Section 1. Accomplishments

1) What are the major goals of the project?

Project Abstract

Recognizing that engineering and computer science are making concerted efforts to increase the diversity of students in their academic programs and in the workforce, the multi-institutional research team proposes a two-pronged approach: (1) To provide scholarships to a diverse population of low-income academically talented students with financial need and (2) to adapt, implement, and test a student experience model designed to increase the success of students in those fields. The model includes a set of well-established evidence-based practices that form an ecosystem of academic and co-curricular supports for students and is designed to foster retention, transfer, and graduation in STEM. The primary disciplinary foci are Electrical, Computer, and Software Engineering (ECSE) with the inclusion of cyber-security at Iowa State University, Des Moines Area Community College, and Kirkwood Community College. To broaden the impact of the effort, the proposal team seeks funding to conduct two research studies. The qualitative phenomenological study is designed to investigate and understand the development and maintenance of professional/career identity. The quantitative comparison study is designed to investigate the influence of individual motivation and the characteristics of the academic and social environments of electrical, computer and software engineering, including cyber-security, on student success, retention, transfer, and degree attainment. The project plans to award a total of 582 scholarships to 272 students (100 unique scholars at Iowa State University; 90 unique scholars at Des Moines Area Community College; and 82 unique scholars at Kirkwood Community College).

Project Overview and Goals

The S-STEM project, ECSEL: Electrical, Computer, and Software Engineers as Leaders, is a multi-institutional collaborative effort among Iowa State University (ISU), Des Moines Area Community College (DMACC), and Kirkwood Community College (KCC) providing scholarships for students majoring (or preparing to transfer) in electrical engineering, computer engineering, and software engineering. The total number of scholarships expected to be awarded across all three institutions over five years is 582. The project is implementing and testing a student experience model that leverages existing program elements from ISU’s Department of Electrical and Computer Engineering, College of Engineering, Program for Women in Science and Engineering, DMACC, and KCC. The ECSEL student experience consists of common practices and supports that span institutions including: learning communities, leadership development, professional development, academic support such as tutoring, academic advising for the ISU Engineering Basic Program, academic preparation for the ECSE field (including cyber security), and state and national resources for inclusive ECSE career awareness, recruiting and teaching. Research studies are exploring how diverse students in ECSE develop and sustain their engineering identities, and what drives these students to thrive and persist in ECSE degree programs.

The objectives of the project are to:

1) Pursue S-STEM goals (SS1-SS3) to recruit and retain diverse students in electrical, computer and software engineering (ECSE) disciplines.
To increase the recruitment, retention, transfer, student success, and graduation of low-income academically talented students with demonstrated financial need who pursue baccalaureate degrees in STEM and enter the STEM workforce or graduate study;

To implement and sustain effective, supportive curricular and co-curricular activities, practices, and strategies for students in (SS1); and

To study models and activities in (SS2) and contribute to understanding the factors that affect academic/career pathways of students in (SS1).

2) Implement a scholarship program and student experience that support various ECSE pathways, emphasizing leadership development and professional preparation.

3) Coordinate key activities (practices, supports, curriculum, prior results, models and studies) across institutions to enhance transfer student success.

4) Investigate research questions to study the effect of project activities and better understand and influence student success and department culture.

5) Establish a community of practice for ECSE faculty to support their mentoring of students, inclusive teaching, and understanding of student success based on research findings.

6) Improve diversity and inclusion in ECSE programs, leveraging and enhancing support for women and other students from underrepresented groups.

7) Strategically manage the organizational, financial, data, and communication aspects of the project within and across institutions.

8) Evaluate project effectiveness, outcomes and impacts.

9) As broader impacts, improve educational pathways and contribute to a diverse workforce prepared to address societal needs including the nation’s information infrastructure and security.

A logic model approach is being used for project management and evaluation. The logic model summarizes project resources, activities, outputs, outcomes and impacts, including measurable student, program, and process outcomes. The logic model is uploaded with this report.

Expected outcomes for the project include these targets for enrollment, retention and graduation:

- Increase the percentage of undergraduate women enrolled in ECSE degree programs to 16%, thus doubling the number of women enrolled from 120 to 240.
- Attain 1-year and 2-year retention rates of 86% and 80%, respectively, for female students in ECSE majors and ECSEL scholars.
- Attain a 6-year graduation rate of 55% for female students in ECSE majors and ECSEL scholars.

