



## **Description, assessment, and outcomes of three National Science Foundation Research Traineeship (NRT) components: transferable skills course, interdisciplinary research proposal and project, and multidisciplinary symposium**

### **Eduardo Santillan-jimenez**

Dr. Eduardo Santillan-Jimenez is PI and project coordinator of a National Science Foundation Research Traineeship (NRT) program designed to enhance graduate education by fully integrating research and professional skill development within a diverse, inclusive and supportive academy. Originally from Mexico, Dr. Santillan-Jimenez joined the University of Kentucky (UK) first as an undergraduate research intern and then as a graduate student performing his doctoral research at the UK Center for Applied Energy Research (CAER) and at the University of Alicante (Spain). After obtaining his Ph.D. in 2008, he worked as a postdoctoral fellow at Utrecht University (The Netherlands) prior to returning to UK, where he now holds the positions of Program Manager at CAER and Adjunct Assistant Professor at the Department of Chemistry. His current research focuses on the application of heterogeneous catalysis to the production of renewable fuels and chemicals, with emphasis on the upgrading of algae and waste oils to drop-in hydrocarbon fuels. His synergistic activities include participating in a number of K-20 educational initiatives designed to increase and broaden participation in STEM fields.

### **Carissa B. Schutzman (Senior Research Associate)**

### **Keren Mabisi**

# **Description, assessment, and outcomes of three National Science Foundation Research Traineeship (NRT) components: transferable skills course, interdisciplinary research proposal and project, and multidisciplinary symposium**

## **1. Introduction**

The University of Kentucky (UK) NRT aims to enhance graduate education by integrating research and professional skill development within a diverse, inclusive, and supportive academy. The main features of this NRT – the main goal of which is to generate an innovative model for STEM graduate student training by identifying and implementing the most effective tools for the training of STEM professionals – have been described in a previous publication [1]. A more recent manuscript has described the first three interventions within this NRT, namely, an onboarding and orientation event, a career exploration symposium, and a multidisciplinary introductory course, along with the assessment and outcomes of each of these interventions [2]. In this and future contributions, we intend to continue showcasing data from the NRT, focusing on the evaluation of its constituent parts. Against this backdrop, this contribution describes three additional interventions within this NRT: a transferable skills course, an interdisciplinary research proposal and project, and a multidisciplinary research symposium, along with the assessment and outcomes of each of these interventions.

## **2. Description of the three interventions within UK's NRT**

### *2.1. Transferable skills course*

Professional skills are often classified as either “hard” or “soft” skills. Hard skills are also called “technical”, “discipline”, or “core” skills because they relate to the technical knowledge necessary to perform the discipline-specific tasks at the core of a job [3]. Soft skills, which are more commonly identified with a worker’s personal qualities, are also called “enterprise” or “transferable” skills since they apply to a variety of workplaces or enterprises, and can easily transfer from one job to the next [3]. Some skills development models place core discipline technical skills at the foundational level, i.e., as the basis of the professional growth leading to transferable enterprise skills [4]. By combining a broad understanding of core discipline technical skills with their managerial application through effective transferable enterprise skills, an individual can strive to develop interdisciplinary skills, which are the highest type and most mature level of skills [3].

In addition to technical or “hard” skills, recent graduates need – but very often lack – “soft” or transferrable skills, including communication, management, leadership, teamwork, and interdisciplinary collaboration [3, 5-7]. Thus, participants in this NRT receive training on key transferrable skills in a 3-credit hour 500-level course. This course offers participants theoretical and practical training in key skills, including ethics, research, communication, teaching, funding procurement, entrepreneurship, management, teamwork, conflict resolution, mentoring, leadership, and outreach. In addition, wellness and well-being skills to not only survive, but thrive in graduate school and beyond are also covered. All trainees register for this course, which is also open to other STEM graduate students and is co-taught by the faculty associated with the

NRT as well as by guest lecturers with expertise in different areas. An abridged version of the syllabus for this course is included below.

### Transferable Skills for Scientists & Engineers – Syllabus

**Course Description:** In addition to technical or “hard” skills, recent graduates with science and engineering degrees need – but often lack – “soft” skills, including communication, leadership, and teamwork skills. In this course, students will receive training on key transferable skills. Specifically, this course will train participants in key skills needed by STEM professionals, including ethics, research, communication, teaching, funding procurement, entrepreneurship, management, teamwork, conflict resolution, mentoring, leadership, and outreach.

