Catalyzing Inclusive STEM Experiences All Year Round (CISTEME365)

April 11, 2019 Webinar
Prof. Lynford Goddard

https://cisteme365.engineering.illinois.edu/
Outline

• Prior Work
• Goals and Objectives
• Research Team
• Program Overview
• Summer Institute
• Action Research Projects
• Q&A
Prior Work

- nano@Illinois Research Experience for Teachers
  - [http://nano.illinois.edu/education/RETmodules/index.html](http://nano.illinois.edu/education/RETmodules/index.html)

- Worldwide Youth Science Camp (WYSE)
  - Girls Learning Electrical Engineering camp
    - [https://www.istem.illinois.edu/news/games.glee.18.html](https://www.istem.illinois.edu/news/games.glee.18.html)
Project Goals

• Overall Goal: to broaden the participation of students from underrepresented groups through year-round technology and engineering rich informal learning experiences so that the students can build discipline-based knowledge and better understand what careers in specific STEM fields entail

• Quantitative Goal: Enable 1,000 MS/HS URSs to participate in sustained, intensive, hands-on STEM learning experiences that build technical knowledge and ability and that offer insights into different STEM careers.
Objectives for Quantitative Goal

1. Equip 24 MS/HS IDEA teams with strategies and resources to promote their students’ interest in, pathway towards, and technical ability to pursue, a career in STEM. We will achieve this by offering a comprehensive 10-day (80 hour) summer institute that teaches key knowledge, attitudes, and behaviors, and provides resources to realize the desired improvements and by facilitating an ongoing networked improvement community (NIC) that conducts action research for equity projects (AREPs) during the school year (20-60 hours) to improve how STEM access is addressed.
Objectives for Quantitative Goal

2. Work with the IDEA teams to develop, launch, fund, and sustain afterschool, weekend, and/or lunchtime STEM clubs/academies that provide unique engineering design, project-based, and other hands-on experiences (60-120 contact hours/year) to 1,000 students during the school year.

3. Provide scholarships to 228 students to attend existing STEM summer camps (27-44 contact hours) at the UIUC campus.
CISTEME365 Team

- Researchers, Instructors, and Evaluators at the University of Illinois, National Alliance for Partnerships in Equity, Iowa State University, and University of North-Carolina Greensboro

Prof. Goddard
Engineering

Dr. Pollock
Equity Instructor

Dr. Williams
CEO/Learning Dev.

Dr. Hebert
Outreach Coord.

Dr. Rosu
ISTEM Director

Prof. Baber
Education Research

Dr. Ahmad
Industry Liaison

Prof. Boyce
External Evaluator
**Logic Model / Theory of Action of Program**

**Situation:** The US economy needs significant growth in the size and the diversity of its STEM workforce to remain competitive. It is critical that more female, underrepresented minority, and low-income MS/HS students develop interest in and have access to educational pathways to these future jobs. However, students from these underrepresented groups often do not have adequate access to transformative learning experiences in STEM. Thus, the fundamental project goal is to enable 1,000 MS/HS students to participate in sustained, intensive, hands-on STEM learning experiences that build technical knowledge and ability and that offer insights into different STEM careers.

