AY21–22 TILT OURA Lab Assessment Report
The Institute for Learning and Teaching
July 2022

The Office for Undergraduate Research and Artistry (OURA), housed within The Institute for Learning and Teaching (TILT), serves as a resource at Colorado State University to promote and expand experiential learning for undergraduate students through research, artistic, and other creative experiences. In Fall 2021, OURA, facilitated two cohorts of the TILT OURA Lab with an emphasis on recruiting transfer students. Students in the Fall 2021 cohorts spent 20 hours in the lab across two weeks. In Spring 2022, another cohort of United in STEMM students participated in the TILT OURA Lab. Students in the Spring cohort spent 72 hours in the lab across 12 weeks. The TILT OURA Lab serves as a place for skills development for CSU STEMM students and aims to reduce barriers to entry and increase rates of undergraduate research participation among undergraduate students with minoritized identities.

During the last week of their TILT OURA Lab experience, participating students were invited to complete the Entering Research Learning Assessment (ERLA), developed by the Wisconsin Institute for Science Education and Community Engagement (Butz & Branchaw, 2020). TILT also conducted three focus groups during the last week of the Spring 2022 cohort to learn about students' experiences in the lab.

This report summarizes Fall 2021 and Spring 2022 TILT OURA Lab participant demographics, results from the ERLA, and student focus group themes and concludes by outlining future directions for the TILT OURA Lab program informed by the assessment results and next steps in the program assessment.

TILT OURA Lab Learning Outcomes
TILT OURA Lab participants will:
- o Develop confidence in their research abilities and demonstrate growth in hands-on skills
- o Associate the TILT OURA Lab as a supportive and caring learning environment
- o Confidently and accurately execute a series of laboratory techniques with the ability to successfully train peers to perform the methods as well
- o Collaborate with peers to analyze information, design experiments, and troubleshoot ideas
- o Summarize their work and duties and communicate them to others

Assessment Highlights
- o **35** students participated in Fall 2021
- o **22** students participated in Spring 2022
- o **61%** of all participants were racially minoritized, **42%** were Pell Grant recipients, & **39%** were first-generation students
- o ERLA constructs with the highest average gains were **practical research skills** (Fall cohorts) **researcher confidence and independence** and **research comprehension & communication** (Spring cohort)
- o Presenting independent research at **MURALS** was a highlight for many students
- o **90%** of students are interested in pursuing **future research opportunities** after completing their TILT OURA Lab experience

TILT OURA Lab Participant Demographics

Table 1. AY 21-22 TILT OURA Lab Participant Demographics

	Fall 2021 Cohorts n = 35		Spring 2022 Cohort n = 22		CSU Undergraduates N = 23,690	
	n	%	n	%	N	%
Gender						
Female	21	60%	17	77%	12,721	54%
Male	13	37%	3	14%	10,969	46%
Non-binary/Transgender	1	3%	2	9%	--	--
Race						
White	28	80%	14	64%	21,045	89%
Hispanic/Latino	7	20%	10	45%	3,730	16%
Asian	7	20%	5	23%	1,733	7%
Multiple	6	17%	2	9%	1,481	6%
Black	5	15%	2	9%	1,004	4%
American Indian	1	3%	2	9%	776	3%
Hawaiian/Pacific Islander	1	3%	0	0%	196	<1%
Racially Minoritized	18	51%	17	77%	6,248	26%
First Generation	15	43%	7	32%	5,430	23%
Pell Recipient	15	43%	9	41%	4,749	20%
Non-Traditional	11	31%	1	5%	3,004	13%
Transfer Student	27	77%	1	5%	1,484	6%
Veteran	1	3%	0	0%	748	3%
Student Class					6,305	27%
Freshman	2	6%	12	55%	5,131	22%
Sophomore	12	34%	5	23%	5,450	23%
Junior	12	34%	3	14%	6,535	28%
Senior	5	14%	2	9%	269	1%
Post Bachelors	4	9%	0	0%	--	--
Major College					4,775	20%
Natural Sciences	18	51%	10	45%	1,652	7%
Warner College of Natural Resources	4	11%	4	18%	1,383	6%
Agricultural Sciences	3	9%	2	9%	2,029	9%
Intra-University	3	9%	0	0%	3,957	17%
Health and Human Sciences	2	6%	1	5%	928	4%
Vet Med & Biomedical Sciences	2	6%	2	9%	2,426	10%
College of Engineering	2	6%	1	5%	4,030	17%
Liberal Arts	1	3%	0	0%	2,510	11%
Business	0	0%	2	9%		

Note:

i. Racial categories do not add to 100% due to some individuals being counted in more than one racial category.

ii. Non-traditional student is defined by IRP&E as undergraduate students over the age of 22.

iii. TILT OURA Lab Participant transfer students include any student who entered CSU as a transfer student.

iv. CSU Undergraduate comparison reports CSU undergraduates at census of Fall 2021

The diversity of identities within the lab was empowering to students.