**Objective/Student Learning Outcomes:** Students will both learn and apply transferrable skills needed by science and engineering professionals. After completing this course, the student will be able to:

- i. Describe foundational concepts associated with the skills needed by science and engineering professionals, including ethics, research, communication, teaching, funding procurement, entrepreneurship, management, teamwork, conflict resolution, mentoring, leadership, project management, and outreach.
- ii. Prepare a research proposal with the goal of securing competitive funding.

Grades will be comprised of the following elements:

#### GRADUATE STUDENTS

Exams: 20%

Quizzes/Attendance: 10%

Homework: 20%

Research Proposal: 50% (comprised of):

Outline	10%
1 <sup>st</sup> Draft	10%
Final Draft	10%
Presentation	10%
Peer Review	10%

#### UNDERGRADUATES

Exams: 30%

Quizzes/Attendance: 15%

Homework: 30%

Research Proposal: 25% (comprised of):

Outline	5%
1 <sup>st</sup> Draft	5%
Final Draft	5%
Presentation	5%
Peer Review	5%

#### Exams

There will be two exams, mid-term and final. Exams will occur in class and may be a mix of multiple choice/short answer questions.

#### Research Proposal

Students will form teams. Using skills acquired during the course, each team will prepare a research proposal with the goal of securing competitive funding (for a research project) made available through the UK NRT program. The schedule for the research proposal will be as follows:

5 weeks: submit proposal outline

8 weeks: submit 1<sup>st</sup> draft of proposal

11 weeks: submit final draft of proposal

14 weeks: presentation of proposal to class

The outline and 1<sup>st</sup> draft will be subject to peer review by one of the other student teams.

To assess individual students in group work, teams should use the track changes feature in the word processor so instructors can see and evaluate the contribution of individual students to each document submitted (outline, initial draft, advanced draft, peer-review, and final version).

### Homework

Specific requirements will be provided in the instruction for the assignment.

Schedule:

<u>Date</u>	<u>Topic</u>
Jan. 26	Course Intro (Time Management, Meeting & Email Etiquette, Networking, etc.)
Jan. 28	Teamwork
Feb. 2	Conflict Resolution
Feb. 4	Intellectual Property in Academic Research
Feb. 9	Funding procurement – Databases; Solicitations; Submission Platforms
Feb. 11	Written Communication – Grant/Proposal Writing
<b>Feb. 16</b>	<b>Research Proposal Workday: Outline (selected instructors)</b>
<b>Feb. 18</b>	<b>Research Proposal Workday: Outline (selected instructors)</b>
<b>Feb. 23</b>	<b>Research Proposal Workday: Outline (selected instructors)</b>
Feb. 25	Surviving and Thriving in STEM – Wellness & Financial Literacy
Mar. 2	Intercultural Communication – Diversity, Equity & Inclusion
Mar. 4	Written Communication – Manuscripts & Abstracts
Mar. 9	Scientific Publishing – Publishing Process & Ethics
Mar. 11	Teaching
<b>Mar. 16</b>	Leadership
<b>Mar. 18</b>	<b>Midterm exam</b>
Mar. 23	<b>Research Proposal Workday: 1<sup>st</sup> Draft</b>
Mar. 25	<b>Research Proposal Workday: 1<sup>st</sup> Draft</b>
Mar. 30	<b>Research Proposal Workday: 1<sup>st</sup> Draft</b>
Apr. 1	Entrepreneurship
Apr. 6	Management
Mar. 11	Outreach
<b>Mar. 16</b>	<b><i>No class (Spring Break)</i></b>
<b>Mar. 18</b>	<b><i>No class (Spring Break)</i></b>
Mar. 23	Management – Project, Budget & Personnel Management; Reporting
Mar. 25	Written Communication – Peer review
Mar. 30	<b>Research Proposal Workday: Peer Review</b>
Apr. 1	Oral Communication – Oral presentations
Apr. 6	Oral Communication – Poster presentations
<b>Apr. 15</b>	<b>Research Proposal Workday: Class Presentations</b>
<b>Apr. 20</b>	<b>Research Proposal Workday: Class Presentations</b>
Apr. 22	Research
Apr. 27	Ethics
Apr. 29	Mentoring
<b>May 4</b>	<b>Final exam</b>

## *2.2. Interdisciplinary research proposal and project*

As is mentioned in the syllabus included in the preceding section, students taking the transferable skills course form several multi-departmental and interdisciplinary teams. These teams are charged with preparing and submitting an interdisciplinary collaborative proposal in a course-long exercise including all elements of a funding opportunity, namely, a solicitation, a competitive peer-review, and a reporting process. Review criteria include the extent of collaboration between trainees from different departments, the extent of inter- and trans-disciplinarity, as well as the intellectual merit and broader impacts of the work proposed. Meritorious proposals are selected for funding at the end of the course, which allows the multi-departmental student teams to receive and manage funds to perform the interdisciplinary research proposed during the following summer and fall. In turn, this provides trainees ample opportunities not only to hone the skills described above, but also to participate in a trans-departmental internship while working with their team on their project.

