

Work-In-Progress: Measuring Systemic Educational Wellness using the Eco-STEM Educational Ecosystem Health Survey

Corin L. Bowen (Postdoctoral Researcher)

Corin (Corey) Bowen (she/her/hers) is a postdoctoral researcher in the College of Engineering, Computer Science and Technology at California State University, Los Angeles, where she is working on the NSF-funded Eco-STEM project. Her engineering education research focuses on structural oppression in engineering systems, organizing for equitable change, and developing an agenda of Engineering for the Common Good. She conferred her Ph.D. in aerospace engineering from the University of Michigan - Ann Arbor in April 2021. Her doctoral research included both technical and educational research. She also holds an M.S.E. in aerospace engineering from the University of Michigan - Ann Arbor and a B.S.E. in civil engineering from Case Western Reserve University, both in the areas of structural engineering and solid mechanics.

Lizabeth L Thompson (Professor)

Dr. Lizabeth Thompson is the Director of General Engineering and a professor in Industrial and Manufacturing Engineering. She holds a BS in Industrial Engineering from Cal Poly, SLO, a MS in Industrial and Systems Engineering and an MBA from University of Southern California, and a PhD in Education from University of California, Santa Barbara. She has been at Cal Poly for nearly 30 years and has held various positions on campus including Co-Director of LAES, Director of Women's Engineering Programs, and CENG Interim Associate Dean. Although she has taught over 25 different courses she current teaches Financial decision making, First year engineering, Senior project, and Change management. Her research is in Engineering Education where she has received \$9.8 million of funding from NSF as either PI or Co-PI. She researches equitable classroom practices, integrated learning, and institutional change. She spent the 2019-2020 academic year at Cal State LA where she taught and collaborated on research related to equity and social justice. With her colleagues at Cal State LA she recently received an NSF grant called Eco-STEM which aims to transform STEM education using an asset-based ecosystem model. She is also a Co-PI on an NSF S-STEM grant called ENGAGE which is working to make a more robust transfer pathway for local Community college students. Dr. Thompson is a Co-PI on an NSF ADVANCE grant called KIND with other universities within the CSU. She is a co-advisor to Engineers without Borders, Critical Global Engagement, and oSTEM at Cal Poly.

Gustavo B Menezes (Professor)

Christina Restrepo Nazar

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Abstract

This work-in-progress research paper introduces the Educational Ecosystem Health Survey (EEHS), an educational survey instrument designed by the Eco-STEM team at California State University, Los Angeles, a federally designated Hispanic Serving Institution. The Eco-STEM project applies a framework of Community Cultural Wealth and explores the metaphor of a healthy ecosystem to envision systemic change that responds to the needs and values the assets of diverse actors, who learn together for both their individual and collective good, within the educational “ecosystem.” As part of the project, the Eco-STEM team has developed the EEHS survey instrument to measure the “health” of the educational ecosystem. The results will provide valuable insight into the perceptions and experiences of students from socially and structurally oppressed groups.

The Eco-STEM EEHS is comprised of constructs from several survey instruments that have already undergone statistical validation within educational contexts, many of them within higher education. The items peruse issues of social climate, belonging, thriving and wellbeing, interest, mindfulness, stress, and perceptions of the future. Given the Community Cultural Wealth framework and the fact that two-thirds of the student body at California State University, Los Angeles identifies as Hispanic, the EEHS is offered in both Spanish and English. Students are asked to provide a multitude of institutionally relevant demographic information, such that results may be disaggregated along many categories. The EEHS is also administered to faculty, staff, and administration / management in addition to students. By including these essential actors in the analysis of the state of the educational ecosystem, we intend to also measure perceptions of experience *serving* the STEM educational community, rather than solely *receiving* it.

We will pilot the EEHS during the Spring 2022 semester. Over the next four years of the Eco-STEM project, semesterly administrations will quantify the progress of the project’s initiatives to implement effective systemic change. Our analyses will investigate the perspectives of those with oppressed social identities – individuals who actually hold majority representation within the unique demographic composition of California State University, Los Angeles. The results will offer critically important feedback to Hispanic-Serving Institutions and all institutions who strive to serve students from communities who have been left behind and even exploited by the existing systems and structures of higher education.

