

Appendix S1. Participating Undergraduate Research Programs

Our study population included students participating in summer undergraduate research programs through Binghamton University (Binghamton, NY). Binghamton University is a public research university in the State University of New York System (SUNY) which hosts several summer undergraduate research programs, including Summer Scholar and Artist Program (SSAP), McNair Scholars Program (McNair), Louis Stokes Alliances for Minority Participation (LSAMP), Collegiate Science and Technology Entry Program (CSTEP), and Bridges to Baccalaureate (Bridges). Each program involves undergraduate students conducting mentored research throughout the summer. Students typically participate in a given program for one summer only. While most research activities are conducted independently with a faculty mentor, students convene as a group throughout the summer with other members of their program to introduce their projects, discuss their progress, and practice communicating their research.

While students in these programs share the experiential identity of being undergraduate summer researchers, other identities of the students may be influenced by the differing requirements and qualifications for participation in each program. For example, McNair is a federal program that is limited to students who come from first generation, low income backgrounds or are of a minority group that is underrepresented in higher education. LSAMP and CSTEP share similar demographic requirements, while Bridges is limited to local community college students from underrepresented groups. Conversely, SSAP has no specific demographic qualifications for participation besides being an undergraduate student conducting research at Binghamton University. As such, students participating in research programs which are limited to specific socio-economic identity factors (McNair, LSAMP, CSTEP, and Bridges) are more likely (but not necessarily) to have shared identities within their programs than students in research programs with no demographic specifications on participation (SSAP). Additionally, while all programs operate separately, McNair, LSAMP, CSTEP, and Bridges students come together weekly throughout the summer for seminars and other group activities, including discussion of being underrepresented in higher education. Combined, the number of students who participated in our study in these four programs approximately equaled the number of students in SSAP.

Students in the LSAMP, CSTEP, Bridges and McNair Programs had weekly professional development and social events together throughout their 10 week programs, having occasion to get to know one another before the dialogue was held at the end of the summer. SSAP students did not have regular program events nor had occasion to meet the students in the other research programs. To keep students in familiar peer cohorts, McNair, LSAMP, CSTEP, and Bridges students participated in dialogues together, while SSAP students conducted dialogues together.

There were approximately 20 students in the Summer Scholars and Artists Program (SSAP) and 35 LSAMP/C-STEP/McNair/Bridges Programs each summer we ran the workshops. All were invited and SSAP students “required” to attend, but given the remote nature of some of their research, they were not able to get to campus for it and were excused. The other programs had recommended attendance rather than mandatory. In year one, 33 students participated and gave research consent, and in year two 26 participated and gave research consent. There were a few students in each year who participated and did not give consent to participate in the research aspect of the workshop.

The specific information regarding each participating program is listed below.

Summer Scholar and Artist Program (SSAP)

Discipline(s): Any; interdisciplinary projects encouraged

Undergraduate year(s) or level(s): Any

Student demographics: Any

Student stipend: Yes

GPA requirement: No

McNair Scholars Summer Research Internship Program (McNair)

Discipline(s): Any

Undergraduate year(s) or level(s): Completed at least 48 credit hours

Student demographics: United States citizen or permanent resident; low-income, first-generation college student and/or historically underrepresented minority (African American, Hispanic/Latino, Pacific Islander or Native American); interested in pursuing a PhD

Student stipend: Yes

GPA requirement: Yes

Louis Stokes Alliances for Minority Participation (LSAMP)

Discipline(s): Science, technology, engineering, or mathematics (STEM)

Undergraduate year(s) or level(s): Any

Student demographics: United States citizen or permanent resident; from an underrepresented racial/ethnic group: Native American, Black, African-American, Hispanic, Latino, Native Hawaiian, or other Pacific Islander

Student stipend: Yes

GPA requirement: Yes

Collegiate Science and Technology Entry Program (CSTEP) Summer Research Internship Program