## *2.3. Multidisciplinary research symposium.*

This NRT has also launched a multidisciplinary research symposium comprising the most representative elements of a scientific conference, i.e., a call for abstracts, plenary and keynote talks, as well as a poster session. Participating in this symposium – and in its organization – gives trainees yet another avenue to practice the skills described above, all while providing them with valuable networking opportunities. To allow trainees to showcase the results of the interdisciplinary research projects described in the preceding section, the event takes place towards the end of the fall semester. Indeed, the first Food, Energy & Water Symposium was held on Thursday, December 9, 2021, which was a “reading day” and helped avoid conflicting with classes, thus facilitating attendance for both students and faculty. Notably, the event was hybrid (both in person and online), which allowed for speakers in different states and even countries to contribute talks remotely, as well as for attendees to join regardless of their geographical location. This approach had the additional advantage of minimizing disruptions associated with COVID-19, e.g., allowing for speakers or attendees to join if they needed to isolate on the day of the event. A more detailed overview of this event, including the timing of different sessions as well as the title of different talks along with the name of the speakers and their affiliations is presented in the program below.



9-10am

**OPENING PLENARY**

**D R . C A P U C I N E D U P O N T**

Senior Lecturer-Researcher in Bioresource Technology, IHE Delft Institute for Water Education

*From waste to biochar added-value materials in the Food-Energy-Water nexus context*

10-10:30am

**COFFEE BREAK**

10:30-12pm

**KEYNOTE SPEAKERS**

10:30-11am

**P R O F . A K I N B O D E A D E D E J I P H . D . , C Q E - A S Q**

Carnegie Fellow & Associate Professor of Food Process Engineering,  
University of Kentucky Department of Biosystems and Agricultural Engineering

*The Age of 'ALT' Proteins: Impact on Water and Energy Conservation*

11-11:30am

**S A M U E L K E L T Y**

Chemical Research Engineer, LG&E and KU

*Kentucky's Clean Energy Successes, Opportunities, and Challenges*

11:30am  
- 12pm

**P R O F . L I N D E L L O R M S B E E P H . D . , P . E . , P . H . ,  
D . W R E , F . A S C E , F . E W R I**

Director, Kentucky Water Resources Research Institute  
Professor, University of Kentucky Department of Civil Engineering

*The Importance of a Systems Approach for Addressing Water Challenges*

12-1:00pm

**LUNCH**

1-2pm

**AFTER LUNCH PLENARY**

**J O N A T H A N W E B B**

Founder & CEO, AppHarvest

*Leveraging Kentucky's Renewable Resources for the Betterment of People and Planet*

2-3pm

**POSTER SESSION**

3-4pm

**CLOSING PLENARY**

**P R O F . A L I C E A G O G I N O**

Roscoe and Elizabeth Hughes Chair in Mechanical Engineering  
Professor, University of California – Berkeley Department of Mechanical Engineering

*Innovations in Food, Energy Water Systems:  
STEM Training for Actionable Research and Global Impact*