Keywords: *Educational Ecosystems, Community Cultural Wealth, Surveys*

Introduction

We argue that today, the current system of higher education in science, technology, engineering and mathematics (STEM) operates similar to a factory. Within this “factory” model of higher education, “...we lose a sense of our students as whole people and unfortunately, students can easily lose their understanding of their personal abilities as *learners* when they feel *powerless* in

the face of a monolithic *factory model* of education that appears *indifferent* to their individual struggles and successes” [1, p. 15, emphasis in original]. The history of the development of the current factory model of Western engineering education is eloquently explained by Tsai, et al. [1]. This factory-like system is ideologically supported by the metaphorical “pipeline” model of engineering education, in which students are assumed to enter and exist their educational journeys in a uniform manner [2]. However, as Pawley and Hoegh point out, “in a country where public education systems (both K-12 and higher education) still seem organized by race and class, what then does the “pipeline” represent?” [3, p. 4]

Graduation rates at California State University, Los Angeles clearly demonstrate the inefficacy of the factory model of education to provide transformative outcomes to students from socially and structurally oppressed groups. California State University, Los Angeles is not only a federally designated Hispanic Serving Institution, but also a majority-minority institution; in fact, 70% of the student body identify as Hispanic [4]. Additionally, 77% of the students are first-generation (defined as lacking a parent with at least a 4-year college degree), and 61% are Pell-grant eligible. Homelessness and hunger are common; a 2019 study found that, of all students within the California State University system, 11% and 42% experience housing and food insecurity, respectively [5]. A lack of effective transportation options (imperative for a commuter campus) also commonly plagues students. Many students are undocumented or Deferred Action for Childhood Arrivals (DACA) recipients (an estimated 9,500 students are undocumented in the California State University system, and about half of those are estimated to have DACA status [6]). Given these crippling challenges students face, it may not be surprising that the university’s four-year graduation rate for Fall 2015 starters was a mere 11% and the six-year graduation rate was 52% [7]. Graduation rates are even lower in STEM fields. Orchestrated interventions have resulted in marginal improvements, but it is clear that the system requires transformative change.

The “ecosystem” model of education has been presented as an alternative to the commonly employed pipeline model [8]. The educational ecosystem model recognizes not only the uniqueness of each actor’s trajectory but also the impact of systemic power structures and individual agency on their interactions within the system. The Eco-STEM project, which launched at California State University, Los Angeles in 2020, embraces this ecosystem model, visualizing the educational process as one of cultivation and ideas as planted seeds, disrupting the replication of a factory-oriented system of standards and quality checks [9]. The goal of this project is to transform the existing STEM educational ecosystem from one that demands that students be “college-ready,” to one that is “student-ready”. To shift the deficit-orientated mindset that is prevailing within the ecosystem, the project employs a framework of Community Cultural Wealth, aiming to leverage the assets students bring from their communities [10]. This significant paradigm and culture transformation is accomplished through several mechanisms (e.g., [11]), and progress will be measured through a number of instruments, including the Educational Ecosystem Health Survey (EEHS).

Overall Survey Methodology

The authors have constructed a quantitative survey to measure the progress of the Eco-STEM project in changing the STEM educational environment to that of a healthy ecosystem. The EEHS is comprised of existing validated constructs on aspects of educational and systemic

wellness. The survey will be administered to all students, faculty, staff, and administration / management with the College of Engineering, Computer Science, and Technology and the College of Natural and Social Sciences on a semesterly basis beginning in Spring 2022. The survey will take approximately 15-20 minutes to complete, and ten \$25 VISA gift cards will be raffled to respondents as an incentive for participation.