The outcomes are being pursued through the ECSEL student experience. The ECSEL student experience uses many existing high-quality, evidence-based program elements, drawing on results from past NSF projects, experts at ISU, and leading researchers. Two complementary research studies are underway to contribute to the knowledge base. One research study is exploring how diverse students in ECSE develop and sustain their engineering identities. The study is examining engineering identity development through the use of Social Cognitive Career Theory (SCCT). This research study is using a phenomenological approach to examine the lived experiences and engineering identity development of ECSEL students using SCCT. The other study is using Self-Determination Theory (SDT) of motivation to understand how the environment can support diverse students to seek out ECSE programs and to persist in completing ECSE degrees. Most environmental supports have not been related to SDT. The study is examining whether environmental supports positively affect students’ perceptions of competence, autonomy, and belongingness and directly and indirectly affect their satisfaction with ECSE majors and intentions to stay in an ECSE program.
The broader impacts outcomes of the project include: opportunities for low-income academically talented students with financial need; partnerships with community colleges, industry, diversity programs, and researchers to broaden participation of diverse students in ECS engineering majors; development of diverse workforce in ECS engineering fields; improved education pathway through the community college into ECS engineering degree programs; engagement with ECS engineering by prospective students, parents, teachers; and capacity-building in cyber security to support national security.

This is a collaborative report prepared by ISU, DMACC and KCC. The accomplishments sections of this report are organized by institution, with each institution’s section having subsections aligned with the goals of the project.

**Iowa State University**

Ten students were awarded ECSEL scholarships starting spring 2017 to form the first ECSEL cohort. These were all current students in ECSE majors. An additional 23 scholarships were awarded starting fall 2017, comprised of 10 current students and 13 incoming students new to ISU. For management purposes, we have divided these scholars into the following groups (note that ISU’s school colors are cardinal and gold):

- Gold Scholars: Scholars who joined the ECSEL program in a previous year (10)
- Cardinal Scholars: Scholars who joined the ECSEL program in the current year (23)

In addition, the cardinal scholars are divided into two groups: incoming (13) and advancing (10). Incoming cardinal scholars are newly enrolled at ISU. Advancing cardinal scholars were previously enrolled and are continuing in their academic programs. Incoming scholars are typically freshmen or transfer students, although some students from high school enter with sophomore classification due to earning college credits. Advancing scholars are sophomores or higher. These groupings reflect the need to support students at different entry points into ECSE majors.

Among the 33 ECSEL scholars in the program as of fall 2017, 13 are CPE majors, 7 are EE, and 13 are SE. They include 8 freshmen, 9 sophomores, 8 juniors and 8 seniors. There are 32 women. Six scholars are from underrepresented minority (URM) groups (18% of scholars), including one male student. As described below, the recruitment and selection process for the first year was directed toward women students with balanced representation across majors and classifications. Ongoing and future recruitment and programming are expanding to other diverse students.

Table 1 (see attached) summarizes undergraduate enrollment in ECSE majors at ISU as of fall 2017. ISU engineering programs have had record enrollments in recent years. Enrollments have started to level off, with EE seeing a decrease this year. SE continues to grow, and CPE remains the largest of the three majors. The percentages of women and URM students have increased among total students and within each major, with larger increases in URM students. The exception is the latest percentage of URM SE students, although the number of students has increased, and the percentage is one of the highest. The number of women and URM students in EE have decreased, although not as steeply as total EE students.

**Scholarship Program Recruitment, Selection and Administration**

As summarized above, 33 ECSEL scholarships have been awarded. Recruitment began fall 2016 and has been ongoing with a rolling applications process aligned with College of Engineering and university timelines for consideration and notification. Scholarship information, requirements, instructions and online application forms for both incoming and current students are available from
the ECSEL website under the “Interested Students” page (see attached):
https://ecsel.ece.iastate.edu/students/interested-students/.

ECSEL team members work closely with department and college student services staff to coordinate recruiting opportunities and scholarship administration. During year 1, current students meeting eligibility requirements were emailed information about the scholarship program and invited to apply. In addition, ECSEL team members, ECSE academic advisers and WISE Program staff reached out to potential students, including holding informational sessions. A marketing flyer was also created (see attached) and used by academic advisers and WISE, including at the annual spring “Engineering Scholars’ Day” when prospective (incoming fall 2017) students and family visit and participate in sessions on campus. Emails were also sent to eligible prospective students in the spring. Academic advisers continued to identify potential students during summer orientation.