### 3. Assessment and outcomes of three interventions within UK's NRT

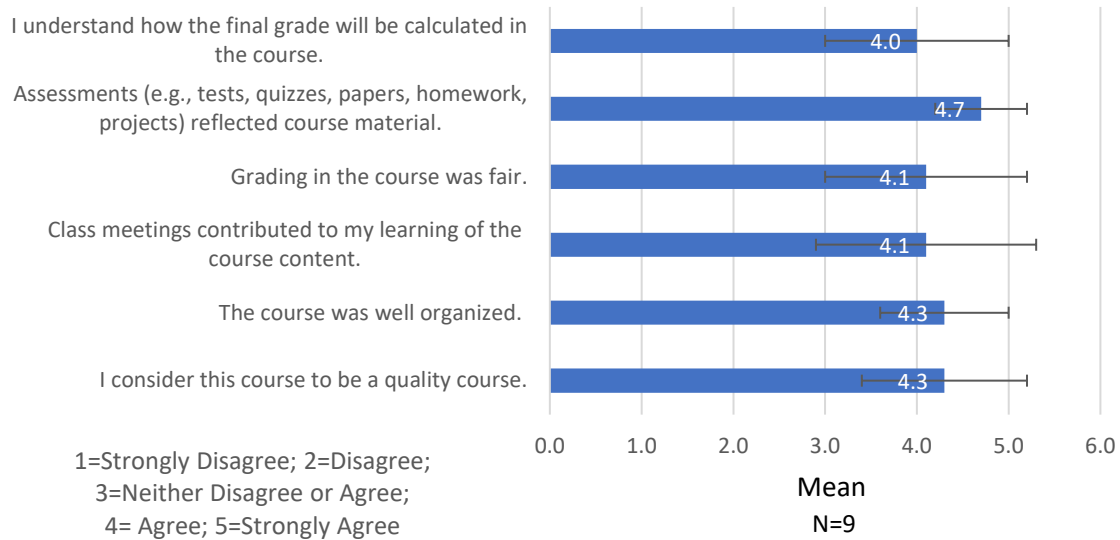
The University of Cincinnati Evaluation Services Center serves as the external evaluator for the UK NRT. The evaluation assesses how well the project meets its goal to integrate an innovative and evidence-based training model with cutting-edge interdisciplinary research focused on the high priority convergent research topic targeted by the traineeship (*viz.*, innovations at the nexus of food, energy, and water systems) [1]. The evaluation also assesses project success in (a) developing and implementing a sustainable training program across multiple cohorts of students and faculty, and (b) improving graduate student technical and professional competencies as well as preparation for a career at the high priority convergent research topic targeted by the traineeship. Using a cohort-sequential design with retrospective and concurrent comparison groups, the evaluation includes both formative and summative activities reflective of best practices per Patton [8], Kundin [9], Schwandt [10], as well as Hendricks, Plantz, and Pritchard [11]. These activities and mixed-methods data, collected across multiple stakeholders, foster continuous program improvement during the project timeline, establish an evidence base for successes and lessons learned, and generate best practice resources.

#### 3.1. Transferable skills course

The 15-week Transferable Skills for Scientists and Engineers course (GS 599) was offered for the first time in spring 2021 to the UK NRT trainees as well as other graduate students and advanced (senior or junior) undergraduates pursuing a STEM degree. All students – i.e., both trainees and non-trainees alike – had the opportunity to complete the Teacher Course Evaluation (TCE). Additionally, trainees also responded to questions about the transferable skills covered in the course in a post-survey as well as in a focus group discussion in the spring of 2021.

Nine of the seventeen students who took the Transferable Skills for Scientists and Engineers course in the spring of 2021 responded to the TCE survey, which was sent electronically to all students by the university. All the respondents anticipated earning an A in the course. The TCE survey included six Likert-style questions that asked the student to evaluate the course. Respondents were asked to rate the extent to which they agreed with statements about the course (strongly disagree = 1, disagree = 2, neither disagree or agree = 3, agree = 4, strongly agree = 5). Mean scores ranged from 4.0 to 4.7 on a 5.0 scale. Results are shown in Figure 1.

## GS 599: Transferable Skills Course Evaluation



**Figure 1. Student evaluation of transferable skills course**

As part of the TCE, students responded to two open-ended questions about the course. The first question asked students to identify which aspects of the course were most helpful and why. Students identified the primary instructors, course material, resources for research, and guest lecturers as the most helpful aspects of the course. One respondent wrote, “*The course is very insightful and well organized!*” Another student commented: “*I think that the idea of having a research proposal as a main project is fantastic and prepares students for a very important topic for grad students to really understand. The wide range of professional development topics covered was great too and answered many questions I had but never thought to ask.*”

The second open-ended question asked students to identify aspects of the course they would change. Student suggestions clustered around the theme of allowing more time for quizzes, more time for teamwork during class, and more time for final presentations. Respondents noted the quizzes required time to allow for higher-level thinking: “*The quizzes sometimes require higher-level thinking otherwise less time creates anxiety and panic.*” One respondent commented that some of the lectures were unnecessary and would have preferred more lecture time be used for team meetings during class. One student suggested the course include more resources for creating PowerPoint presentations for seminars and conferences.

In addition to responding to the TCE, trainees were asked in an NRT program evaluation post-survey to rate their current skill levels in 12 domains. They rated each of these skills using a five-point scale ranging from 0 (“Not at all”) to 4 (“Great deal”). Higher values indicate higher ratings of skills. As shown in Table 1, the students on average indicated Teamwork (mean=3.7) as their highest rated skill. The students also rated their Communication and Leadership skills highly (mean=3.3). In contrast, the lowest rated skills by students were Funding Procurement (mean=1.8) and Entrepreneurship (mean=1.2), indicating that these are areas where opportunity exists for growth.



