportunities they've had to get to know one another through weekly updates and discussions. This has helped foster a sense of belonging among students where they feel welcome to share their point of view.

Course improvements

- While a few students shared that the adaptability of the course was a strength, more than half of them felt that the course needed more structure and direction. Several students mentioned wanting to have a clear end goal/objective.
- Evaluator's suggestion: Now that students have been prompted with the Tree Phenology class assignment and began brainstorming project ideas on jamboard, it might help to have a narrowed down list of potential outcomes and work within each group to develop specific actionable objectives for the semester.

Remote learning

Some students expressed that they preferred the remote learning format for this course. A few students expressed they did not mind the remote format but also did not express a strong preference toward it. Less than half of the students shared that they would participate more if the course was in person.

Jayakody's observation: The students who responded saying they preferred remote learning are also students we often hear participating in class. And the ones who responded saying they preferred in person are often not participating in group discussions. When we had polled students in class several weeks ago about whether they wanted to return to in-person learning, it sounded like students predominantly wanted to remain remote. Although this survey does not reflect the entire class, it's interesting to see that there is more of a division between students' preferences.

Instructor reflections:

Positive themes: Students did exceptionally well in devising projects that connected to the teaching-learning theme, and integrated well with the objectives of Frontiers. Products

produced by some of the groups are immediately relevant to teaching and undergraduate training needs in the Dept of Plant Biology.

Challenges: MSU started the semester exclusively online due to the continuing pandemic. In late January, classes were shifted back to in-person, but Forum students had become accustomed/comfortable with the online setting and did not engage in the in-person component. Because the course was large relative to previous offerings (18 vs. < 12), it was difficult to get active contributions from all students during discussions.

IV. Report of Findings from Survey to Elicit Trainee Feedback on CSS 844 Frontiers in Computational Plant Science, Spring 2022 Date: 2022-2-21

Survey Objectives:

- To obtain feedback about the Frontiers course (CSS 844)

Key Findings

- Students enjoy the real-world problem solving and collaboration this class provides
- Students expressed a need for more background in module topics and guidance in data analysis
- Students enjoy the flexibility of remote learning, but several students are having trouble with video calls on discord.

Method

A survey was designed by Kumar and Jayakody and shared via discord in the CSS844 announcements channel on 2022-2-21. Students were asked to complete the survey and the feedback was collected and shared by Jayakody. Survey results reflect the responses from 10 students out of a class size of 17. *Terminology:* Evaluator's suggestion refers to suggestions made by Jayakody and/or Kumar. Student's suggestion refers to suggestions made by students found in survey responses. Jayakody's observation refers to observations Jayakody made using information outside of what was found in the survey

Questions Posed to Trainees:

In your opinion,

1. Is this course useful to you with respect to professional goals and interests? Please explain.
2. Please comment on course strengths.
3. Please identify area(s) where you think the course could be improved.
4. How does the remote learning format impact your participation or performance in the course? Please describe any affordances or challenges you encountered.
5. Please add any other comments you wish to make about the course.

Summary of Findings

Recurring themes:

Usefulness of course toward student's professional goals and interests

More than half of the students agreed that this course was useful to them with respect to their professional goals. Commonly, they enjoyed the focus on real world data, problem solving, and collaborative work. Less than half of the students felt that the course was only somewhat aligned with their professional goals. Commonly, these students did not feel that the specific

module topics, like image analysis, was relevant to their intended career goals. None of the responders felt that the course was not useful to their professional goals.

Course strengths

Students really enjoy the collaboration, problem solving, and networking the class provides. Most students commented on enjoying getting to work in groups.

Course improvements

More than half of the students expressed the need for more foundation and guidance in coding and data analysis.

Student's suggestions: One student suggested it would be helpful to have a co-instructor or TA that is dedicated to helping students with issues in code implementation. Two other students suggested providing detailed example code for each module.

Less than half of the students felt the modules were challenging to complete in the time allotted and they found it difficult to balance the amount of work needed outside of class.

Remote learning

Less than half of the students explicitly enjoy the remote learning format. A few students enjoyed the flexibility of remote learning but also found other aspects more challenging when remote. A few of the students did not have a strong preference, in part because they have not experienced this course in person. Very few students do not prefer remote learning. Students who commented on enjoying aspects of remote learning mentioned liking the flexibility, particularly the ease of attending class regardless of their location or other commitments. Of the students that mentioned it was more challenging they listed causes relating to, being harder to pay attention or engage online, more challenging to ask clarifying questions and discussions aren't as natural/smooth online.