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Participants</th>
<th>Activities</th>
<th>Short Term Outcomes</th>
<th>Projected Impact</th>
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<tbody>
<tr>
<td>1. A cohesive 3-pillar program grounded in prior education research</td>
<td>1. MS/HS counselors and educators (72 total) form IDEA teams at 24 schools and do activities A-C</td>
<td>A. Host summer institute (80 hrs) for IDEA teams to learn key KAB and technical skills</td>
<td>[Act. A-D] Improved student knowledge of, interest in, and aspirations for STEM careers and educational pathways</td>
<td>[Act. C-D] Students are exposed to content and career options likely otherwise unknown</td>
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<td>2. Faculty and staff time and distinct expertise</td>
<td>2. MS/HS students from underrepresented groups (1000 total) do activity C; some also do activity D</td>
<td>B. IDEA teams conduct action research under PI guidance in a school-year networked improvement community (20-60 hrs/yr)</td>
<td>[Act. C-D] Increased student self-efficacy and discipline specific skills / knowledge</td>
<td>[Act. A-D] More participating students enroll in advanced HS science and math classes and pursue STEM majors / careers than a control group of similar URSs</td>
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<td>3. Past experiences of participating counselors and educators</td>
<td>3. PIs and staff lead or assist on activities A-F</td>
<td>C. Launch STEM clubs to provide 1,000 students with engineering design, project-based, and other hands-on experiences (60-120 hrs/yr)</td>
<td>[Act. A-C] Improved educator and counselor understanding of STEM careers and paths</td>
<td>[Act A-C] Schools are more effective in identifying and addressing behaviors or policies that contribute to inequities in STEM</td>
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<td>4. A network of school districts, CTE consortia, out-of-school youth programs, and industry</td>
<td>4. Education researcher (Dr. Lorenzo Baber) leads activity E</td>
<td>D. Scholarships given to 300 students for summer camps (27-44 hrs)</td>
<td>[Act. A-C] Improved educator and counselor attitudes on who belongs in STEM and motivation to act as advocates</td>
<td>[Act A-C] Schools serve underrepresented students in STEM more effectively</td>
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<td>5. Validated assessment tools for measuring student outcomes</td>
<td>5. External evaluator (Dr. Ayesha Boyce) leads activity F</td>
<td>E. Conduct research on student self-efficacy and content knowledge and on IDEA team KAB</td>
<td>[Act A-C] Counselors and educators adjust their practices and help to address inclusion, diversity, equity and access issues in STEM</td>
<td>[Act. E-F] Follow-up program to SPrEaD to schools across the US</td>
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<td>6. Framework for conducting action research in a networked improvement community</td>
<td>6. Advisory board (Prof. Lizanne DeStefano, Dr. Mark Lippi, and Mr. Terry Koker) provides feedback on all activities</td>
<td>F. Internal and external evaluation coordinate to assess the effectiveness and impact of each proposed intervention.</td>
<td>[Act. E-F] Program impact / effectiveness / sustainability are demonstrated</td>
<td>[Act A-F] A larger and more diverse STEM workforce is developed</td>
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<td>7. A vetted curriculum for STEM club activities</td>
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<td>[Act. E-F] Research results are published in journals</td>
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<td>8. The infrastructure and resources of the existing UIUC summer camps</td>
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<td></td>
<td>[Act. E-F] Program best practices are disseminated at regional and national teacher and counselor conferences</td>
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Commitments from the School / Application Process

• Brief review of letter
Summer Institute

• Days 1-5: Dr. Pollock will facilitate the discussions on best practices for promoting STEM awareness, academic planning, and subject knowledge. She will also explain how to form the NIC and to do AREPs.

• Days 6-10, the teams will break into focus groups.
  • Teachers and STEM club coordinators will meet with PI Goddard to: (1) learn the curriculum for the clubs by building each project in the lab and (2) brainstorm/try out new projects that students can do in the clubs.
  • Counselors will learn about: (1) summer STEM opportunities for their students by auditing selected camps, (2) educational pathways to STEM majors by meeting with university admissions counselors and with reps from pathway and mentoring programs focused on URSs, (3) careers in STEM, workforce development, and how to place their students in technical internships by meeting with university career counselors and job recruiters and by visiting startups and Fortune 500 companies at the UI Research Park, and (4) grand challenges in STEM fields and opportunities for their students to be involved in research through lab tours and discussions with faculty.
  • On the last day, both groups will reflect on and share what they learned at the institute.
What is an AREP

• The AREP is similar to a capstone project. It is the culmination of action research. It is not a thesis, and participants do not defend a dissertation, of sorts.

• The written report is short. Participants provide a 10-15 minute oral presentation. The project may be completed individually or by a team of 2-3 people.