Discipline(s): Pre-law; pre-health; engineering; nursing; accounting; psychology

Undergraduate year(s) or level(s): Any

Student demographics: New York state resident; African-American, Hispanic/Latino, American Indian or Alaskan native; economically disadvantaged

Student stipend: Yes

GPA requirement: No

Bridges to Baccalaureate (Bridges)

Discipline(s): Science, technology, engineering, or mathematics (STEM)

Undergraduate year(s) or level(s): Community college student

Student demographics: United States citizens or permanent residents; full-time Monroe, Onondaga, or Westchester Community College students; interest in conducting biomedical research and obtaining a STEM bachelor's degree; belong to a NIH under-represented population

Student stipend: Yes

GPA requirement: Yes

Appendix S2. Instrument and learning outcome prompts.

A. Instrument Prompts

Objective

Core Question: What is the main purpose of research (includes creative activity) in general?

1. Good research gives people something to think about.

Disagree

Agree

1 2 3 4 5 Don't know. Not applicable.

2. Good research convinces people of something.

Disagree

Agree

1 2 3 4 5 Don't know. Not applicable.

3. Good research shows people how to do something.

Disagree

Agree

1 2 3 4 5 Don't know. Not applicable.

4. A good researcher should be primarily concerned with realizing their own vision for their project.

Disagree

Agree

1 2 3 4 5 Don't know. Not applicable.

5. Most undergraduate researchers at Binghamton have the same kind of objectives.

Disagree

Agree

1 2 3 4 5 Don't know. Not applicable.

Audience

Core Question: Who is the primary audience for your research (includes creative activity) project?

1. Good research has something to say to everyone.

Disagree

Agree

1 2 3 4 5 Don't know. Not applicable.

2. Good research speaks to people interested in the subject.

Disagree

Agree

1 2 3 4 5 Don't know. Not applicable.

3. Good research speaks to experts in the field.

Disagree

Agree

1 2 3 4 5 Don't know. Not applicable.

4. A good researcher shouldn't worry about what their audience thinks.

Disagree

Agree

1 2 3 4 5 Don't know. Not applicable.

5. Most undergraduate researchers at Binghamton feel the same way about their audience.

Disagree

Agree

1 2 3 4 5 Don't know. Not applicable.

Inputs and Outcomes

Core Question: What kind of raw material (e.g., articles, observations, information) does your research project use (including creative activities), and for what outcomes?

1. Good research is grounded in facts about the world.

Disagree

Agree

1 2 3 4 5 Don't know. Not applicable.

2. Good research is grounded in the opinions of experts.

Disagree

Agree

1 2 3 4 5 Don't know. Not applicable.

3. The goal of my research project is to arrive at the truth rather than express myself.

Disagree

Agree

1 2 3 4 5 Don't know. Not applicable.

4. The goal of my project is to help me advance in my career.

Disagree

Agree

1 2 3 4 5 Don't know. Not applicable.

5. All undergraduate researchers at Binghamton have the same research outcomes.

Disagree

Agree

1 2 3 4 5 Don't know. Not applicable.

Process

Core Question: How will you get from research (includes creative activity) inputs to outcomes?

1. I use transferable skills (e.g., oral and written communication, critical thinking, logical reasoning) that I have learned in courses in my research process.

Disagree

Agree

1 2 3 4 5 Don't know. Not applicable.

2. The primary reason for participating in research is to develop specialized skills.

Disagree

Agree

1 2 3 4 5 Don't know. Not applicable.

3. A research project combines learned skills in original ways.

Disagree

Agree

1 2 3 4 5 Don't know. Not applicable.

4. The research process is just as important as the result.

Disagree

Agree

1 2 3 4 5 Don't know. Not applicable.

5. Undergraduate researchers with the same set of research materials, applying the same research process, should reach the same conclusion.

Disagree

Agree

1 2 3 4 5 Don't know. Not applicable.

