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AI-UPP IRES Year 2: Insights into Program Effectiveness and Student Development

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Abstract

This International Research Experience for Students (IRES) NSF project (*IRES: Artificial Intelligence and Data Science for the Understanding, Prediction and Prevention of Disease (AI-UPP)*) focuses on creating an immersive international summer research experience in Stockholm for students enrolled in a primarily undergraduate institution (PUI). Over the course of a three-year grant period, this IRES site seeks to: (1) develop and disseminate artificial intelligence (AI) and data science tools aimed at understanding, predicting and preventing disease; (2) train and mentor 24 diverse undergraduate students from PUIs in AI and/or data science research in a collaborative and international setting; (3) encourage and prepare undergraduate students from PUIs for enrollment in graduate programs in computer science, artificial intelligence, bioengineering, bioinformatics, or related fields; (4) foster existing collaborations and develop new research collaborations between the University of San Diego and scientists in Sweden; and (5) develop a diverse cohort of globally engaged scientists/engineers that seek career opportunities and collaborators throughout the world.

Program description & evaluation

The first year of this program took place in 2025 from March-October and successfully trained 8 undergraduate students. Program activities included a 6-week virtual training series (March-May), a welcome weekend in Stockholm (June), a 10-week research experience in Sweden (June-August), and the opportunity to present at the Biomedical Engineering Society annual meeting in San Diego (October). Program structure and activities are described in full detail in the first ASEE paper on this program, including the motivation for applying AI to biomedical research projects, relevant supporting literature, and explicit alignment with NSF IRES goals related to strengthening U.S. leadership and economic competitiveness [1]. Briefly, the program addresses the critical need for an interdisciplinary, diverse workforce capable of navigating the computational complexities of 'big data' biology while actively mitigating algorithmic biases that threaten equitable healthcare. This is an essential step in maintaining U.S. leadership in biotechnological innovation and ensuring a globally competitive, inclusive STEM pipeline. This paper will report on data from the external assessment of the first year of the program.

An external evaluation of all program activities took place at the end of the first year. This evaluation focused on student perceptions of personal and professional gains from the program's activities (Table 1), program activities (Table 2), and impacts of participating in the program (Tables 3). URSSA survey questions were used to assess participant gains in research-related competencies as a result of their international research experience [2]. Participants self-reported gains in four areas on a scale of 1 (no gains) to 5 (great gain). Across the four areas, participants reported very high gains in: identifying limitations of research methods and designs, understanding theory and concepts related to their project, developing patience with the pace of research, keeping detailed documentation in a digital notebook, engaging in real-world science, feeling responsible for their project, interacting with scientists from other institutions, and feeling like a part of a scientific community (Figure 1). Areas where the participants reported moderate gains included: making an oral presentation, defending an argument when asked a question, and feeling like a scientist (Figure 1).

Table 1: External program evaluation questions asked to assess student gains in numerous areas as a result of their participation in the IRES program. Evaluation questions were sourced from the Undergraduate Research Student Self-Assessment (URSSA) verified tool [2].

Category 1: Thinking and Working Like a Scientist	
How much did you GAIN in the following areas as a result of your most recent research experience? 1 (no gains) - 5 (great gain)	
1.1	Analyzing data for patterns
1.2	Figuring out the next step in a research project
1.3	Problem-solving in general
1.4	Formulating a research question that could be answered with data
1.5	Identifying limitations of research methods and designs
1.6	Understanding the theory and concepts guiding my research project
1.7	Understanding the connections among scientific disciplines
1.8	Understanding the relevance of research to my coursework
Category 2: Personal Gains	
How much did you GAIN in the following areas as a result of your most recent research experience? 1 (no gains) - 5 (great gain)	
2.1	Confidence in my ability to contribute to science
2.2	Comfort in discussing scientific concepts with others
2.3	Comfort in working collaboratively with others
2.4	Confidence in my ability to do well in future science courses
2.5	Ability to work independently
2.6	Developing patience with the slow pace of research
2.7	Understanding what everyday research work is like
2.8	Taking greater care in conducting procedures in the lab or field
Category 3: Skills	
How much did you GAIN in the following areas as a result of your most recent research experience? 1 (no gains) - 5 (great gain)	
3.1	Writing scientific reports or papers
3.2	Making oral presentations
3.3	Defending an argument when asked questions
3.4	Explaining my project to people outside my field
3.5	Preparing a scientific poster
3.6	Keeping a detailed lab notebook
3.7	Conducting observations in the lab or field
3.8	Using statistics to analyze data
3.9	Calibrating instruments needed for measurement
3.10	Working with computers
3.11	Understanding journal articles
3.12	Conducting database or internet searches
3.13	Managing my time
Category 4: Attitudes and Behaviors	
During your research experience HOW MUCH did you: 1 (none) - 5 (a great deal)	
4.1	Engage in real-world science research
4.2	Feel like a scientist
4.3	Think creatively about the project
4.4	Try out new ideas or procedures on your own
4.5	Feel responsible for the project
4.6	Work extra hours because you were excited about the research
4.7	Interact with scientists from outside your school
4.8	Feel a part of a scientific community