Approval for the research is provided by the Institutional Review Board at California State University, Los Angeles. After first consenting to participate in the research, EEHS respondents will select whether they would like to take the survey in English or in Spanish. This is a critical aspect of the work, considering the location and demographics of the institution. The EEHS has been professionally translated into Spanish and verified by local native Spanish speakers, several of whom are members of the Eco-STEM team. It is of interest to the research team whether many respondents will elect to take the survey in Spanish and whether those respondents who do have significantly different responses to the survey.

Independent Variables of Interest

Whether the EEHS is taken in English or Spanish will be one independent variable in future analyses of the results. Additionally, a detailed selection of demographic information will be collected from the respondents, as shown along with the corresponding survey logic in Figure 1. This will ensure that results can be disaggregated amongst many independent variables that could be predictors of dependent variable values. It is important to note, however, that respondents may choose to skip any question(s) in the survey, allowing them to choose to disclose only some or none of their demographic information and still complete the survey. Table 1 describes the independent variables to be probed.

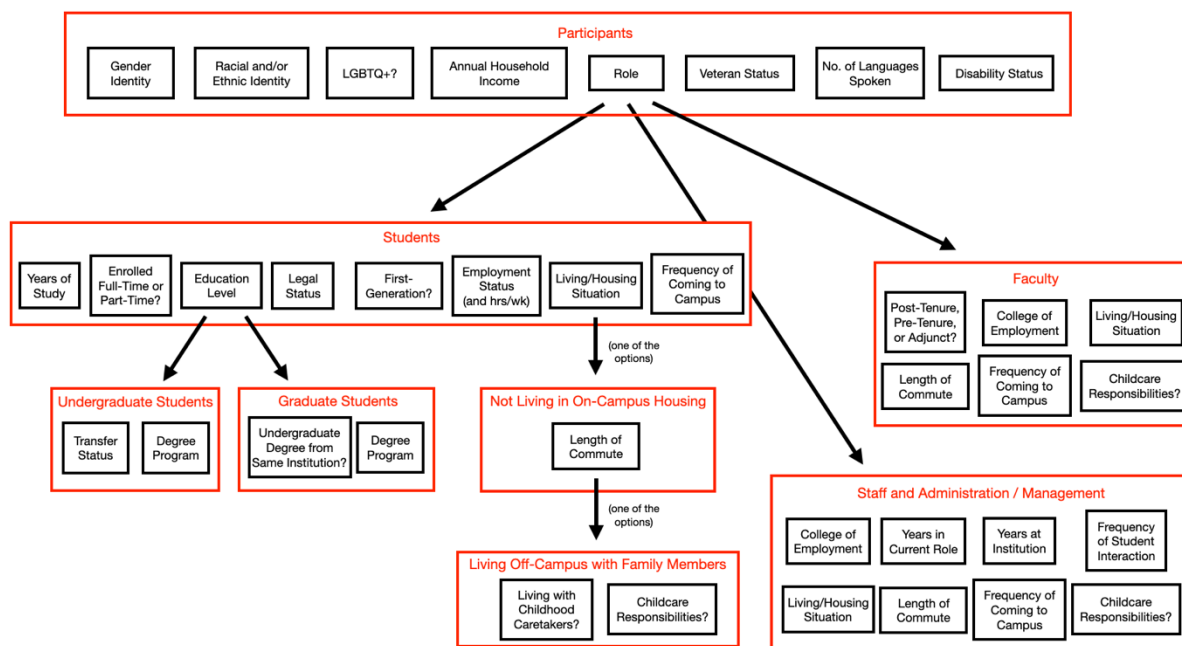


Figure 1: Demographic queries and logic flow of EEHS

Table 1. Independent Variables

Variable	Description	Selection Options
<i>Language</i>	Respondents are asked to select the language in which they would like to take the survey	English or Spanish
<i>Gender Identity</i>	Respondents are asked to provide their gender identity	“Man”, “Woman”, “Non-binary / Genderqueer / Gender Non-Conforming / Third Gender / Two-Spirit”, “Other”, or “Prefer not to say”
<i>Racial and/or Ethnic Identity</i>	Respondents are asked to provide their racial and/or ethnic identity, selecting all that apply	“African American / Black”, “Asian / Asian American”, “Hispanic / Latinx”, “Native American / American Indian / Indigenous American / Alaskan Native”, “Native Hawaiian / Pacific Islander”, “Middle Eastern / North African”, “White / European”, “Other”, and “Prefer not to say”
<i>LGBTQ+?</i>	Respondent are asked whether they identify as LGBTQ+	“Yes”, “No”, or “Prefer not to say”
<i>Annual Household Income</i>	Respondents are asked to provide their approximate annual household income level, (students are advised to select the same income reported on their FAFSA)	“\$0 - \$25,000”, “\$25,000 - \$50,000”, ... , “\$150,000 +”, “Unsure”, or “Prefer not to say”
<i>Disability Status</i>	Respondents are asked whether they identify as having either a physical or mental disability	“Yes”, “No”, or “Prefer not to say”
<i>Veteran Status</i>	Respondents are asked whether they are a veteran of the U.S. military	“Yes” or “No”
<i>Number of Languages Spoken</i>	Respondents are asked to provide the number of languages they can fluently speak	“1”, “2”, “3+”
<i>Role</i>	Respondents are asked to provide their role on campus	“Student”, “Faculty”, “Staff”, or “Administration / management”
<i>Education Level</i>	Students are asked for their education level	“Undergraduate” or “Graduate”
<i>Transfer Status</i>	Undergraduate students are asked whether they entered the university as a freshman or a transfer student	“Freshman” or “Transfer”
<i>Undergraduate Degree from Same Institution?</i>	Graduate students are asked whether their undergraduate degree was completed at California State University, Los Angeles	“Yes” or “No”