Identities

Core Question: How do researchers' identities shape research (includes creative activity) in general?

1. I have the opportunity to do research this summer because I worked hard to earn it.

Disagree

Agree

1 2 3 4 5 Don't know. Not applicable.

2. Research is not shaped by a researcher's identities.

Disagree

Agree

1 2 3 4 5 Don't know. Not applicable.

3. All undergraduate students at Binghamton have equal access to undergraduate research opportunities.

Disagree

Agree

1 2 3 4 5 Don't know. Not applicable.

4. My identities influence how people interact with me as a researcher.

Disagree

Agree

1 2 3 4 5 Don't know. Not applicable.

5. The identities of other researchers determine how I interact with them as researchers.

Disagree

Agree

1 2 3 4 5 Don't know. Not applicable.

6. All research should take into account issues of justice, equity, and inclusion.

Disagree

Agree

1 2 3 4 5 Don't know. Not applicable.

B. Learning Outcome Questions

1. Do you see value in learning about the intellectual perspectives of your fellow scholars?
2. Did you learn something about your own intellectual perspective? If so, what?
3. Did you learn something about your fellow scholars' intellectual perspectives? If so, what?
4. Did you learn anything that you could integrate into your research?

C. Prompts discussed in each dialogue

	2021 McNair, LSAMP, CSTEP, and Bridges	2021 Artists & Scholars	2022 McNair, LSAMP, CSTEP, and Bridges	2022 Artists & Scholars
Objective Prompts	Group A: 2, 3, 4	Group A: NA Group B: 1, 2	Group A: 2, 4, 5 Group B: 1, 2, 3, 4 Group C: 1, 2, 4	Group A: 1, 2, 5 Group B: 1, 2, 4, 5
Audience Prompts	A: 3	A: NA B: NA	A: 1, 4, 5 B: 1, 2, 3 C: 1, 2, 3, 5	A: 2, 3, 5 B: 1, 2, 3, 4, 5
Inputs and Outcomes Prompts	A: 5	A: 4 B: 2, 3	A: 2, 3, 5 B: 1, 3, 4, 5 C: 3, 4	A: 2, 5 B: 1, 2, 3, 4, 5
Process Prompts	A: 2, 4, 5	A: 4 B: 2, 3, 5	A: 1, 2, 3, 5 B: 1, 2, 4 C: 1, 2, 3, 4	A: 1, 5 B: 1, 4
Identities Prompts	A: 2, 4, 5	A: 3, 4 B: 1, 2, 3, 4, 6	A: 1, 2, 3, 4, 6 B: 1, 3, 4 C: 1, 2, 3, 4, 5, 6	A: 1, 2, 3, 6 B: 1, 3, 4, 5, 6

Appendix S3. Coding guidelines & codebook.

Approach to coding:

Coding is done by examining sequences of utterances within transcripts.

1. Have a copy of the Binghamton-Toolbox instrument handy for reference.
2. Read through the entire transcript.
3. Analyze each transcript by coding it in depth:
 - i. Each speaking turn could receive more than one code. Try to align each code with the specific portion of the utterance that illustrates the code. Speaking turns that are not interpretable (mmm hmms, laughter) do not receive codes.
 - ii. As you read the thread, **make note of key content** in the discussion, including which core question is being discussed, key distinctions, how participants seem to be engaging with each other, and other things that could inform us about the impact/outcomes of the workshop.
 - iii. If one is debating between two interpretations, all else being equal, *go with the more conservative interpretation*. (This is especially true in the case of reconciliation between coders.)
 - iv. If one speaking turn includes more than one distinct instance of a conversational function, use more than one instance of the code.

Appendix S3 Table 1. Thematic codebook.