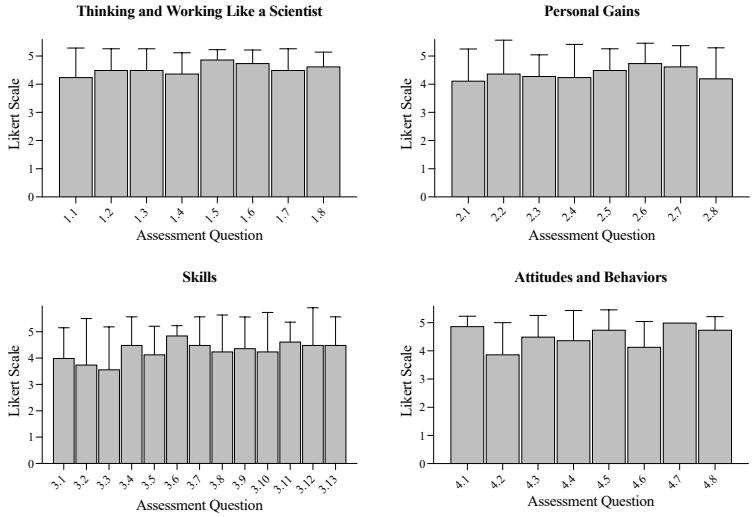

Figure 1: Undergraduate Research Student Self-Assessment (URSSA) survey results. Table 1 contains the corresponding questions. Data are presented at mean ± standard deviation

Feedback on the training sessions was highly favorable (Figure 2). In particular, abstract writing, journal club, and weekly mentorship meetings were cited as highly useful for developing key skills. The utility of the DataCamp tutorials and coding preparation activities was dependent on the individual participant's prior experience and the specific needs of their research project. Participants were highly satisfied with their overall research experience and with their working relationship with their research mentor and program director (Figure 2). The standard deviations show a strong consensus among respondents in both areas. Comments here and on the overall program highlighted an appreciation for the relationships formed with mentors, supervisors, and group members. The areas with the lowest average scores were the amount of time spent doing meaningful research and the amount of time spent with the research mentor. Based on the free-response portion of the survey, participants faced common challenges inherent in a research setting, particularly in the initial phases of their projects. Lastly, several comments about program improvements indicated a desire for additional opportunities for the participants to meet and socialize as a group.

Table 2: External program evaluation questions asked to assess student perceptions of the IRES program.

Category 5: Preparatory Activities	
How much did the following activities support your learning? *1 (not at all) - 4 (a great deal)*	
5.1	Virtual training series sessions 1-3
5.2	Journal club presentations
5.3	Poster making and presentations
5.4	Elevator pitch activity
5.5	Lab presentations/scientific figure activity
5.6	Coding sessions in DataCamp
5.7	Weekly 1:1 mentorship meetings
5.8	Abstract writing activity
5.9	Preparatory coding activities or tutorials provided by the host lab
Category 6: Perspectives on the Research Experience	
Please rate you perception of the following *1 (poor) - 4 (excellent)*	
6.1	My working relationship with my research mentor
6.2	My working relationship with research group members
6.3	Support and guidance from the program director
6.4	The amount of time I spent doing meaningful research
6.5	The amount of time I spent with my research mentor
6.6	The advice my research mentor provided about careers or graduate school
6.7	The research experience overall

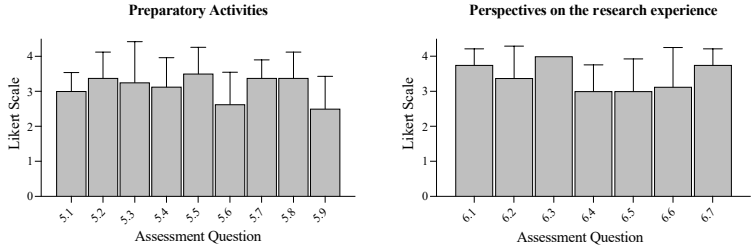

Figure 2: Student perceptions of IRES program. Table 2 contains the corresponding questions. Data are presented at mean ± standard deviation.

