Year 1 Annual External Evaluation Summary Report for NRT-HDR: Intersecting computational and data science to address grand challenges in plant biology

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Year 1 Summary

Following the departure of their external evaluator, researchers at Michigan State University (MSU) reached out to the University of Northern Iowa Center for Social and Behavioral Research (CSBR) for consultation on evaluation activities for their NRT-HDR grant. The grant period had begun in 2018 and the first year of grant activities were underway when CSBR joined the effort. The leadership team provided the CSBR team with all existing documentation, including the full proposal and responses to questions from NSF, their existing logic model, lists of subcommittee members and meeting dates, and a summary of the findings from a student trainee focus group held March 22, 2019. CSBR Director Mary Losch and Assistant Director Megan Ruxton traveled to MSU on April 23-24, 2019 to meet with the leadership team and the executive committee, review the activities completed already, update the logic model and discuss plans for evaluation activities to be completed in subsequent years.

During this visit, the executive committee met and discussed the curriculum and feedback from students received during the focus group. Students perceived a bias in the training towards enabling plant scientists to further their work using computation, whereas those focusing on computational disciplines do not receive adequate training in plant biology. The committee discussed adjustments to the curriculum and the possibility of adding a bootcamp prior to the fall semester for those with a lack of exposure to the foundations of plant biology and/or computation. The executive committee also addressed concerns about variation in the quality of co-mentor advising students had received during the year. Committee members recognized that faculty serving as co-mentors would likely need additional training and oversight to better understand how to best serve students in the program, and committed to following up with these affiliated trainers.

Following the executive committee meeting, the CSBR team met with the leadership team. In discussing challenges from the first year of grant activities, the internal evaluator (Tammy Long) highlighted issues related to a variety of project activities. She noted that the number of required forums may be excessive in terms of implementation and impact. Adjustments to the forums were discussed, and a decision was made to reduce the number of required forum meetings going forward. Additionally, the content will be streamlined to more efficiently address the main goals of training students in communication, teaching, leadership, management and mentoring. Importantly, the team was able to identify specific activities and planned professional development workshops that would enable students to receive training in multiple goal areas simultaneously (i.e. teaching as a method of communication in which one must understand how to explain complex concepts to a lay audience). Several evaluation activities have already taken place, and additional evaluation activities will continue through the end of the semester.

The afternoon was spent updating and adding detail to the program's logic model (see Table 1). The leadership team identified existing resources and inputs, including an existing infrastructure of content and collaboration among plant sciences and computational modeling. They detailed the planned activities of the program, including curriculum, professional development, outreach, and other

activities which were then linked directly to their outputs. These were in turn linked to short-term and long-term goals, as articulated in the grant proposal. The updates included the adjustments they had decided on based on student feedback and experience through the first year of the grant.

Following the external evaluators' visit, the logic model was drafted by the external evaluators and sent to the leadership team for review and use as the first grant year comes to a close. In addition, an evaluation framework (see Table 2) linking activities to specific measurement activities and short- and long-term outcomes was created to guide the leadership team in planning their evaluation activities for the subsequent years of the program. The leadership team will continue to consult with the CSBR team for guidance on evaluation activities, measurements and instruments. The external evaluator will continue to provide annual summaries of evaluation activities. Beginning in Year 2, an inventory of evaluation activities will be maintained.