Applications are compiled in an intranet database and reviewed by an ECSEL scholarship committee. The committee made decisions based on eligibility and a broad set of factors. The first scholarship cohort starting spring 2017 is now referred to as gold scholars. These scholars have diverse backgrounds and experiences and are well-positioned to serve as near-peer role models for future scholars. During spring semester, the committee made selections for scholarships starting fall 2017, referred to as cardinal scholars.

**Student Experience Planning and Implementation**

The ISU ECSEL student experience uses evidence-based practices to support scholars through graduation using a variety of academic and extracurricular activities focused on professional and leadership development. We are using the proposed student experience model as a roadmap, as depicted at the website (https://ecsel.ece.iastate.edu/students/) and shown in Figure 1 of the attached 2016 Frontiers in Education Conference paper.

During spring semester 2017, the ECSEL scholar cohort met weekly with ECSEL ECE team members to learn about the program and share information, interests, ideas, insights and experiences. A Blackboard LMS site was maintained for the group (see attached), and weekly meetings were documented in a wiki. The scholars also set up a Slack workspace for communication, which was also available to team members. Cohort-building and leadership development were fostered through an outreach service learning project to create and offer a WISE Taking the Road Less Traveled (TRLT) session for high school girls in April 2017. The scholars used an Adafruit kit for a “sunscreen reminder hat” to provide participants with a fun hands-on design activity involving ECSE skills and using technology to help people. A few slides with photos and information from the event are attached. The scholars also led a department FAN (Friday AfterNoon) Club in September 2017 to promote TRLT outreach to other students. This cohort began planning for the Grace Hopper Conference last spring, and 9 of the 10 scholars will be attending GHC in October. This cohort also helped team members set up newly allocated space as an ECSEL Lab in Coover Hall dedicated for their use.

A welcome open house was held for all ECSEL scholars at the start of fall semester 2017, launching the following meeting plan for 2017-18. Scholar meetings are held biweekly for all three scholar groups (gold, cardinal-advancing, cardinal-incoming). Cardinal scholars are expected to attend regular meetings for their first year in the program. Gold scholars have flexibility and may attend cardinal scholar meetings. Scholars participate in monthly meetings with ECSEL faculty mentors. Meetings are held as needed to participate in various ECSEL student experience activities and discussion sessions for CPRE/EE/SE 166, 294, and 394. Fall semester meeting topics include: orientation; mentoring; sketchnoting; professional networking; leadership; and design thinking. Spring semester meeting topics include: cybersecurity and other grand challenges;
Flexible activities include: project-based learning; leadership development through selected ECSEL student experience activities and leadership roles; discussion topics; peer mentoring for ECSEL scholars; and industry networking. Selected WISE leadership programming is being coordinated for ECSEL scholars. All cardinal-incoming scholars are participating in a learning community (WISE, CPE, EE, and/or SE).

Faculty Engagement

ECSE faculty members are involved as project team members and mentors and also have scholars in their courses. Student-faculty interaction is both formal and informal. The formal faculty mentors include Phillip Jones, Diane Rover and Joe Zambreno (CPE students); Julie Dickerson, Mani Mina (coordinator), and Gary Tuttle (EE students); and Doug Jacobson, Suresh Kothari, and Kristin Rozier (SE students). Each mentor is assigned a small group of scholars and will be involved with a meeting topic or lab project. The following resources were selected for mentor training: selected chapters of The Mentor’s Guide, Lois Zachary; Talk to Me materials, EngageEngineering.org; Mentoring and Women in Engineering, Catherine Amelink (SWE-AWE-CASEE); and Mentoring and Diversity: A Handbook for Faculty Mentoring, LSAMP Indiana.

The ECSEL project is being conducted in tandem with the NSF RED-funded RIDE project in the department. Faculty are involved with RIDE activities and change processes. The projects are synergistic in various ways, and we use both projects to engage faculty to support student success.

Diversity and Inclusion Support

ECSEL partners with diversity programs on campus including WISE, LEAD (multicultural students in engineering) and student organizations such as Digital Women and SWE. WISE Program staff are directly involved with project planning and activities, and WISE activities are part of the ECSEL student experience. The ECSEL team draws on the expertise of team members and researchers who have various experience with diversity and inclusion in programs such as ISU ADVANCE, WISE and their research. In concert with the RED RIDE project, there are efforts to enhance awareness and understanding among faculty and staff in the department. For example, a classroom implicit bias module from the college’s Diversity and Inclusion Committee was discussed at a faculty meeting. Faculty and staff are encouraged to participate in ISU CELT seminars and workshops, such as the Inclusive Classroom Faculty Development Workshop.