TILT OURA Lab participants were considerably more diverse than the CSU undergraduate student body, especially with regard to the proportion of students identifying as racially minoritized, first-generation, and/or Pell Grant recipients. Notably, 77% of Fall 2021 participants were transfer students due to recruitment efforts through Wolves 2 Rams and CSU transfer advisors.

A key finding from the focus groups was that students found the diversity of identities in the lab empowering. Students noted that the lab personnel and participants were mostly women and people of color, and that it was nice to be in a space on campus where they were not a minority, especially within a STEMM/laboratory setting. Students described the environment as being comfortable, inclusive, and a place where they could be themselves. As one student shared, *"I felt very supported that I could use both she and they pronouns [in the lab] because I don't do that in a lot of social situations. But, I felt very much like there was a diverse group of students and they would support you no matter what or how you identified."*

One student stated that seeing graduate assistants, who were mostly people of color, who looked like them and "who knew their stuff," sent the message that they can be a successful scientist, too, no matter their identity. Another student stated that as a person from an underrepresented group at a Predominantly White Institution, there are barriers to getting certain jobs, but the TILT OURA Lab could help reduce those barriers by teaching students transferable skills.

Several students mentioned that MURALS gave them the opportunity to express their interests and represent their identities through their scientific work. For example, one student chose to complete her independent research project about acid rain in Puerto Rico, where she lived as a child and still has family. She spoke about how meaningful it was to do her research project on this topic and to contribute to research that will help keep the islands she grew up on beautiful. Another student stated, *"My identity as a queer person led me to explore more projects at MURALS that were focused on people's different identities, and I got to learn more about that."*

Entering Research Learning Assessment (ERLA)

During the last week of their lab experience, students in the Fall and Spring cohorts were invited to complete the Entering Research Learning Assessment (ERLA). The ERLA is a validated survey designed to measure changes in seven constructs among undergraduate and graduate student early researchers: 1) Research Comprehension and Communication Skills, 2) Practical Research Skills, 3) Research Ethics, 4) Researcher Identity, 5) Researcher Confidence and Independence, 6) Equity and Inclusion Awareness and Skills, and 7) Professional and Career Development Skills. The survey instrument is comprised of 53 items on a 5-point rating scale ranging from "No Gain" to "Great Gain." The average gain was calculated within each of the seven constructs (Figure 1). The frequency of reported "good gain" or "great gain" within all 53 survey items is reported in Appendix A. The Fall 2021 response rate was 69%, and the Spring 2022 response rate was 73%.

Students reported moderate to good gains within all ERLA constructs.

Overall, all average reported gains fell between a moderate gain (mean = 3.0) and slightly above a good gain (mean = 4.0). Students in the Spring cohort reported greater average gains in all constructs, except research ethics, than students in the Fall cohorts.

Among the Fall cohorts, students reported the greatest gain within their development of practical research skills (mean gain = 3.88), followed by research confidence and independence (mean gain = 3.85). The lowest gain among the Fall cohorts was within equity and inclusion awareness and skills (mean gain = 3.16), however students still reported a moderate gain within this construct.

Students in the Spring cohort reported the greatest gains within researcher confidence and independence (mean gain = 4.11) and research comprehension and communication skills (mean gain = 4.11). They also reported a good gain within practical research skills (mean gain = 4.02). The lowest gain among the Spring cohort was within research ethics, but students still reported a moderate-to-good gain within this construct (mean gain = 3.67). And while the Fall cohorts reported a good gain in equity and inclusion awareness and skills, this increased among the Spring cohort to a good-to-moderate gain (mean gain = 3.69).