Table 1. IMPACT NRT – Michigan State Logic Model DRAFT 5/2/19

Inputs	Activities	Outputs	Outcomes: Short-Term	Outcomes: Long-Term
Trainers/Faculty – engaged, productive, with research expertise → including a science educator CMSE Large, successful, productive plant sciences including collaborations across departments and faculty Central administration support – includes student scholarships, funding for symposium Multiple existing outreach activities, opportunities Existing professional development activities offered by graduate school Internship opportunities at federal level Existing networks/relationships with industry Strong student pool across disciplines Historically strong relationships among Exec Committee and trainers Efforts focused on the HDR "big ideas" from NSF CSBR evaluation	Recruiting Bootcamp (?) Development and implementation of foundational courses • Foundation in Computational and Plant Science • Frontiers in Computational and Plant Science • (Plant Science only, implementation only) Introduction to Computational Modeling Forums – 1 credit, 2 required IMPACTS mentor training • Peer mentoring, undergrads, REU mentoring (What else?) • Develop individual development plan (IDP)- trainees Professional development workshops Interdisciplinary research experience with co-mentors Develop outreach • Raspberry Pi Jam Link trainees to existing outreach • 4-H Garden • Girls Math and Science • Coding Camp • Darwin Days • MSU Science Day Trainee subcommittee participation (1 year) or Symposium organization committee participation Social events Internship – link and expand Social media and blog presence Process and summative evaluation activities	Successful recruitment of trainees Boot camp attendance and reflections (?) Course performance and instructor reflections Forum attendance and reflections IDPs Occurrence of PD workshops, reflections of attendees, PD products Presentations, manuscripts, posters, dissertations, proposals Outreach attendance and reflections • Video Subcommittee attendance and reflections Social event occurrence and attendance Internship report (?), reflection Portfolios Social media and blog posts Evaluation reports	Increased recruitment and retention of good, engaged trainers Expanded trainer participation • Including areas of need: ecology, computational engineering IMPACT students can communicate and teach computational and plant science topics to diverse audiences • Able to communicate across disciplinary fields Strong project management, mentorship and leadership skills held by IMPACT students IMPACT students possess the knowledge and ability to do interdisciplinary research and collaborate • Ability to generate important interdisciplinary research questions • Ability to conduct interdisciplinary research to answer the questions they have generated • Ability to collaborate effectively across multiple disciplines Increased recruitment of URM Transferable skill set	IMPACT students possess the ability to advance solutions to grand challenges by incorporating plant biology and computational methods Increased diversity in the disciplines IMPACT students serve as leaders in collaborative science IMPACT students are employable across multiple STEM contexts

Evaluation

Internal/External evaluation activities - formative, implementation, and progress evaluations in recursive design to inform and to guide project throughout planning and implementation phases

External/Contextual Factors

University and departmental structure and expressed interest
History of transdisciplinary work
Proportion of underrepresented student populations in the state and region

Assumptions

Secure funding throughout the project
Buy-in from transdisciplinary faculty
Institutional adoption of curricular changes

Table 2. IMPACTS NRT-HDR Draft Table of Metrics and Measures (5/22/2019)

Activity	Output	Specific Measures Instruments/Process	Short-term Outcomes Supported	Long-term Outcomes Supported
Objective: Establish and sustain IMPACT doctoral program				
Student recruiting	Number and type of students participating in the program	Assessment of demographic profile of recruited students	Increased recruitment of URM	Increased diversity in the disciplines
Trainer recruiting	Trainers committed to working with the program	• Number of trainers • Disciplinary home of trainers • Area of expertise • Level of engagement – teaching, mentoring, activity participation (number and type)	• Increased recruitment and retention of good, engaged trainers • Expanded trainer participation, including areas of need: ecology, computational engineering	
Training Goal 1: Proficiency in core knowledge in plant and computational sciences				
Development, implementation of foundational courses	• Foundations in Computational and Plant Science • Frontiers in Computational and Plant Science • Introduction to Computational Modeling (PS only; implementation only)	• Student course performance – assignments, exams, course grades • Instructor reflections (questionnaire – what went well, what would you change, satisfaction with content and format)	IMPACT students possess **knowledge** and ability to do interdisciplinary research and collaborate • Ability to generate important interdisciplinary questions • Ability to conduct interdisciplinary research to answer the questions they have generated • Ability to collaborate effectively across multiple disciplines	IMPACT students possess the ability to advance solutions to grand challenges by incorporating plant biology and computational methods
Bootcamp (?)	Bootcamp occurrence	Reflections • Leadership team (questionnaire – what went well, what would you change, etc)	Same	Same

		• Trainees (questionnaire and/or quick capture – satisfaction with content and format) Bootcamp products – assignments, models, code, etc. Pre/post-test of knowledge, understanding (?)		
Training Goal 2: Expertise in interdisciplinary research in plant biology and computation				
Interdisciplinary research experience with co-mentors	• Presentations • Manuscripts • Posters • Dissertations • Proposals	Assessment of interdisciplinary content and collaboration • Title, location, date • Abstract, journal, status (accepted, R&R, rejected) • Title, location, date • Abstracts, chapter titles • Title, summary, recipient, date, status Year-end trainee focus group • Assessment of co-mentor experience (satisfaction, what worked, what can be improved) • Assessment of collaborative experiences (satisfaction, what worked, what can be improved)	IMPACT students possess knowledge and **ability** to do interdisciplinary research and collaborate • Ability to generate important interdisciplinary questions • Ability to **conduct interdisciplinary research** to answer the questions they have generated • Ability to **collaborate effectively across multiple disciplines**	IMPACT students possess the ability to advance solutions to grand challenges by incorporating plant biology and computational methods
Internship – link and expand	Student internship experience provides ability to conduct interdisciplinary research and collaborate across multiple disciplines	Internship report/reflection • Research questions pursued/answered, content areas included, number of collaborators and their areas of expertise	Same	Same