Thematic Code <i>Subcode</i>	Description	Examples
Epistemology (EP)	Ways of knowing	
<i>EP - Objectivity</i>	Research as grounded in “facts” or evidentiary or empirical base, “truth”	“So I think that it is important for humanities research to keep in mind the goal of the finding at least what you believe to be the truth is of your research, or at least an overarching idea that can be found in your research, instead of just simply using – I don't know. The freedom of this discipline to pursue whatever and argue whatever. I've noticed this even in some scholarly papers I've read. These people do selective quoting.”
<i>EP - Subjectivity</i>	Ways of knowing as being subjective; including research as opinions interpreted by “experts” or other lens	‘I think the idea of facts about the world is very subjective. Even though it's so hard – the whole point of the word facts is that it's not something subjective. But I feel like to say that something is a fact about the world can get dicey quick. Because science is always evolving science is always changing and things that we think are facts are all of a sudden not facts. Like before we even know it.’
<i>EP - Self-expression</i>	Research as a form of self-expression (i.e. rather than “truth,” or stand alone as expression)	“Because my project, not to whatever, but it's just targeting sex differences in the brain that exist that have never been looked at, before. So that's what I care about and that's what I'm expressing myself through. Making neuroscience societally and culturally relevant. That being said, I guess the specific goal of my research is far more specific than that. But that specific isn't what is the reflection of me. It's the overall purpose.”
Research Relevance (RR)	Relating to the relevance of the research objectives	
<i>RR - Personal</i>	Personal reasons why students chose to do research	“I think when I – my research is my Honors thesis. Obviously part of that's getting an Honors degree, which is very lucrative. And now that I – where I am with my research, it might be something that I can be published, which will help me advance my career a huge way.” “So I think it's also helping advance my career, just like my life in general, and it's helping me figure out who I am and what I want to do in the future. Like do I want to stay in the research field, do I want to stay in academics, or do I want to go to industry to do research?”
<i>RR - Societal</i>	Research is for a higher purpose than personal motivations and rewards, for the benefit groups of people, relevant to society	“I also agree like it doesn't necessarily have to show you how to do something. But I think that descriptive methodology is really important for, more for research and less for like the outside world implications.”

<i>RR - Scholarship</i>	Research is for the purpose of advancing scholarship and/or the field	"Research goal I would say is to advance the field rather than necessarily my own career."
<i>RR - Fundable</i>	Research topic that would garner the interest of funders, research as dependent on funding	"I also think going off the same question, when I was considering the convincing part like applying for grants, you have to convince someone that your research is important and [unintelligible 0:10:50] for it to be approved and for you to get a grant to continue your research. So in a sense if your research is irrelevant and people think your research is unprovable, then they're not convinced then that may indicate that your research is bust [?]."
Ethics (ET)	Ethical responsibilities of researchers	
<i>ET - Outcomes</i>	Harmful or beneficial, the purpose of research (outcomes as an indicator of purpose), concrete or abstract, utilitarian or conceptual outcomes	"So my research is exactly as I said the big thought bubble of academia taking all of these perspectives from all these different researchers out of it and trying to find the common thread of it. And I think that from my perspective, that being research, I definitely think that – I don't want to say the point of research, there's a lot of points of research. But one of the big ones is that we're advancing our thought and we're opening our minds and having things to think about that maybe we didn't think about before."
<i>ET - Bias</i>	Use of opinion, personal experience or motivation to shape research	"So, I don't think you can ever be 100% without bias. I think the best you can do is just try to acknowledge where your biases are. And then do as much research as you can. Especially research that can challenge your biases, so that you can come to ideas that challenge you and confront those biases."
Identities (ID)	Seeking understanding about self to contribute to productively to society	
<i>ID - Positionality</i>	Influence of identity on research and as a researcher (how others see or treat you as a researcher, how you see or treat other researchers based on identity)	"And so personally, I like to include as much diversity as I can in my research, because I myself am a Black man, so I want to know about Black skin, to know about people of color's skin, and stuff like that. And I think if I did not have that connection, I might not feel the same way, so I definitely think it is shaped by someone's identity."
<i>ID - Access</i>	Opportunity, contingency, program requirements, privilege, difference in opportunities in STEM vs humanities	"And it just kind of shows like it's a factor of like privilege, because you have to know people to get into research. That's kind of like – I think that's pretty much a fact. I just have figured that out just being at the school. But also like there's undeniable standards of what type of student you have to be, what type of background you need to have, what sort of skills you're supposed to come in with already. And I think it just makes it really hard if you come from a background where research was never something your parents did or your guardians or anyone in your life. So I think that it's not equal access but also there's just not enough spots for everyone at this school."
<i>ID - Trust in self or others</i>	Admitting anxieties about scholarly identity, finding	"I think it's important to acknowledge your own work and to acknowledge that even though it doesn't feel like you're working