<i>Degree Program</i>	Students are asked to identify their STEM degree program	A list of available STEM degree programs provided as options
<i>Years of Study</i>	Students are asked how long they have been a student at California State University, Los Angeles	“1”, “2”, ... “8+”
<i>Enrolled Full- or Part-Time?</i>	Students are asked to identify whether they are enrolled full- (12 or more units) or part-time	“Full-time” or “Part-time”

<i>Legal Status</i>	Students are asked to provide their legal status (a reminder is provided to respondents that they may skip any question they choose to, given the extremely sensitive nature of this question)	“U.S. Citizen”, “U.S. Permanent Resident”, “DACA Recipient”, “International Student”, “Undocumented”, or “Prefer not to say”
<i>First-Generation?</i>	Students are presented with the definition of a first-generation student as one who is lacking a parent who has received at least a 4-year college degree and asked whether they fit that definition	“Yes”, “No”, “Unsure”, or “Prefer not to say”
<i>Employment Status</i>	Students are asked whether they currently have paid employment (including work-study), and, if so, how many hours per week they work	“Not employed”, “Employed part-time: less than 10 hours per week”, “Employed part-time: 10-20 hours per week”, ... “Employed full-time: 40+ hours per week”
<i>Frequency of Coming to Campus</i>	Respondents are asked how many days per week they currently travel to campus in-person	“Rarely or never”, “1-2 days per week”, “3-4 days per week”, or “5+ days per week”
<i>Living/Housing Situation</i>	Respondents are asked to select the option that best describes their current housing situation	“Live in on-campus housing”, “Live off-campus with family members”, “Live off-campus with friends/roommates”, “Live off-campus alone”, “No stable living situation”, or “Prefer not to say”
<i>Length of Commute</i>	Respondents (including students who do not live on-campus) are asked to provide the usual length of their commute one-way	“Less than 30 mins”, “Between 30 mins and 1 hr”, “Between 1 hr and 2 hrs”, and “More than 2 hrs”
<i>Living with Childhood Caretakers?</i>	Students living off-campus with family members are asked to identify whether they currently live with the same individual(s) who raised them	“Yes” or “No”
<i>Childcare Responsibilities?</i>	Respondents (including students who are living off-campus with family members) are asked whether they hold regular childcare responsibilities	“Yes” or “No”
<i>Post-Tenure, Pre-Tenure, or Adjunct?</i>	Faculty members are asked to provide their current faculty rank	“Tenure-track post-tenure”, “Tenure-track pre-tenure”, or “Lecturer”
<i>College of Employment</i>	Faculty, staff, and administration / management are asked to identify their college of employment within the university	“[engineering college name redacted for blind review]” or “[science college name redacted for blind review]”
<i>Years in Current Role</i>	Staff and administration / management are asked to state their length of service within their current role	“Less than 5 years”, “5-10 years”, or “More than 10 years”
<i>Years at Institution</i>	Staff and administration / management are asked to state their length of service within the institution	“Less than 5 years”, “5-10 years”, “More than 10 years”
<i>Frequency of Student Interaction</i>	Staff and administration / management are asked how frequently they normally interact directly with students through their current position	“Every day”, “A couple of times per week”, “A couple of times per month”, or “Very rarely or never”