		• Assessment of experience: • Satisfaction, what was gained from experience • What went well, what could be improved • Would they recommend experience to another NRT student • Portfolio (?) – assess products of internship through research questions/methods, supervisors/collaborators involved: disciplinary areas/areas of focus and/or expertise		
Training Goal 3: Development of communication, leadership and management skills*				
Forums (*communication, leadership, management*)	Forums foster opportunities for IMPACT students to engage in activities and discussions to enhance their ability to *communicate* computational and plant science topics to diverse audiences, and enhance their *leadership* and project *management* skills to assist in their ability to engage in interdisciplinary research and collaborations	Reflections • Leadership team (questionnaire – what went well, what would you change, satisfaction with content, specific in-forum activity format) • Trainees (questionnaire and/or quick capture – satisfaction with content and format) Year-end trainee focus group • Assessment of activities: • Satisfaction with content and format • What and to what degree did they learn new **skills** related to communication,	IMPACT students can **communicate** and teach computational and plant science topics to diverse audiences Strong **project management, mentorship and leadership** skills held by IMPACT students IMPACT students possess knowledge and ability to **do interdisciplinary research and collaborate** • Ability to generate important interdisciplinary questions • Ability to conduct interdisciplinary research to answer the questions they have generated	• IMPACT students serve as leaders in collaborative science • IMPACT students are employable across multiple STEM contexts

		leadership, project management • Areas of improvement (content or format)	• Ability to collaborate effectively across multiple disciplines	
Professional development workshops (*communication, leadership, management*)	Professional development workshops foster opportunities for IMPACT students to engage in activities and discussions to enhance their ability to *communicate* computational and plant science topics to diverse audiences, and enhance their *leadership* and project *management* skills to assist in their ability to engage in interdisciplinary research and collaborations	Reflections – trainees • Questionnaire and/or quick capture – satisfaction with content and format) Products • CVs/Resumes • Biosketches • Time management plans • Etc. Year-end trainee focus group • Assessment of activities: • Satisfaction with content and format • What and to what degree did they learn new **skills** related to communication, leadership, project management • Areas of improvement (content or format)	Same	Same
Develop/link trainees to outreach (*communication, leadership*)	Develop new outreach activities and link trainees to existing outreach opportunities to support and reinforce their leadership and communication when communicating computational and plant sciences to diverse audiences and in diverse formats • Raspberry Pi Jam • 4H Garden • Girls Math and Science	Video of outreach participation • Rubric/guidelines for individual assessments by leadership team • Assess for clarity, quality of interactions, active participation, etc. Reflections – trainees • Questionnaire and/or quick capture – satisfaction with content and format, self-assessment of their level/quality of participation as well as communication and	Same	Same

	• Coding Camp • Darwin Days • MSU Science Day	leadership skills as applied to outreach activities) Year-end trainee focus group • Assessment of activities: • Satisfaction with content and format • Areas of improvement (content or format)		
• **Trainee subcommittee participation OR** • **Symposium organization committee participation (*communication, leadership, management*)**	Participation in the subcommittee or symposium organization committee will foster opportunities for IMPACT students to apply and enhance their ability to *communicate* in collaboration with others across disciplinary fields, and enhance their *leadership* and project *management* skills to support their sub/committee work	Trainee reflections • Questionnaire at completion of committee work – satisfaction with experience, what went well, what could be improved, self-assessment of their level/quality of participation as well as communication and leadership skills as applied to committee work) Year-end trainee focus group • Assessment of activities: • Satisfaction with content and format • Areas of improvement (content or format)	Same	Same
Social events (*communication*)	Trainees participate in social events to enhance their ability to communicate across disciplines	Trainee reflections • Questionnaire/quick capture – perceptions of value, satisfaction with events	Transferrable **skill** set – interdisciplinary communication	• IMPACT students serve as leaders in collaborative science
Internship – link and expand (*communication, leadership, management*)	Student internship experience enhances trainees' communication, leadership and project management skills to support their ability to	Internship report/reflection • Trainee assessment of value for enhancing skills in communication, leadership, project management; self-assessment of skills as	IMPACT students can **communicate** and teach computational and plant science topics to diverse audiences	• IMPACT students serve as leaders in collaborative science IMPACT students are employable across multiple STEM contexts