• Example: Will teaching a unit on growth mindset change students’ perceptions about their ability to take a more rigorous mathematics class and/or pursue a STEM career?
Questions?
AREP FREQUENTLY ASKED QUESTIONS

What is an AREP?
The AREP is similar to a capstone project. It is the culmination of action research. It is not a thesis, and participants do not defend a dissertation, of sorts. The written report is short. Participants provide a 10- to 15-minute oral presentation. The project may be completed individually or by a team of 2-3 people.

Why an AREP?
The AREP provides participants with application and hands-on learning of the equity concepts learned through professional development. Collaborative Team Meetings help participants stay on task with the AREP development, implementation, and completion. These meetings provide a safe learning environment for participants to ask questions, further understand concepts, and develop strategies. If participating in one of NAPE’s Comprehensive Educational Equity Programs, participants are required to present their AREP outcomes.

How in-depth do we go with the AREP?
The AREP is action research. It involves collection of data, which can be qualitative or quantitative. However, the key is the action research, not hours of statistical analysis. Participants explore baseline data (of underrepresented or marginalized populations), formulate a hypothesis for one or more root causes, confirm the hypothesis, and select and implement a strategy to address the cause(s)—all within an academic year (sometimes shorter). The baseline data could range from performance data to asking elementary school students to draw their interpretation of an engineer. The goal is to use PIPE for continuous improvement in your classroom or at your school to further increase access, equity, and diversity.

What is meant by action research?
Action research is inquiry or research in the context of focused efforts to improve the quality of an organization and its performance. It typically is designed and conducted by practitioners who analyze the data to improve their own practice. Action research can be done by individuals or by teams of colleagues. The team approach is called collaborative inquiry.

Do LCLs need to complete an AREP?
In some cases, LCLs are not required to complete an AREP. However, many LCLs find it beneficial to do so, because they play a key role in participants’ completion. They provide guidance and oversight through the collaborative team meetings. In some cases, grant contracts may require the LCL to complete an AREP.

Do you have examples of AREP projects?
Super strategies are designed to address specific equity barriers for students. Example AREP topics and super strategies are provided in this workbook.

What is PIPE?
PIPE stands for Program Improvement Process for Equity™. This model outlines the goals for collaborative team meetings to support AREP completion, as lead by the LCL. PIPE is a systematic, research-based model that demonstrates effectiveness in increasing access, equity, and diversity. PIPE is designed for use by (1) educators in classrooms and (2) school teams focused on larger school-based issues. The process has six modules with the foundation of action research. This process is described in detail later in this guide.

What is an appropriate time-line of activities in this process?
The timeline depends on how much time participants have for AREP completion, which is determined by the start date of the professional development. You and your NAPE Instructor should determine an appropriate timeline.
# AREP Example Topics

Here are some examples of Action Research for Equity Project Topics or research questions.