**Table 1. Cohort 1 Current Skill Levels**

<b>Item</b>	<b>n</b>	<b>Mean</b>	<b>SD</b>
Teamwork	9	3.7	0.50
Communication	9	3.3	0.71
Leadership	9	3.3	0.71
Management	9	3.2	0.83
Teaching	9	3.1	0.78
Research	9	2.9	0.60
Conflict Resolution	9	2.9	0.60
Research Ethics	9	2.8	0.97
Mentoring	9	2.7	1.41
Outreach	9	2.3	1.22
Funding Procurement	9	1.8	0.97
Entrepreneurship	9	1.2	0.83

Scale: 0= Not at all, 1=Very little, 2=Somewhat, 3=Quite a bit, 4= Great deal

The Transferable Skills for Scientists & Engineers course formally covered the skills listed in Table 1 during the spring of 2021 semester. However, students started practicing many of these skills in a multi-disciplinary course on Innovation at the Nexus of Food, Energy, and Water Systems (GS 598) they took in the fall of 2020 semester as they began working in teams and collaboratively writing a literature review [1, 2]. Furthermore, students also had opportunities to apply these skills as they wrote proposals, presented at conferences, and taught classes. In the open-ended questions of the post-survey, trainees reported that the trans-departmental internship (see Section 2.2) also provided opportunities to work in another department, which also helped improve their interpersonal and interdisciplinary skills.

In addition to the results of the five-point scale open-ended responses, students remarked in the focus group about learning the necessity for teamwork and good communication when working toward solving problems that fundamentally require an interdisciplinary solution. Several students commented that they had gained an increased appreciation for teamwork. One student said, *“It just shows us [that] if you want to be able to work together well, you have to recognize that there are just things that you're not good at and to rely on others to complete those things.”* Another student commented on the value of communication skills: *“Communication between the different disciplines ... you know there are some barriers there in communicating with these disciplines. So, learning the proper steps or how we can communicate better, I think it will help in the long run.”*

### *3.2. Interdisciplinary research proposal and project*

Through the purposeful design of the introductory course on Innovations at the Nexus of Food, Energy & Water Systems (INFEWS) taught in the fall of 2020, students were immediately immersed in a multidisciplinary space. Faculty from several disciplines co-taught the course, which was organized around four INFEWS research questions requiring an interdisciplinary approach. This work continued into the spring 2021 Transferrable Skills course where students worked in multidisciplinary teams to write a research proposal on an INFEWS-related challenge of their choosing.

The post-survey results did not show a significant change in student orientation toward multidisciplinary work; however, student responses on the post-survey open-ended questions and the focus group discussion indicated students had developed an appreciation for multidisciplinary research. In fact, students expressed that the multidisciplinary approach had positively influenced their own research. Due to the purposeful multidisciplinary training in both courses, these results could represent the nuanced difference between students appreciating and embracing multidisciplinary work but still in the process of learning how to conduct multidisciplinary research.

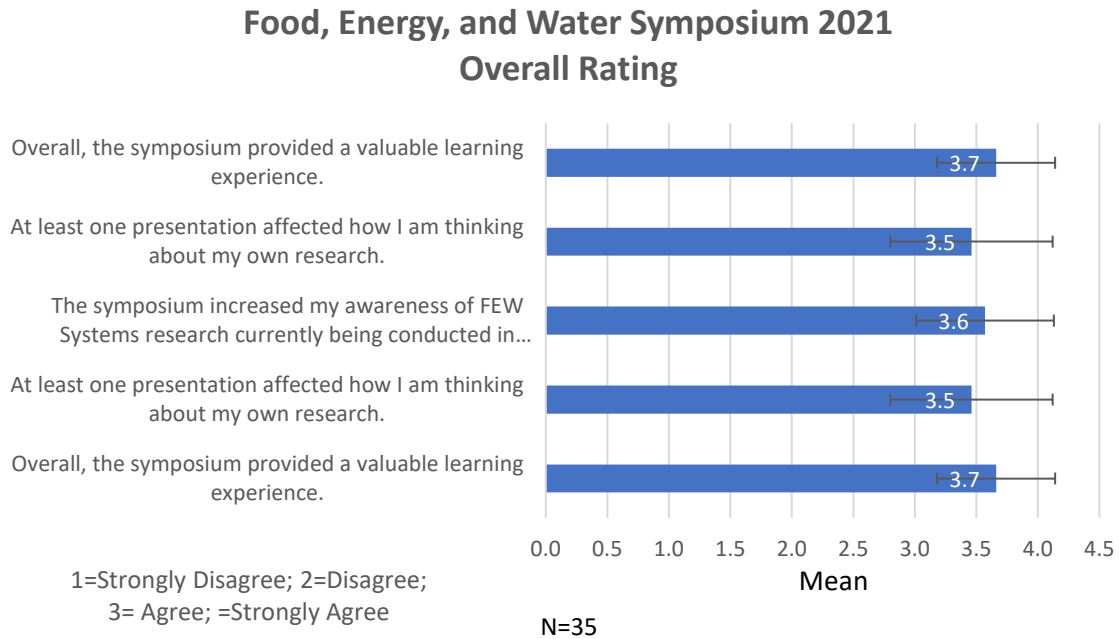
In terms of participants' decision-making process regarding the research topic, one student shared in the focus group that their team members all came into this program with an interdisciplinary mindset, and the development of their research focus was a natural process based on every team member's background. They appreciated the technology and content knowledge brought in by different disciplines, and they made sure that everyone on the team felt included and excited about the research. In the quote below from the focus group, a trainee provided a specific example of how the multidisciplinary approach to their research had affected their perspective: *"I'm currently in one of the electives called a global Appalachia.... It's housed in anthropology, so it does take more of an ecological perspective.... And so, I greatly appreciate that without this program I would not have taken that class...."* Another student expressed a similar thought and described the impact of adding a non-STEM researcher to their committee (a feature of the traineeship [1]): *"So, I was just going to say that it's really helping broaden my research by adding that committee member that's outside of my department. And really, you know, adding the sociological aspects to my research, I think it's really strengthened it and allowed me to really connect growing plants or crops or agriculture in general to how that affects the surrounding communities".* Additionally, students shared that the multidisciplinary approach had provided an opportunity for them to gain a new appreciation for the social sciences, which represents an important objective of the National Science Foundation Research Traineeship program in general and of the UK NRT in particular.