Research Studies

Two research studies are underway: 1) ECSE identity development of ECSEL students, and 2) student motivation and the characteristics of ECSE academic and social environments. The research activities are synergistic with an NSF RED project in the department (https://ride.ece.iastate.edu), being conducted in tandem with the ECSEL project. A research and evaluation retreat for project team members was held at the end of fall semester 2016 to review and coordinate activities. Comments and feedback were collected and documented.

The identity research team is led by Sarah Rodriguez and includes three graduate students (one doctoral and two masters). Year 1 of this study focused on the recruitment of participants, rapport-building, and the beginning of data collection for ISU. This research study utilized a phenomenological approach to examine engineering identity development in the experiences of six undergraduate women involved in the ECSEL program and majoring in ECSE academic programs at a predominantly white public institution.
Student Questionnaire. This study utilized a questionnaire which was administered to participants at the beginning of the study in order to gather demographic and background information. In addition, the questionnaire also had items addressing engineering experiences at the institution. Data received enabled the researcher to create greater understanding of the student participant profile for the group as well as be able to tease out any aspects of a student’s experience that might need to be explored in more depth during the interview and journaling processes.

Phenomenological Interviews. Each student participated in one semi-structured interview. Interviews lasted approximately one and a half hours and were digitally recorded and transcribed verbatim for analysis. Individual interviews allowed the researchers to delve more deeply into the participant’s experience, particularly around engineering identity development and clarify issues which were unclear to the researcher.

Student Reflective Journals. Participants were asked to engage in an on-going process in which they kept electronic reflective journals of their engineering experiences and subsequent engineering identity development. Students were given from 4-5 questions bimonthly as a means to reflect upon their experiences and interactions with others (e.g. with faculty, peers, family) as well as a place to provide reflection on their engineering identity development.

Analysis. Using a phenomenological analysis approach, the researchers engaged in a four-step data analysis process. In Step 1, the researchers set aside their beliefs about the phenomenon (epoche) which enabled them to be receptive to the meanings that students ascribed to engineering experiences. In Step 2, they read the transcripts to gain to their core understandings (eidetic reduction). In Step 3, they examined the meaning units that students created from their experiences and considered the phenomenon from a variety of standpoints (imaginative variation). In Step 4, they integrated meanings and defined the essence of the phenomenon utilizing raw transcript data to verify the results (synthesis and verification).

The identity team met regularly to discuss data collection, analysis, and preparation of a conference proposal for initial data collection period. These meetings helped to make decisions regarding study design and analysis as well as clarify direction of the identity study in terms of dissemination and publications. The graduate students assisted with the identity study by composing protocol questions, setting up infrastructure for data collection and management, analyzing transcript and reflections data, and preparing conference and publication materials. Year 1 data collection resulted in the production of one conference proposal to the American Educational Research Association.

Rodriguez and doctoral student Kelly Cunningham also attended regularly scheduled ECSEL meetings with the larger team to discuss grant activities and provide progress reports on the identity study. These meetings helped to facilitate recruitment of identity study participants through team member connections to the project and provide context for understanding the ECSEL experience for students.

Des Moines Area Community College. Year 1 of this study focused on recruitment and program rapport-building between the ISU researcher and the DMACC team, including conversations between stakeholders to understand the recruitment process of DMACC students, determine IRB requirements, and establish a working relationship between researchers and DMACC institutional partners. These relationships will be used to facilitate identity student recruitment in Fall 2017 and continued engagement throughout the duration of the grant.

For the second research study, the motivation/quantitative research team is led by Lisa Larson and Mack Shelley. During Year 1, this research team generated survey items, obtained IRB approval, set up a Qualtrix survey, and administered the survey in late spring semester 2017 to 10 ECSEL
scholars. The survey will be administered in the coming year to all scholars (33 as of fall 2017). A part-time graduate research assistant was hired in August to assist the researchers in 2017-18.

Evaluation

The evaluation team at ISU consists of Mari Kemis (RISE evaluator), Mack Shelley, and Mani Mina. They are regular participants in project meetings.