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<thead>
<tr>
<th></th>
<th>Topic</th>
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<tbody>
<tr>
<td>1</td>
<td>Will deliberate use of micro-affirmations change rate of participation (retention, grades, or other outcome measure) of under-performing students?</td>
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<tr>
<td>2</td>
<td>Will deliberate use of micro-affirmations change students’ reports of self-efficacy?</td>
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<tr>
<td>3</td>
<td>How are my students’ perceptions and/or behavior of potential STEM career vocations influenced by exposure to diverse speakers on the topic?</td>
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<td>4</td>
<td>Will having a (or a series of) female STEM professional(s) change girls’ reported STEM course choices? Career interests? Career pursuits?</td>
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<td>5</td>
<td>Will teaching a unit on growth mindset change students’ perceptions about their ability to take a more rigorous mathematics class and/or pursue a STEM career?</td>
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<td>6</td>
<td>Will providing interventions to reduce stereotype threat improve students’ performance on assessments?</td>
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<td>7</td>
<td>If I “re-label” my students in my mind as leaders and professionals and act accordingly (despite their own labeling), can I motivate students to assume the new labels? Will their peers pick up on my micromessaging and re-label them as well?</td>
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<tr>
<td>8</td>
<td>If I teach a main concept that is critical for my students to know using the four self-efficacy sources, will I be able to increase self-efficacy to a greater extent than if I used traditional models?</td>
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<td>9</td>
<td>If I teach my students attribution theory and micromessaging as an inoculation strategy for micro-inequities, will they be able to use the language to increase a sense of empowerment and self-efficacy, leading to retention and consideration of a STEM course or career?</td>
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<tr>
<td>10</td>
<td>If I re-label science as “cool” for young women by using media as a communication medium, will females change their perception of the “attractiveness” of science-related careers?</td>
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<td>11</td>
<td>If I successfully guide female students through a stereotypically “male-related STEM” task, will it change their perception of their self-efficacy in performing other similar stereotypically male STEM tasks?</td>
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<tr>
<td>12</td>
<td>Will students who are under-performing in STEM report increased interest in STEM careers after completing a STEM group project related to their expressed area of interest?</td>
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<td>13</td>
<td>Will use of daily positive affirmation of under-performing students’ ability change performance on a unit quiz or assessment?</td>
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<td>14</td>
<td>Will female students’ use of positive affirmations of their ability change patterns of performance on a unit quiz or assessment?</td>
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<tr>
<td>15</td>
<td>How do variations of wise feedback affect students?</td>
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<tr>
<td>16</td>
<td>Will having students complete gender-specific research projects of STEM accomplishments/careers change self-reports of intentions to pursue advanced STEM coursework?</td>
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**AREP EXAMPLE SUMMARY**

This is an example of a completed Action Research for Equity Project Summary. A blank worksheet is provided as a template.

<table>
<thead>
<tr>
<th>AREP Title</th>
<th>You Go Girl: Increasing Girls’ Interest and Performance in STEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contributor(s)</td>
<td>Meagan Pollock, <a href="mailto:mpollock@napequity.org">mpollock@napequity.org</a></td>
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<tr>
<td>Location</td>
<td>Sample Middle School, 6th grade science</td>
</tr>
<tr>
<td>Class Periods</td>
<td>1st, 2nd, and 4th periods</td>
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<tr>
<td>Number of Students Reached</td>
<td>105 students</td>
</tr>
<tr>
<td>Research Issue</td>
<td>Can I increase the number of female students interested in STEM careers using micromessaging strategies, by using micromessages to communicate opportunities, by showing them a variety of occupations and encouraging them?</td>
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</table>
| Strategies Applied | - Presented neuroscience and growth mindset lessons  
- Had students research and give oral presentations about scientists; posted 20 pictures of scientists in the classroom (majority were females)  
- Provided micro-affirmations (emphasized effort; praised progress)  
- Had five female professionals speak to classes (a veterinarian, music data journalist, digital animator, engineer, and underwater archaeologist)  
- Had students compete in two robotic competitions |
| Results | Compared pre-survey of student interest in STEM careers following strategies - increased positive responses for females for three areas:  
- “Science is interesting” (improved from 27% to 90% Strongly agree and agree categories).  
- “I think I can be a successful scientist” (improved from 25% to 75%).  
- “I am interested in pursuing a STEM career” (improved from 20% to 70%).  
Other results or observations:  
- Also noticed an increase for male students in all three areas (average percentage increase for male students was 25% points).  
- Students of color also showed increased scores (on average up by 30% points compared to initial responses). |
| Reflections | Using several strategies throughout the year, I showed students a wide variety of STEM career opportunities. Having the students conduct research, present STEM careers, and compete in the robotics challenges made science interesting for them. I found myself collecting more references and articles about new STEM jobs so that I could share “hot jobs.” I was surprised about how readily the professionals shared their personal stories, including their struggles and what made them successful. |
| Goals for next year | I plan to repeat the experiment next year with a weekly STEM career reveal, monthly visits by scientists, and conduct Mindset Mondays (remind students that the struggle is a good thing). I think that I will also plan to share more about what we are doing with the students’ parents. |
Recommended Reading