Additional comments One student requested assigning presenters prior to class to give time for students to prepare.

Instructor reflections

Strengths: The instructor mentioned that starting the course with pre-generated examples that had some code already written was a good introduction. As to the coding learning outcome, regardless of coding familiarity, students were comfortable when adapting a tutorial workflow to their problem vs having to come up with their own workflows.

Challenges: The instructor mentioned that one of the challenges for the module was using datasets that were more cutting edge than what students were perhaps used to, which led to issues in pre-processing. Also since the data was not made available to students at the beginning of the module, it was challenging for students to conceptualize data workflows with only example datasets

Another observation from the instructor was that focusing on phenomics led the students to struggle to understand that the techniques and skills they were learning could be abstracted/applied to a multitude of other problems and tasks outside those specific use cases.

The instructor suggested providing more structure, guidance and background information in the next iteration of the course to demonstrate the skill sets learned in this course apply to other areas of domain science.

Additionally, the group projects are very valuable for learning, but there were struggles this year with format with online vs hybrid, though this year was particularly challenging in this regard.

Evaluation of Spring 2022 courses

Thilani Jayakody

Plant Breeding, Genetics and Biotechnology

Mentors: Dr. Tammy Long, Plant Biology &

Dr. Jyothi Kumar, Plant Biology

2022-5-4



What is IMPACTS

Integrated training Model in Plant And Compu-Tational Sciences is an NSF-funded program for training doctoral students to employ advanced computational/data science approaches to address grand challenges in plant biology.

IMPACTS: Integrated training Model in Plant And Compu-Tational Sciences



Spring 2022 NSF-NRT-IMPACTS program activities

1. Core Course: Frontiers in Plant Science (3 credits)

- Apply foundation
- Teamwork
- Remote - Discord

2. Weekly Forum: STEM Teaching & Learning (1 credit)

- Foundation in lesson planning
- Develop educational material
- Remote – Zoom

Overlapping module between Frontiers and Forum

- Create original educational material using large datasets



- **Research Question 1:** Does the Spring 2022 NSF-NRT-IMPACTS program activities meet course objectives?
- **Research Question 2:** How can the Spring 2022 NSF-NRT-IMPACTS program activities be improved to meet course objectives?

Formative and Summative Evaluation Methods

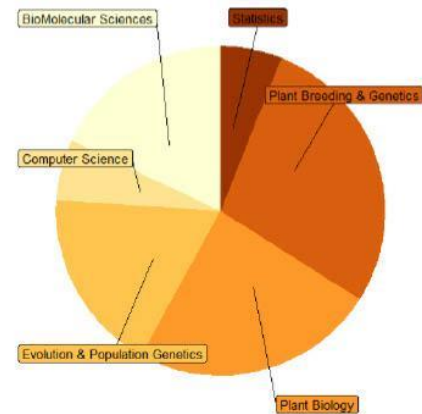
Participants: PhD students in the NSF-NRT-IMPACTS program participating in the spring Forum and Frontiers courses

- Graduate programs range from: CS, STT, PLB, PBGB, BMS
- Mostly 1-3 year students

Procedure:

1. Develop and distribute mid semester survey to assess strengths and improvements of spring 2022 NSF-NRT-IMPACTS program activities (summative /formative)
 - 2022-2-21: Surveys distributed
 - 2022-3-4: Summarize as Evaluation Report
2. Evaluate outcomes and improvements in focus group (formative)
 - 2022-4-26: Focus Group conducted

Student Degree Programs



Mid-Sem Survey Objectives

- Usefulness
- Course Strengths
- Course Weaknesses
- Remote learning

Mid-Sem Survey Reoccurring Themes

- Most students found both courses useful
- Most students enjoy groupwork and discussions
- Students want more structure and guidance
- Students are challenged by remote learning

Core Course: Frontiers in Plant Science

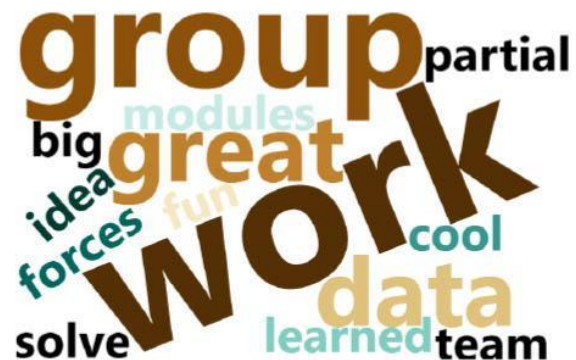
Mid-Semester Survey Results

Build interdisciplinary expertise

- Commonly, they enjoyed the focus on real world data, problem solving, and collaborative work.