### 3.3. Multidisciplinary research symposium

A total of 41 participants in the 2021 UK Food, Energy, and Water Symposium (FEWS) responded to a post-survey (29 completed the survey fully while 12 partially completed the survey). Of the 40 participants who responded to the question about their participation in the UK NRT, 17 (42.5%) were a part of the UK NRT, 21 (52.5%) were not, and two (5%) answered "do not know." Of the 14 UK NRT participants who responded, six started the traineeship in fall 2020 (42.9%), two started in spring 2021 (14.3), and six started in fall 2021 (42.9%); in addition, four (28.6%) were enrolled in a master's degree, 9 (64.3) were enrolled in a doctoral degree, and one participant noted that they were faculty (7.1%). The majority of participants (94.6%; n=35) were affiliated with the University of Kentucky. Two (5.4%) were affiliated with other organizations or private companies (Fayette County Public Schools and Bruker BioSpin).

FEWS participants were asked to respond to a set of statements about their overall experience attending the symposium. Participants (n=35) expressed an overall positive attitude towards the statements regarding the event. All the items were rated 3 and above (agree to strongly agree).

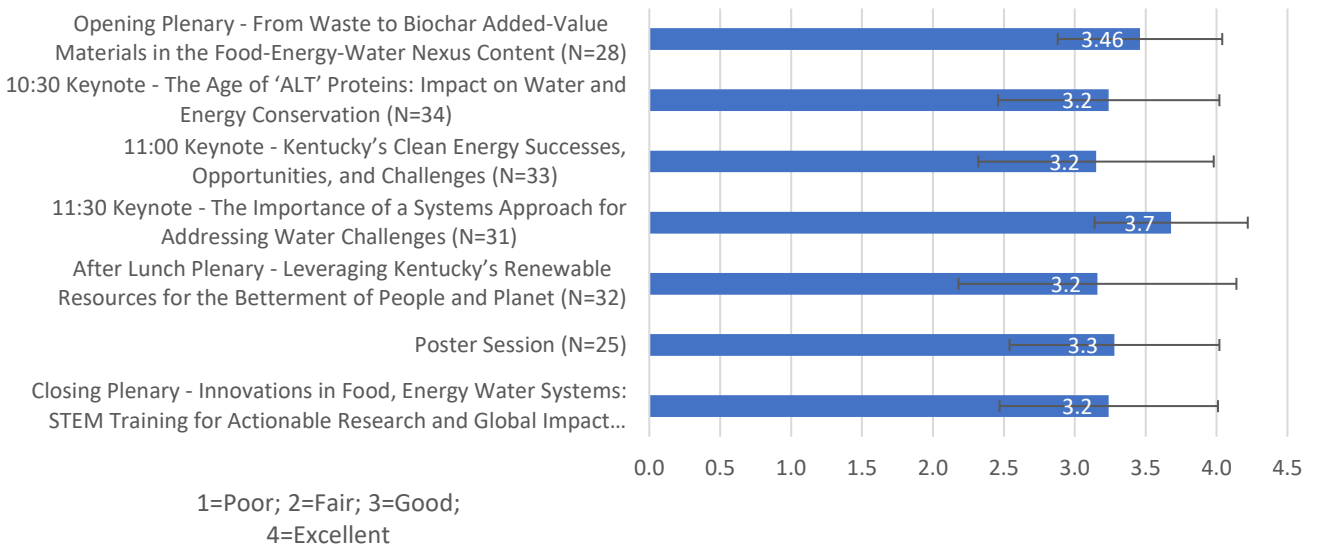
The top three rated statements were “Overall, the symposium provided a valuable learning experience” (mean=3.66, SD=0.48), “The symposium increased my awareness of Food, Energy, and Water Systems research that is currently being conducted in Kentucky” (mean=3.57, SD=0.56), and “Overall, the symposium presenters were engaging” (mean=3.51, SD=0.66). For results per statement, please see Figure 2 below.