Figure 1. *Students reported moderate-to-good gains in all ERLA constructs after participating in the TILT OURA lab*
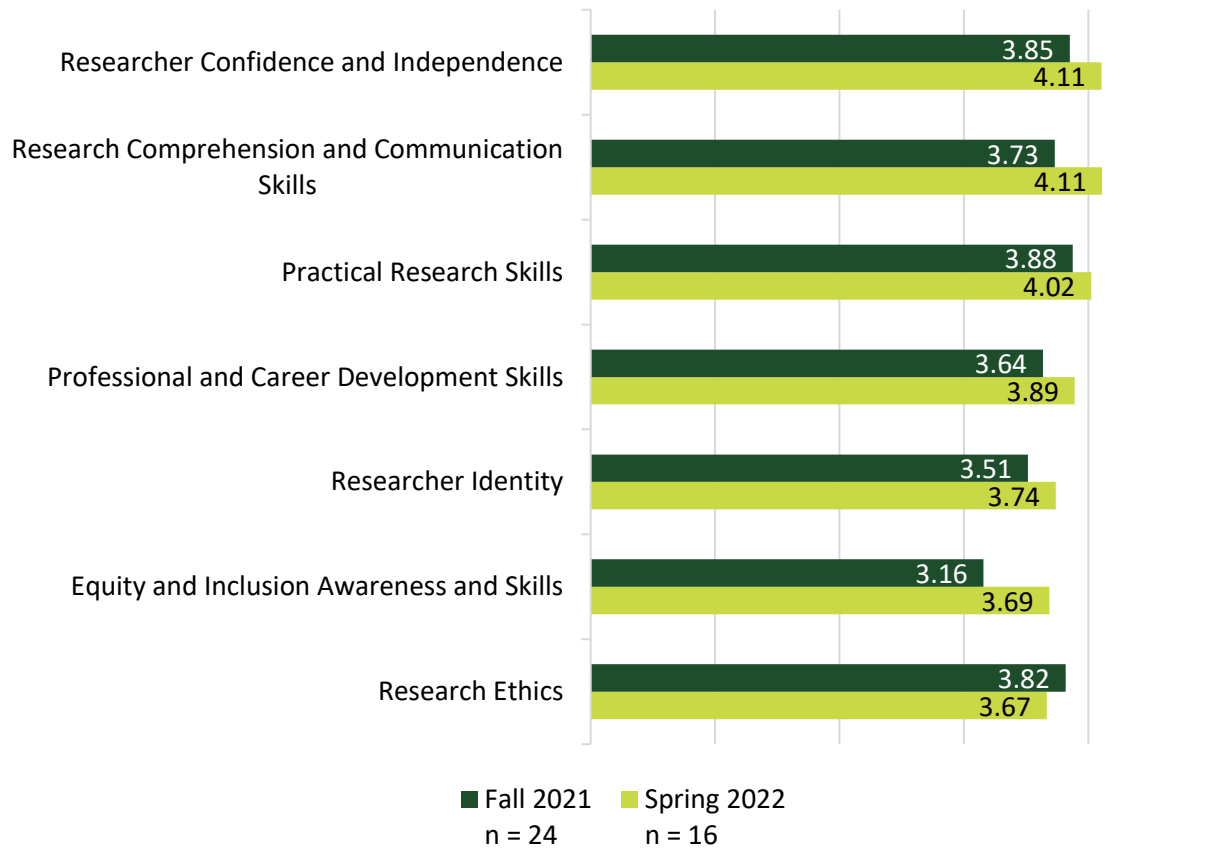
Prior and Future Research Experience

Almost all students plan to pursue future research opportunities and feel the TILT OURA Lab prepared them to do so.

Within the ERLA survey, students were asked about their research experience before joining the TILT OURA lab and their likelihood of pursuing future research opportunities after completing the TILT OURA Lab experience. Among both the Fall and Spring cohorts, 75% of students reported having no prior research experience before the TILT OURA Lab. Eighty-eight percent of students in Fall and 94% of students in Spring said they were either somewhat or extremely likely to pursue future research opportunities.

During the focus groups, students reported that they felt prepared to pursue future research opportunities due to the transferable practical lab skills they learned (e.g., pipetting, using an autoclave, setting up gels for electrophoresis) and the increased confidence these skills provided them in pursuing future lab experiences. They believed the skills they gained through the TILT OURA Lab could help them gain a position in a research lab at CSU.