Interact as a cohort, learn from each other

- Most students commented on enjoying getting to work in groups.



Method

A survey was designed by Kumar and Jayakody and shared via discord in the CSS844 announcements channel on 2022-2-21. Students were asked to complete the survey and the feedback was collected and shared by Jayakody. Survey results reflect the responses from 10 students out of a class size of 17.

Core Course: Frontiers in Plant Science

Mid-Semester Survey Results

Course Weaknesses

- 60% of responders expressed the need for more foundation and guidance in programming
- 40% of responders felt the modules were challenging to complete
- several students are also struggling with poor video and voice quality from streaming through discord.

Method

A survey was designed by Kumar and Jayakody and shared via discord in the CSS844 announcements channel on 2022-2-21. Students were asked to complete the survey and the feedback was collected and shared by Jayakody. Survey results reflect the responses from 10 students out of a class size of 17.

Weekly Forum: STEM Teaching & Learning

Mid-Semester Survey Results

Professional Development

Interact as a cohort, learn from each other

- The responders really enjoy the opportunities they've had to get to know one another through weekly updates and discussions.

A word cloud of survey results for the Weekly Forum. The words are arranged in a circular pattern, with 'discussions' and 'time' being the most prominent. Other words include 'good', 'focus', 'group', 'virtual', 'share', 'fluid', 'covered', 'approach', 'adaptability', 'talk', 'create', 'belonging', 'control', 'driven', and 'discuss'.

Method

A survey was designed by Kumar and Jayakody and shared via email to the PLB843 class list on 2022-2-21. Students were asked to complete the survey and the feedback was collected and shared by Jayakody. Survey results reflect the responses from 9 students out of the total class size of 16.

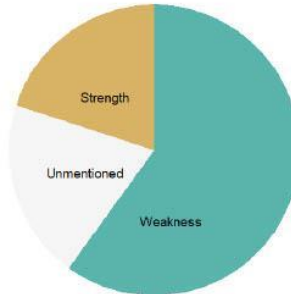
Weekly Forum: STEM Teaching & Learning

Mid-Semester Survey Results

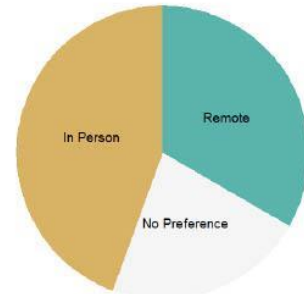
Course Weaknesses

- The majority thought the course needed more structure and direction. Several students mentioned wanting to have a clear end goal/objective.
- Most responders expressed they would participate more if the course was in person

Adaptable Schedule



Remote Learning Preferences



Method

A survey was designed by Kumar and Jayakody and shared via email to the PLB843 class list on 2022-2-21. Students were asked to complete the survey and the feedback was collected and shared by Jayakody. Survey results reflect the responses from 9 students out of the total class size of 16.

Focus Group Objectives

- Discussion on course weaknesses
- Impression of overlapping module

Core Course: Frontiers in Plant Science

Focus Group

Further assessment of course weaknesses

- Work among team members was unbalanced
- Interacting as a cohort, but not learning from each other
- Virtual setting makes working collaboratively on programming challenging
- High expectations/not enough time to complete projects, particularly for novice programmers
- A hybrid class was planned, it was noted by an instructor that there was good in person participation.

Method

Focus group script and questions were designed by Kumar and Jayakody. Students participating in both Forum and Frontiers this semester were invited to join the focus group which was held on April 26 at 9-10:20am on Zoom. Focus group reflect the responses from 11 students out of a total size of 12. Jayakody led the focus group and Kumar was the co-moderator

Weekly Forum: STEM Teaching & Learning

Focus Group

- Focus group respondents commonly mentioned that **the early class time or other commitments prevented them from attending in person.**
- Students did not recognize any other changes in the course being implemented

Method

Focus group script and questions were designed by Kumar and Jayakody. Students participating in both Forum and Frontiers this semester were invited to join the focus group which was held on April 26 at 9-10:20am on Zoom. Focus group reflect the responses from 11 students out of a total size of 12. Jayakody led the focus group and Kumar was the co-moderator

Overlapping Module

Focus Group

- Students in Forum were prepared with the necessary background to guide the projects
- Overlap between two classes provided more total time to work through projects
- Knowing the end goal motivates students to complete the project

Method

Focus group script and questions were designed by Kumar and Jayakody. Students participating in both Forum and Frontiers this semester were invited to join the focus group which was held on April 26 at 9-10:20am on Zoom. Focus group reflect the responses from 11 students out of a total size of 12.