**Figure 2. Food, energy, and water symposium 2021 overall rating**

FEWS participants were also asked to respond to a set of statements about the individual sessions at the symposium. The session that was attended by the most participants was the Keynote titled “*The Age of ‘ALT’ Proteins: Impact on Water and Energy Conservation*” (n=34), while the Closing Plenary “*Innovations in Food, Energy Water Systems: STEM Training for Actionable Research and Global Impact*” (n=21) had the fewest attendees. Participants were asked to rate the sessions that they attended at the symposium. Their ratings reflected an overall satisfaction with the sessions with all means greater than 3.1, meaning that most of the sessions were rated as Good or Excellent. The session that was rated the highest by the participants was the Keynote titled “*The Importance of a Systems Approach for Addressing Water Challenges*”, with a mean rating of 3.68 (SD=0.54). For detailed results, see Figure 3 below.

## Food, Energy, and Water Symposium 2021 Session Rating



**Figure 3. Food, energy, and water symposium 2021 session rating**

In addition to the Likert-style questions, attendees had the opportunity to respond to two open-ended questions. When asked what they valued the most about the symposium, several themes emerged:

- FEWS was a quality learning opportunity that added new knowledge and provided inspiration for the audience. (*“I liked how the students were the target audience which really got me thinking about how I can move forward with the NEXUS of food, energy, and water in my own career. I could really see all these different paths interconnecting in my own work. The presenters were very experienced too to really walk us through essential parts of what they do.”*)
- Attending FEWS was beneficial for students. (*“Trainees and students, those who engaged in NRT would definitely have benefited from this symposium. The event has provided students with many opportunities to dream big and work on real world challenges that I could see from their presentation as well as from their engagement with plenary and key note speakers.”*)
- FEWS speakers provided different perspectives from both academia and industry. (*“I valued the balance of speakers- some were scientists/researchers and some were from industry. While research was discussed, the speakers weren't talking about research projects, per say. I can read published literature about research and learn more than if someone is lecturing me about it. Instead, the speakers had bigger ideas to convey, and I appreciated that.”*)
- Attendees thought FEWS was a great networking opportunity where they felt connected with people who were interested in doing similar things. (*“The ability to connect with researchers and learn from their plethora of research. Now I have a ‘go-to’ when I need research or make inquiries pertaining to FOOD, ENERGY and WATER in Kentucky.”*).

- Attendees appreciated the wide range of topics presented at the symposium and the emphasis on connectedness and interdisciplinary thinking. (*“The main thing I got out of the symposium was the connectedness of everything, how it is all interrelated, and that is why cross-collaboration is so important in addressing these problems. It is also why symposiums that combine speakers from across different disciplines are important.”*)

FEWS attendees were asked what changes they would recommend for future symposiums. Whereas the majority of respondents were satisfied, some participants noted areas that could be improved. Some of the recommendations focused on changing the form and structure of the symposium. For example, participants recommended reconstructing the breakout rooms in a way that poster presenters could have more “*breathing room*” and could also learn from each other and connect. As one poster presenter wrote, “...coming out of a session to find that another poster was literally taped over to my poster added to my frustration. Then during the dedicated poster time we aren't able to stand next to our work because there are too many posters.” The second area for improvement identified by the participants was the timing of the symposium. As one participant wrote, “*The timing of the symposium may be difficult for students to attend due to final exams and projects.*” For the content of the presentations, some participants were hoping to see actual research projects conducted by industrial companies, rather than “*their blank marketing talks.*” As one participant shared, “*Bringing in public corporations is great and much better than having just university researchers. However, we need people that will actually talk about the work and not give blanket marketing talks that do not discuss what the science is doing.*” Participants also mentioned the technical difficulties that had taken valuable time from the presenters. Finally, some attendees are hoping for an entirely in-person symposium next time and for more local industry and government representatives.