Students also reported learning about the culture of a lab, such as how to work in the lab, the importance of details, safety procedures, keeping a lab notebook, staying organized, collaborative problem solving, and how research is conducted by working both independently and with others. Students also mentioned that the experience helped them feel more comfortable in a lab environment and led them to want to do more research in the future. As one student stated, *"[TILT] OURA Lab made it clear to me that I can belong, and I do belong, in the lab. Sure, there's always going to be first day fear walking into a new lab, but I know I can be in a research group."*

Students, however, also described several barriers to pursing future research opportunities that continue to exist after their TILT OURA Lab experience. First, students named their busy schedules as a barrier to gaining a research position at CSU. Students said that their schedules are very full and irregular, which leads to difficulty in determining a consistent schedule to work in a lab or field research position. Students also described challenges with networking and connecting with professors as a continued barrier. They mentioned meeting professors at MURALS and then not knowing how to build upon those introductions. One student said that they needed to know where to go after the TILT OURA Lab experience and that they would like a better understanding of how to reach out to professors about research opportunities. Other students mentioned a desire for faculty or research scientists from across campus to visit the lab as guest speakers to talk about the research and their work as scientists. Students also shared a desire for gaining additional skills before feeling ready to pursue research positions in labs on campus. They said that the skills they learned in the TILT OURA Lab were good basic skills, but they feel they still lack the skills needed for specific disciplines, such as microbiology or wildlife biology. And lastly, students mentioned that funding was a barrier, and the need to support themselves and/or their families financially put limitations on their ability to devote time to unpaid or low-paying research positions.

Students' TILT OURA Lab Experience

Students had variable experiences with independent learning in the lab.

A common theme across focus groups was the emphasis on independent learning in the lab, where students were tasked with self-discovery versus being directed in their learning. Some students appreciated being asked to try to figure out things on their own, while other students felt they needed more guidance. Some felt that the opportunity for independent problem solving helped them to grow as a scientist. They enjoyed the freedom to experience the lab and use the materials without someone telling them what to do at each step. Others felt frustrated by the emphasis on independent learning and felt like they did not always know what they should be doing at times or how to do the experiments.

Students appreciated the collaborative nature of the lab.

While the emphasis on independent learning was enjoyed by some students and frustrating to others, students mentioned that this emphasis led to authentic collaboration among lab members as they worked together to figure out how to do the experiments. Students reported working with each other to learn procedures, and students coming into the lab on different days would explain how to do the activity to students who were just beginning the activity. One student said it was very powerful to work on problem solving as a group, and that she learned the most in the lab from peers. Some students reported experiencing a feeling of teamwork through informal conversation and collaboration, particularly when there were transitions to new activities.

Students bonded closely with other students who worked in the lab at the same time as them, but they desired closer connections with the full lab cohort. Many of the students reported feeling uncomfortable when they would cross paths in the lab with someone who they had not seen before and who typically was not in the lab on the same days as them. There were also some reports of students thinking that a fellow student participant was an LA or TA and vice versa, and one student reported working with someone for several weeks and never knowing their name. Students' suggestions for improving this aspect of the lab experience were to hold more events that brought the entire lab cohort together, a greater emphasis on team building across the cohort, and providing each lab member with a nametag that identified their name and lab role.

Students desired increased funding for the lab.

Students desired an increase in funding for the lab for a variety of reasons. First, students expressed frustration over the availability and state of equipment in the lab. Some mentioned that the lab was not equipped with tools they needed to carry out their desired independent projects, and several mentioned that additional funds were needed to repair and maintain the lab equipment. Students reported frustration and excessive downtime during the lab due to equipment failure, especially the pH meter. Increased funding was also desired by the students, as it would allow for more students to participate in the TILT OURA Lab and would allow students to participate for more hours each semester.

Future Directions

Based on the ERLA and focus group findings, the TILT OURA Lab is achieving many of its objectives, including developing students' confidence in their research abilities, development of hands-on laboratory techniques and skills, fostering peer collaboration, developing scientific communication skills, and creating a supportive and caring laboratory environment. Areas for improvement identified by students in the lab include increased opportunity for cohort team building and additional scaffolding for lab activities.

From this feedback, the following changes are planned for Fall 2022 to improve students' lab experience and learning:
  - Shifting from a virtual to in-person orientation that includes a community-building activity
  - Displaying photos and name tags for the assistants and the TILT OURA Lab participants so they get to know each other more quickly
  - Including new "challenge activities" designed to build students' metacognitive and self-evaluation skills that students can engage in to demonstrate proficiency in the lab techniques and skills learned that week
  - Provide students with additional time and support for exploring future research opportunities beyond the OURA Lab