Final Thoughts & Future Directions

Summative/Formative Evaluations

- IMPACTS program excels at collaboration/teamwork
- Students want more background and structure or time in their classes
- Implementing an overlapping module gave students more time and needed background information

Evaluation results will be summarized in an annual report and used to improve subsequent course offerings

Acknowledgements

Mentors and Instructors

Dr. Tammy Long
Dr. Jyothi Kumar
Dr. Addie Thompson

IMPACTS Forum Students IMPACTS Frontiers Students

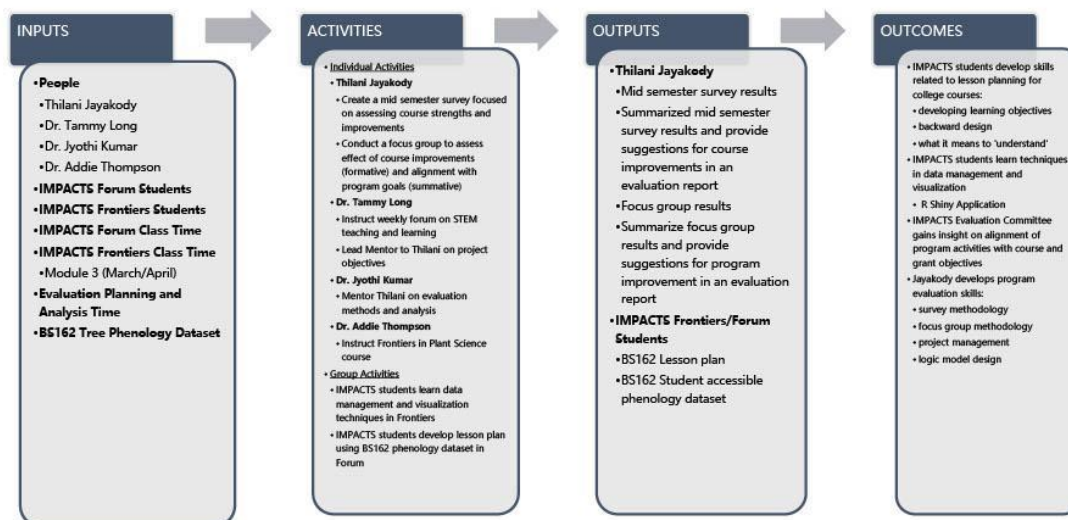
FAST Steering Committee

Vicky Phun
Dr. Henry (Rique) Campa III
Dr. Kirstin Parkin
Dr. Stefanie Baier
Dr. Michael Everett
Dr. Diane Ebert-May

2021- 2022 FAST Fellows



Spring 2022 NSF-NRT-IMPACTS Evaluation Logic Model



VI. Table for Evaluation Activities and Instruments

Date	Semester	Context	Item	Description	Artifacts	Questions asked within the instrument
9/17/21		Forum	Reflection: Lightning Talk v1	Trainee perceptions about their first experience delivering a lightning talk. What did they do well? what needs to improve?	Google Form with Reflective Feedback	<p>Question 1: What were some of the best or most effective qualities of the lightning talks you saw today?</p> <p>Question 2: What do you wish to focus on as an area of improvement for next time?</p> <p>Question 3: What did YOU do particularly well in your talk?</p>
10/21/21		Forum	Mid semester Survey about the course	Trainee responses to help inform the approach to the course the specific semester, as well as in subsequent offerings.	Google Form with survey questions for course Feedback	<p>Question 1: Please comment on what has been working well so far in the course.</p> <p>Question 2: Please identify area(s) where you think the course could be improved.</p> <p>Question 3: What did you like best about the 2 roundtables organized so far with Bayer Crop Science and MSU tech transfer?</p> <p>Question 4: Please provide comments or suggestions on how the roundtables could be organized in the near future (we have one with Corteva in Dec, we might be able to schedule another one in Nov if schedule permits).</p> <p>Question 5: How is the HyFlex (or hybrid) course format impacting your participation or performance in the course? Please describe any affordances or challenges you have encountered so far.</p> <p>Question 6: Please add any other comments you wish to make about the course.</p>