Given the critical nature of the framework of Community Cultural Wealth, it is vital to attribute any discrepancies found in the results to inequitable systemic conditions that are negatively impacting communities' wellness, rather than deficiencies of the communities themselves [10]. Thus, the researchers query the correlation of these potential independent variables with measures of the health of the educational ecosystem in an effort to 1) identify groups of actors within the ecosystem who are not currently experiencing systemic conditions that support their ability to thrive and 2) determine whether the change mechanisms enacted through the Eco-STEM project brings about the educational empowerment of these actors.

Dependent Variables of Interest

The objective of the EEHS is to quantitatively measure the wellness of the STEM educational ecosystem. Substantial research and development of survey instruments measuring forms of wellness already exists. Thus, existing validated constructs were collected that measure aspects of healthy education ecosystems, including feelings of belongingness, markers of thriving or wellbeing, identity formation, mindset, personal motivation, perceptions of climate, and stress levels. The authors selected constructs with strong reported internal consistency, as measured by Cronbach's Alpha, in relevant educational contexts. We selected individual constructs to include in the EEHS, prioritizing those that we believed measured vital considerations for the construction of a healthy educational ecosystem.

Table 2 presents each of selected constructs. Given the rapidly-evolving nature of the educational ecosystem (especially complicated by the COVID-19 pandemic), repeated measurement of these dependent variables is necessary to track how actors' perceptions and experiences respond to changes in the state of the ecosystem. We note that these changes may be caused by both intentional developments resulting from the Eco-STEM institutional change mechanisms as well as reactionary measures in response to sociopolitical events occurring beyond the community, such as the COVID-19 pandemic.

Table 2. Dependent Variables

Variable	Construct and Source	Adaptations to Source Material
<i>Interest</i>	"Interest" from Godwin's "Engineering Identity Scale" [12]	– Replaced "engineering" with "my major" for students – Replaced "engineering" with "my field" for faculty, staff, and administration / management
<i>Mindfulness</i>	"Mindfulness Attention Awareness Scale" from Rieken et al. [13], developed from the prior work of Brown and Ryan [14]	– Changed introductory text to: "Below is a collection of statements about your everyday experience at Cal State LA"
<i>Frustrations</i>	"Stressors – Frustrations" from Gadzella et al.'s "Student Life – Stress Inventory" [15]	– Replaced "auto" with "transportation" – Deleted an item that queried respondents dating experiences – Posed to faculty, staff, and administration / management twice, once referring to the department/unit level and once to the college level