#### 4. Conclusions

This contribution describes three interventions within an NRT – namely, a transferable skills course, an interdisciplinary research proposal and project, and a multidisciplinary research symposium – as well as their assessment and outcomes. Regarding the transferable skills course, students identified the primary instructors, course material, resources for research, and guest lecturers as the most helpful aspects. Students ranked teamwork as the skill in which they are most proficient, communication and leadership also being rated highly. In contrast, funding procurement and entrepreneurship were ranked the lowest, indicating that these are areas where opportunity exists for growth and additional training and practice could be most beneficial.

Reflecting on their experience with the interdisciplinary research proposal and project, students remarked learning the necessity for teamwork and good communication when working toward solving problems that fundamentally require an interdisciplinary solution. Several students commented that they had gained an increased appreciation for teamwork. In addition, trainees reported that the opportunity to work in another department in a trans-departmental internship helped improve both their interpersonal and interdisciplinary skills. Notably, while several students reported developing an appreciation for multidisciplinary research, some students

expressed that the multidisciplinary approach had positively influenced their own research or allowed them to gain a new appreciation for the social sciences.

Participants of the multidisciplinary research symposium found the presenters engaging (most sessions were rated as either good or excellent) and expressed an overall positive attitude towards the event, identifying the latter as a valuable learning experience capable of increasing awareness of topical research. Moreover, in the responses to an open-ended question about what they valued most about the symposium, several themes emerged: 1) the symposium was a quality learning opportunity that added new knowledge and provided inspiration for the audience; 2) attending the event was beneficial for students; 3) speakers provided different perspectives from both academia and industry; 4) the event was a great networking opportunity to connect with people with similar interests; and 5) attendees appreciated the wide range of topics presented and the emphasis on connectedness and interdisciplinarity.

### Acknowledgement

This material is based upon work supported by the National Science Foundation Research Traineeship Program under Grant No. 1922694.

### References

1. E. Santillan-Jimenez, Q. Duan, J. Dariotis, and M. Crocker, "Enhancing graduate education by fully integrating research and professional skill development within a diverse, inclusive and supportive academy," in *2020 ASEE Virtual Annual Conference*, 2020, DOI: 10.18260/1-2--34569. [Online]. Available: <https://peer.asee.org/34569>
2. E. Santillan-Jimenez, J. E. Parker, K. Mabisi, C. B. Schutzman, and M. Crocker, "Description, Assessment, and Outcomes of Three Initial Interventions Within a National Science Foundation Research Traineeship (NRT): Onboarding Event, Career Exploration Symposium, and Multidisciplinary Introductory Course," in *2021 ASEE Virtual Annual Conference Content Access*, 2021, DOI: 10.18260/1-2--36900. [Online]. Available: <https://peer.asee.org/36900>
3. E. Koromyslova and A. Koromyslov, "An Advanced Teaching Methodology to Improve Student Learning Outcomes in Core Discipline Content and Soft Skills," in *2019 ASEE Annual Conference & Exposition*, 2019, DOI: 10.18260/1-2--32053. [Online]. Available: <https://peer.asee.org/32053>
4. E. Lai, K. DiCerbo, and P. Foltz, "Skills for Today: What We Know about Teaching and Assessing Collaboration," *Pearson*, 2017.
5. <http://www.forbes.com/sites/karstenstrauss/2016/05/17/these-are-the-skills-bosses-say-new-college-grads-do-not-have/#1a1aa618596e> (accessed February 2022)
6. M. Hora, "Beyond the skills gap. National Association of Colleges and Employers," ed: Available, 2017.
7. P. Merry, "Changing education: Why we need more focus on 'soft' skills," *Government Technology Magazine*, 2016.
8. M. Q. Patton, *Utilization-focused evaluation*. Sage publications, 2008.
9. D. M. Kundin, "A conceptual framework for how evaluators make everyday practice decisions," *American Journal of Evaluation*, vol. 31, no. 3, pp. 347-362, 2010.

10. T. A. Schwandt, "The centrality of practice to evaluation," *American Journal of Evaluation*, vol. 26, no. 1, pp. 95-105, 2005.
11. M. Hendricks, M. C. Plantz, and K. J. Pritchard, "Measuring outcomes of United Way–funded programs: Expectations and reality," *New Directions for Evaluation*, vol. 2008, no. 119, pp. 13-35, 2008.