2021-11-2	Fall 2021	Foundations	Mid semester Survey about the course	Interdisciplinary: from engineering/biological disciplines Intercultural: dependent on university/location, prior learning experiences and communication style	Google Form with survey questions for course Feedback	<p>Section 1: General Information</p> <p>Question 1: Please share the name of your program and your university</p> <p>Question 2: What did you expect to learn from this course? In what way did you expect the course to help with your research?</p> <p>Question 3: How would you rate your current understanding, knowledge in these topics</p> <p>(likert: Beginner, Advanced beginner,, Competent, Proficient, Expert)</p> <ul style="list-style-type: none"> -Bioinformatics -Molecular biology -Genetics and Plant Breeding -Phylogenetics -Using computational tools and resources -Coding in python <p>Question 4: How are the skills you are learning in this course helping you with your research/learning goals, if at all? (feel free to share examples of projects)</p> <p>Question 5: How does this course compare with in terms of difficulty other domain-specific courses (for example - biology or coding) that you've taken at your university?</p> <p>Section 2: Interdisciplinary & Intercultural experiences interactions</p>
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	Fall 2021				<p>Question 1: What do you like best about working in an interdisciplinary team?</p> <p>Question 2: Please share any challenges you encounter while working in an interdisciplinary team</p> <p>Question 3: What do you like best about working in an intercultural team?</p> <p>Question 4: Please share any challenges you encounter while working in an intercultural team</p> <p>Question 5: Based on your class experience working with interdisciplinary & intercultural teams, please choose that best applies to you for each of these statements</p> <p>(likert scale: Never Rarely Sometimes Usually Very often/always)</p> <p>-I am able to explain concepts to students from other disciplines</p> <p>-I feel competent enough to understand concepts outside of my primary discipline that are part of this class</p> <p>-I am able to adapt my communication style to effectively communicate with people from other disciplines</p> <p>-If I don't understand what my colleague is saying I make an attempt to ask questions</p> <p>-I get lost in jargon while my colleagues are communicating their ideas with me</p> <p>-I have to adjust my communication to explain concepts to students from other disciplines</p> <p>-I sometimes refrain from asking questions from my team members for clarifying concepts</p> <p>-I tend to communicate my ideas multiple times and multiple</p>
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					<p>ways to ensure my colleagues understand me better</p> <p>Section 3: Self efficacy formative questionnaire</p> <p>Questions from the Self-efficacy assessment suite: Technical report. College & Career Competency Framework (Gaumer Erickson & Noonan, 2021)</p> <p>Question 1: Please choose the option that you feel is most relevant/applicable to you</p> <p>(1 - Not very like me 2 - Somewhat like me 3 - Neutral 4 - More like me 5 - Very Like me</p> <p>-If I worked at it, I could learn just about any skill.</p> <p>-I feel discouraged when I'm told I did something incorrectly</p> <p>-Once I've decided to accomplish something, I keep trying, even if it is harder than I thought.</p> <p>-I believe that the brain can be developed like a muscle</p> <p>-I can always get better, even if I am really good at something</p> <p>-I think people should realize when they aren't good at something and quit</p> <p>-I'm willing to work on something challenging, even if I know it will take a lot of effort and I may not succeed at first</p> <p>-I see making mistakes as a normal part of learning</p> <p>-When I receive feedback that I didn't do well on something, I try even harder to learn it</p> <p>-I want to quit when I'm told I did something incorrectly</p> <p>-When I'm struggling to accomplish something difficult, I focus</p>
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	Fall 2021					<p>on my progress</p> <p>-When a task sounds very hard, I tell myself that I can do hard things</p> <p>-I have negative thoughts about myself when I make mistakes</p> <p>-It helps me to learn from other people's stories of success</p> <p>-When facing a new challenge, I think about goals that I've accomplished successfully</p> <p>-Sometimes I give up when I'm afraid I can't do something. (Steps, N)</p> <p>-When I am having trouble learning a new skill, I get advice from people I know</p> <p>-When facing a new challenge, I think about what I did to succeed in other difficult situations</p> <p>-When I hear about how others overcame difficulties, I feel like I can succeed too</p> <p>-I can calm myself down when I'm anxious about something</p> <p>-When I'm told I did something incorrectly, I try even harder to get it right</p> <p>-I use feedback to get better</p> <p>-When given a choice, I usually take the easiest option</p> <p>-I like to challenge myself to learn new things</p> <p>Question 2: Are there any comments you wish to share that were not addressed earlier in this survey?</p>
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12/08/2021		Foundations and Forum	Reflections from Instructors	Instructors share their reflections on teaching the courses	Google Form with Reflective Feedback	Please identify area(s) where you think the course could be improved.
2/21/2022	Spring 2022	Frontiers	Mid-semester Survey	Survey instead of focus group because of Covid-19 quarantine; feedback about the course including shifting to online classes	Google Form with Reflective Feedback	<p>Question 1: In what way did you find this course most valuable with respect to your building your skills (interdisciplinary communications, using computational tools, etc)</p> <p>Question 2: Please identify area(s) where you think the course (or modules) could be improved.</p> <p>Question 3: How did the shift online impact your participation or performance in the course? Please describe any affordances or challenges you encountered.</p> <p>Question 4: Please add any other comments you wish to make about the course</p>
2/21/2022		Forum	Mid-semester Survey	Survey instead of focus group because of Covid-19 quarantine; feedback about the course including shifting to online classes	Google Form with Reflective Feedback	<p>Question 1: Was this course useful to you with respect to professional goals and interests? Please explain.</p> <p>Question 2: Please comment on course strengths.</p> <p>Question 3: Please identify area(s) where you think the course could be improved.</p> <p>Question 4: How did the shift online impact your participation or performance in the course? Please describe any affordances or challenges you encountered.</p> <p>Question 5: Please add any other comments you wish to make about the course.</p>
4/26/2022		Frontiers+forum	Focus group	Focus group for a subset of students who enrolled in both courses	Focus group video + presentation	