Participants were asked a series of questions to assess the potential long-term impact the program had on their future studies and career. The responses and comments indicate that the participants found the experience impactful, with little variability among the participants (Figure 3). Participants reported that the program helped them gain a clearer understanding of their future paths. Results indicate that the program has significantly increased the likelihood of pursuing advanced degrees in STEM fields and working as a scientist (Figure 3). The lowest mean scores, suggesting a minimal or no change in likelihood, are for enrolling in medical or dental school and pursuing a teaching certificate. Lastly, students reported strong agreement that participation

in this IRES program had a significant positive impact on navigating international work environments (Figure 3).

Table 3: External program evaluation questions asked to assess impact of student participation in the IRES program.

Category 7: Perceived academic and career preparation	
Rate how much you agree with the following statements *1 (strongly disagree) - 4 (strongly agree)*	
7.1	Doing research confirmed my interest in my field of study
7.2	Doing research clarified for me which field of study I want to pursue
7.3	My research experience has prepared me for advanced coursework or thesis work
7.4	My research experience has prepared me for graduate school
7.5	My research experience has prepared me for a job
Category 8: Impact on future academic and career plans	
Compared to your intensions BEFORE doing research, how likely are you now to: *1 (not more likely) - 5 (extremely more likely)*	
8.1	Enroll in a Ph.D. program in science, mathematics, or engineering
8.2	Enroll in a master's program in science, mathematics, or engineering
8.3	Enroll in a combined M.D./Ph.D. program
8.4	Enroll in medical or dental school
8.5	Enroll in a program to earn a different professional degree (i.e. law, veterinary medicine)
8.6	Pursue certification as a teacher
8.7	Work in a science lab
Category 9: Impact of international experience	
Rate how much you agree with the following statements *1 (strongly disagree) - 4 (strongly agree)*	
9.1	I gained significant knowledge about engineers/scientists and engineering/science in Sweden
9.2	I am better prepared to meet and work with engineers/scientists from Sweden.
9.3	I am better prepared to meet and work with engineers/scientists from different countries.
9.4	I will be able to work more effectively in the global engineering/science profession.
9.5	I now have a better understanding of how my perspective as an engineer/scientist is different from those of engineers from other countries.
9.6	I will now be better at working with people who define problems differently than I do.
9.7	I will be able to work more effectively in diverse and multicultural environments

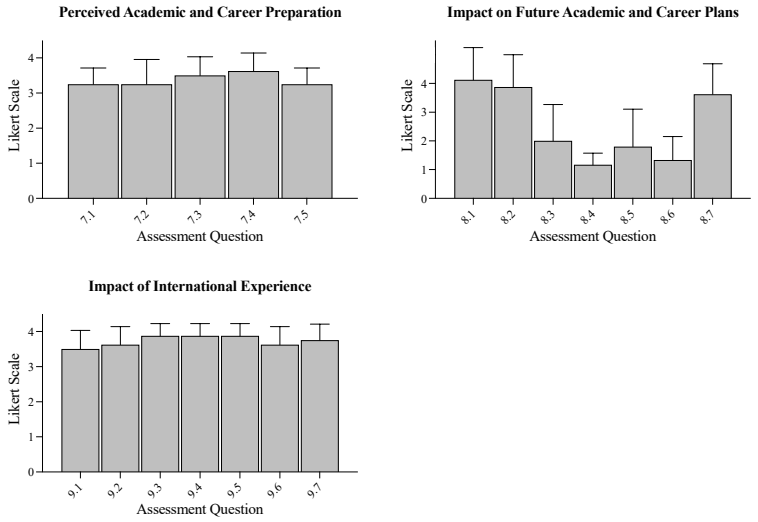

Figure 3: Impact of IRES program on students. Table 3 contains the corresponding questions. Data are presented at mean ± standard deviation

Conclusions

Overall, the program's first year was particularly successful at engaging participants in authentic and interesting projects, promoting personal and professional growth, and in providing a supportive community and exceptional mentorship. Areas for future program improvement include fostering more social interactions among participants and continuing to develop the preparatory coding activities.

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