	strength in difference in themselves	hard for yourself, you are working hard and working hard can give you opportunities even if they are not necessarily equal opportunities.'
Communicating Research (CR)	The purpose and/or process of communicating research and research findings	
<i>CR - Ethics</i>	Researchers have (or do not have) an ethical responsibility to communicate their research accurately and/or to or for specific audiences and/or for the betterment of society	"But wouldn't it make sense for there to be some sort of person to then decide for the research and then explain it to parents? Like, what if it was to a level that was dangerous for babies? You can't leave it up to individual parents to go read your paper and make that decision. You have to get the information out there."
<i>CR - Process/ Objective</i>	Communicating research is an integral part of the research process (e.g., like making a hypothesis or carrying out the experiment) and/or an integral objective; the way that your research will be communicated and/or the audience to whom it will be communicated impacts the process of the research itself	"I think the primary goal of research is just informing people of, well, in my specific research discipline, it's about medicinal chemistry, or just drug intake or pharmaceuticals. It will be very important to inform people about, like, what are the safeties of this, and it's up to them if they want to choose to take the drug."
<i>CR - Feedback</i>	The purpose of communicating research is to get feedback and ideas from others (e.g., other experts, colleagues, stakeholders) to help shape your current/future work (e.g., peer review, questions at conferences, community input)	"They should know all the answers, but they should still be curious enough to go back to you and oh, how are you gonna move on from this point, or, like, could you expand on the data sheet or something. I feel like they should be thinking about it in a way that is about the future research, rather than why or how you did it, because that should be already presented in the first place."
<i>CR - Audience</i>	Research is communicated differently depending on the audience; research is communicated to or for different groups (e.g., for other experts, for specific stakeholders, or for general/lay audiences)	"You don't use all of the same fancy jargon when you're talking to the regular people who might not know anything about your field. But you do if you're writing specifically to other researchers who already know the basics and you're trying to get into really advanced stuff. So, the audience varies entirely from project to project, person to person, ideas."
Research Process (RP)	Practices in the research process (use of data, involvement of participants, analysis of data, etc.)	"I feel like oftentimes you can come across things while researching your project that you didn't think of and you will have to change the way you were going about doing things because you didn't consider certain things. So, I think you have to be very flexible."
Mentorship	Any mention of student interaction or relationship with their advisor / mentor, especially as it relates to being a support or barrier	"I feel like the more expert – if I know there is someone in the audience like my mentor or my professor who literally knows what I'm talking about more than me, that puts a lot of pressure."

DEI Lens in Research (DEI)	Refers to using DEI as a lens to interpret, assess, and understand different research stages, from team's composition to specific research processes and outcomes.	"What I mean in particular, like an example – because like for alcohol use disorder, in the past 50 years, now they're only doing studies on female mice, for instance, and that was not any portion. Like that's a significant body of people to be able to translate that to humans. It's really hard. So that's what I mean particularly. But it doesn't mean that research is not informative. Because I think even though research on the mice is important, and it does translate in some ways, I think sometimes it doesn't have something to say for everyone, because it's purposefully excluding bodies that need to be represented."
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