5/2/2022		Frontiers and Forum	Reflections from Instructor	Instructors share their reflections on teaching the courses	Google Form with Reflective Feedback	<p>Question 1: Which course are you providing reflections for?</p> <p>Question 2: Please comment on what went well in your course. What strategies, activities, etc., were particularly successful or improved course outcomes?</p> <p>Question 3: Please comment on any challenges you experienced. Describe strategies or activities that did not go well or barriers you encountered that impacted course outcomes?</p> <p>Question 4: What advice would you give a first-time instructor of this course?</p> <p>Question 5: Please feel free to share any additional thoughts or reflections about the course. We are particularly interested in your thoughts about the course with respect to its role within the program and our process for evaluating outcomes.</p>
4/13/2022		Symposium	About symposium planning, organizing experience			<p>Question 1: Please describe your role(s) with respect to organizing the symposium. What was your contribution in terms of activities, planning, etc.?</p> <p>Question 2: What aspects of your participation did you find most valuable with respect to your personal career/training goals? Please explain.</p> <p>Question 3: What aspects of your participation did you find most unproductive with respect to your personal career/training goals? Please explain.</p> <p>Question 4: In your opinion, do you think your experience has increased your ability to plan and implement other professional activities in the future?</p> <p>Question 5: Was there any part of the Symposium that you would have liked to participate in but, did not? Or, do you have ideas for different activities that could be offered in association with the Symposium in the future as part of your training?</p>

Spring 2022

						Question 6: Please provide any feedback you wish to share with the NRT management. We welcome your comments on any aspect of your training thus far.
5/5/2022		Internship				<p>Question 1: Based on the goals that you outlined previously in your internship application, was the internship what you expected? Did it provide you with any outcomes that you had not anticipated?</p> <p>Question 2: What were the activities of your internship and how did the activities help you fulfill your learning goals?</p> <p>Question 3: How has your internship experience influenced your professional direction and career goals?</p> <p>Question 4: What knowledge and skills did you gain and how do you plan on applying them in the future? Identify knowledge and skills you now possess that can be applied to future positions</p> <p>Question 5: Were you able to build positive professional relationships and take advantage of networking opportunities?</p> <p>Question 6: What recommendations would you give to improve the internship experience with regard to: (1) internship site and supervisor; (2) MSU support?</p> <p>Question 7: List all the products from your internship (Check all that apply)</p> <ul style="list-style-type: none"> -Publication -blog post or social media post -education material -Data available on GitHub

	Spring 2022					-Other...
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