	conduct interdisciplinary research and collaborations	applied to internship experience Internship supervisor report • assessment of trainees' performance, ability to communicate, ability to take on leadership roles, project management skills Portfolio (?) – assess products of internship for ability to communicate (oral/written)	Strong **project management, mentorship and leadership** skills held by IMPACT students IMPACT students possess knowledge and ability to **do interdisciplinary research and collaborate** • Ability to generate important interdisciplinary questions • Ability to conduct interdisciplinary research to answer the questions they have generated • Ability to collaborate effectively across multiple disciplines	
Social media/blog presence *(communication*)	Develop social media/blog posts to communicate computational and plant sciences to divers audiences	Social media/blog posts • Assess for clarity, tone, whether appropriate for audience	Same	Same
Training Goal 4: Development of trainees' teaching and mentoring skills*				
IMPACTS mentor training Peer mentoring, undergrads, REU mentoring (what else?) (*mentoring*)	Trainees receive mentorship training to serve as leaders and mentors to peers, undergrads and others in service to mentoring the next waves of computational and plant scientists to continue advances in interdisciplinary research	• IDPs - Rubric/guidelines for individual assessments by leadership team • Assess for clarity, quality of Mentor/mentee satisfaction questionnaire Year-end trainee focus group • Assessment of activities: • Satisfaction with content and format • Areas of improvement (content or format)	IMPACT students can **communicate** and teach computational and plant science topics to diverse audiences Strong **project management, mentorship and leadership** skills held by IMPACT students Transferrable skill set	• IMPACT students serve as leaders in collaborative science • IMPACT students are employable across multiple STEM contexts

Forums (*teaching, mentoring*)	Forums foster opportunities for IMPACT students to engage in activities and discussions to enhance their ability to *teach* computational and plant science topics to diverse audiences, and enhance their *mentoring* skills to assist in their ability to enhance and engage in interdisciplinary research and collaborations	Reflections • Trainees (questionnaire and/or quick capture – satisfaction with content and format; perceived value to building teaching and mentoring skill set) Year-end trainee focus group • Assessment of activities: • What and to what degree did they learn new **skills** related to teaching and mentoring • Areas of improvement (content or format)	Same	• Same
Professional development workshops (*teaching, mentoring*)	Professional development workshops foster opportunities for IMPACT students to engage in activities and discussions to enhance their ability to *teach* computational and plant science topics to diverse audiences, and enhance their *mentoring* skills to assist in their ability to engage in interdisciplinary research and collaborations	Reflections – trainees • Trainees (questionnaire and/or quick capture – satisfaction with content and format; perceived value to building teaching and mentoring skill set) Year-end trainee focus group • Assessment of activities: • What and to what degree did they learn new **skills** related to communication, leadership, project management • Areas of improvement (content or format)	Same	Same
Develop/link trainees to outreach (*teaching, mentoring*)	Develop new outreach activities and link trainees to existing outreach opportunities to support and reinforce their teaching when communicating computational and plant sciences to diverse	Video of outreach participation • Rubric/guidelines for individual assessments by leadership team • Assess for clarity, quality of interactions, active participation, etc. Reflections – trainees	Same	Same

	audiences and in diverse formats, and their ability to mentor others new to computational and plant sciences • Raspberry Pi Jam • 4H Garden • Girls Math and Science • Coding Camp • Darwin Days • MSU Science Day	• Questionnaire and/or quick capture – satisfaction with content and format, self-assessment of their level/quality of participation as well as teaching and mentoring skills as applied to outreach activities) Year-end trainee focus group • Assessment of activities: • Satisfaction with content and format • Areas of improvement (content or format)		

*** Element(s) that can be captured by measurement listed in italics, refine as appropriate per activity**