Future assessment efforts for the TILT OURA Lab include:
  - Conducting focus groups and surveys with students one year following their TILT OURA Lab experience to learn about their current research activities and their reflections on the preparation they received in the TILT OURA Lab
  - Survey TILT OURA Lab participants as graduating seniors to learn about their on- and off-campus research experiences during their undergraduate career
  - Track TILT OURA Lab participants receiving Celebrate Undergraduate Research and Creativity (CURC) awards, competitive research scholarships and fellowships, such as the NSF Graduate Research Fellowship Program, and receiving admissions to graduate or professional school within a STEMM discipline

Appendix A

Frequency of "good" and "great" gains within Researcher Confidence and Independence ERLA construct

	Fall 2021 n = 24	Spring 2022 n = 16
Work independently on your research project	83%	94%
Investigate problems when they arise in your research (e.g., troubleshoot)	71%	88%
Confidence in conducting research	67%	88%
Confidence in coping with challenges when they arise in your research project	63%	88%
Confidence in staying motivated and committed to your research project when things do not go as planned	58%	88%
Determine the next steps in your research project	67%	81%
Confidence in completing your research training	79%	75%

Frequency of reported "good" or "great" gains within Research Comprehension and Communication Skills ERLA construct

	Fall 2021 n = 24	Spring 2022 n = 16
Accept and use criticism of your research to improve your research	75%	94%
Understand that the process of discovery is iterative and never ending	75%	94%
Ask questions to clarify your understanding of your research project	79%	88%
Practice regular and open communication with your research mentor	71%	88%
Work in the research environment comfortably	67%	88%
Understand the theory and concepts guiding your research project	67%	88%
Use logic and evidence to build arguments and draw conclusions from data	63%	88%
Use logic and evidence to interpret data	58%	88%
Analyze data	54%	88%
Communicate the context, methods, and results of your research	63%	81%
Demonstrate understanding and comprehension regarding your research project	63%	81%
Communicate the relevance of your research to others	54%	81%
Practice regular and open communication with your research team members	83%	75%
Tailor your research communications for different audiences	46%	75%
Align your research experience goals and expectations with your research mentor's	42%	63%

Frequency of "good" or "great" gain within Practical Research Skills ERLA construct

	Fall 2021 n = 24	Spring 2021 n = 16
Do experiments	92%	94%
Collect data	83%	94%
Conduct a research project	73%	94%
Design a research project	63%	88%
Make detailed observations	79%	81%
Formulate a research question/hypothesis	67%	81%
Determine an analysis plan/statistical methods to analyze your data	54%	81%
Understand the safety precautions relating to your research	67%	75%
Work effectively with the subject of study (e.g., mathematical models, mice, plans, rock formations)	63%	75%
Use the tools, materials, and equipment needed to conduct research	83%	69%
Keep detailed research records (e.g., a lab/field notebook)	83%	69%
Make a case for your research question based on the literature	42%	63%
Determine the appropriate experimental approach to investigate your research question	71%	56%

Frequency of reported "good" or "great" gains within Professional and Career Development Skills ERLA construct

	Fall 2021 n = 24	Spring 2022 n = 16
Develop a plan to pursue a research career (determine the next steps in your training)	63%	75%
Confidence in pursuing a career in research	58%	75%
Set research career goals	58%	75%
Explore possible research career pathways	54%	63%

Frequency of reported "good" or "great" gains in Researcher Identity ERLA construct

	Fall 2021 n = 24	Spring 2022 n = 16
Think of yourself as a scientist/researcher	**67%**	**81%**
Fit in with the research culture of your discipline	**54%**	**81%**
Fit in with the culture of your research group	**58%**	**69%**
Feel like you belong in research	**50%**	**69%**
Behave like a researcher in your discipline	**63%**	**56%**
Call yourself a researcher when talking to others	**33%**	**50%**

Frequency of reported "good" or "great" gains in Equity and Inclusion Awareness and Skills ERLA construct

	Fall 2021 n = 24	Spring 2022 n = 16
Understand the impact of biases on your interactions with others in a research environment	**46%**	**81%**
Understand how others might experience research differently based on their identity (e.g., race, socioeconomic status, first-generation status, etc.)	**63%**	**69%**
Advocate for others who may be marginalized or excluded from the research environment	**58%**	**69%**
Identify the biases and prejudices that you have about others	**42%**	**63%**
Identify the biases and prejudices that others may have about you	**21%**	**50%**

Frequency of reported "good" or "great" gains within Research Ethics ERLA construct

	Fall 2021 n = 24	Spring 2022 n = 16
Identify forms of unethical practices or research misconduct	79%	63%
Understand the consequences of unethical practices or research misconduct	71%	56%
Take action to address unethical practices or research misconduct	50%	50%