<i>Pressures</i>	“Stressors – Pressures” from Gadzella et al.’s “Student Life – Stress Inventory” [15]	– Replaced “spouse” with “partner” – Posed to faculty, staff, and administration / management twice, once referring to the department/unit level and once to the college level
<i>Faculty Quality</i>	“Good Professors” from Litzler et al.’s “Project to Assess Climate in Engineering” [16], developed from the prior work of Brainard et al. [17] and Laanan [18]	– Rephrased the items as statements evaluated along a Likert scale – Posed to students only – Replaced “engineering” with “my major”
<i>Faculty Support</i>	“Perceived Faculty Support/Comfort” from Hoffman et al.’s “Sense of Belonging Scale” [19]	– Changed introductory text to: “Please rate your agreement with the following statements, which relate to your comfort levels about having discussions, academic, personal, or otherwise, with members of the Cal State LA community” – Posed to students only – Replaced “teacher” and “faculty member” with “professor”
<i>Faculty Empathy</i>	“Empathetic Faculty Understanding” from Hoffman et al.’s “Sense of Belonging Scale” [19]	– Changed introductory text to: “Please rate your agreement with the following statements, which relate to your comfort levels about having discussions, academic, personal, or otherwise, with members of the Cal State LA community” – Posed to students only – Replaced “faculty member” with “professor”
<i>Classroom Comfort</i>	“Perceived Classroom Comfort” from Hoffman et al.’s “Sense of Belonging Scale” [19]	– Changed introductory text to: “Please rate your agreement with the following statements, which relate to your comfort levels about having discussions, academic, personal, or otherwise, with members of the Cal State LA community” – Posed to students only
<i>Peer Support</i>	“Perceived Peer Support” from Hoffman et al.’s “Sense of Belonging Scale” [19]	– Changed introductory text to: “Please rate your agreement with the following statements, which relate to your comfort levels about having discussions, academic, personal, or otherwise, with members of the Cal State LA community” – Posed to students only
<i>Student Community</i>	“Student Community” from Litzler et al.’s “Project to Assess Climate in Engineering” [16]	– Rephrased the items as statements evaluated along a Likert scale – Posed to students only – Replaced “engineering” with “my major”
<i>Connectedness</i>	“School Connectedness Scale” from Renshaw and Bolognino’s “College Student Wellbeing Questionnaire” [20]	– Replaced “this school” and “here” with “in my major” for students – Posed to faculty, staff, and administration / management twice, once referring to the department/unit level and once to the college level

<i>Belongingness</i>	“Engineering Belongingness Scale” from Scheidt et al.’s “SUCCESS Survey” [21], developed from prior work [22–24]	– Replaced “engineering” with “my major” for students – Changed introductory text to: “The following items are about how you feel that you fit in your major and belong in this community” for students – Posed to faculty, staff, and administration / management twice, once referring to the department/unit level and once to the college level – Changed introductory text to “The following items are about how you feel that you fit in and belong in the community of your ____”, inserting “department/unit” for faculty and “college” for staff and administration/management – Dropped the word “classes” from the items for faculty, staff, and administration / management and removed an item that became a duplicate of another upon doing so
<i>Thriving</i>	“Brief Inventory of Thriving” from Su et al. [25]	– Changed introductory text to: “Please rate your agreement with the following statements, which are related to your experience at Cal State LA”
<i>Rewarding</i>	“Engineering Rewarding” from Litzler et al.’s “Project to Assess Climate in Engineering” [16]	– Rephrased the items as statements evaluated along a Likert scale – Posed to students only – Replaced “engineering” with “my major”
<i>Perceptions of Future</i>	“Perceptions of the Future” from “Future Time Perspective” within Scheidt et al.’s “SUCCESS Survey” [21]	– Posed to students only – Replaced “engineering” with “going into my current major” – Replaced “be an engineer” with “work in my major” – Changed introductory text to: “The following questions relate to your attitudes and beliefs about your experiences within your major.”

Future Work

The EEHS will be administered to the affiliates of the College of Engineering, Computer Science, and Technology and the College of Natural and Social Sciences at California State University, Los Angeles during the Spring 2022 semester. First, we will perform structural validation of the survey via confirmatory factor analysis. We will then statistically analyze the survey results to determine the baseline relationships between the independent and dependent variables. The EEHS will then be administered once every semester over the remaining four years of the Eco-STEM project. The results will provide insight into if and how the change models employed by the project are succeeding in creating a healthy educational ecosystem for all actors within the STEM education community.

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