Evaluation activities for Year 1 focused on providing information for the NSF S-STEM data reporting. Data were successfully uploaded and submitted for ISU’s ten Spring 2017 scholars in May 2017. Instructions and notes were developed to describe the database variables, data sources available through the ISU registrar’s system and elsewhere, and timelines for future reference.

Scholars were also surveyed at the end of the Spring 2017 semester for their feedback on their participation in ECSEL, including what they saw as positive and also their suggestions for improvement. The majority of the scholars indicated that they liked getting to know faculty and staff in the ECE Department on a more personal level, as well as joining a community of other women in their field of study, many saying that they had not met any of the others before. Two scholars noted that they enjoyed participating in the Road Less Traveled activity with youth.

Several of the scholars indicated that they would like to structure their attendance through a required course. Some said they wanted more faculty involvement, industry visits, and additional group activities, especially where they can explore ideas through a collaborative and open environment.

Project Management and Coordination

The ECSEL project team is comprised of the PI and team members listed in the participants section of this report. The ECSEL ECSE team is a subset consisting of team members who are ECSE faculty and staff members. The entire project team met every two weeks during the year, and the ECSE team met weekly. Other subsets, e.g., research, evaluation, scholarship committee, met additionally as needed. A research and evaluation retreat was held in December to review and coordinate activities. In addition to conference calls with DMACC and KCC, a cross-institutional collaborative retreat was held in May. Topics included: project management (coordination, communication); academic and faculty-related activities (mentoring, courses/curriculum); student-related activities (scholar transfer process and transition support, student experience activities); and research and evaluation activities.

An online file-sharing repository was set up for the project team using CyBox, Iowa State’s Box service. A project website was created, https://ecsel.ece.iastate.edu. A project manager (Megan Heitmann) was added to the project team through staff support provided by the Engineering Research Institute (https://www.engineering.iastate.edu/research/eri/). A graduate research assistant works with PI team members on project tasks as well as cyber security research. Three peer mentors, one each for CPE, EE and SE, were hired for 2017-18. A dedicated work/study space for the ECSEL scholars was allocated in Coover Hall. A visual identity for the project and scholars program was created around ECSE icons and “The Moth” statue and story tied to Grace Hopper (http://archive.inside.iastate.edu/2008/1024/moth.shtml, http://www.publicartarchive.org/work/moth-0) (see attached visual elements).
The news articles, publications, presentations and websites listed in the Products section support communication and dissemination to various audiences. Refer to the Dissemination section of this report.

**Broader Impacts**

Project activities supporting broader impacts during year 1 focused on providing opportunities for low-income academically talented students in ECSE; partnering with community colleges, diversity programs, and researchers to broaden participation of women in ECS engineering majors; improving the education pathway through the community college into ECS engineering degree programs (also noted in the DMACC and KCC sections of the report); and capacity-building in cyber security (refer to the DMACC section of the report for the new Iowa Cyber Security Hub).

Another potential broader impact of the project is institutional strategic planning that enhances the visibility of engineering education research and the capacity to conduct such research. Refer to the Institutional Impacts section of the report.

**Des Moines Area Community College Accomplishments**

**Scholarship Program Recruitment, Selection and Administration**

In Year 1, DMACC reviewed and finalized the scholarship selection criteria for the full and explorer scholarships. An online scholarship application was developed to pull information directly from the college student records system to determine student eligibility. In addition, marketing materials (website, fliers and targeted emails to eligible students) were developed to promote the ECSEL (full and explorer) scholarships targeting a diverse group of low-income academically talented students interested in pursuing baccalaureate degree studies. Sample marketing materials and scholarship criteria are uploaded with this report. Information is available at the DMACC ECSEL website: [https://www.dmacc.edu/ecsel](https://www.dmacc.edu/ecsel).

To date, seven full scholarships and one explorer scholarship have been awarded for the Fall 2017 semester. Engineering faculty and academic advisors are continuing to recruit qualified applicants to award additional scholarships for fall and spring semesters. ECSEL team members are visiting engineering orientation courses (EGR 100) at three campuses to promote scholarship activities as well as to ensure students are enrolled in appropriate transfer coursework.

**Student Experience Planning and Implementation**

During Year 1, the DMACC team adjusted the Student Experience Model (see attached) to ensure ECSEL participants receive leadership and professional preparation to ensure a smooth transfer for baccalaureate studies. ECSEL team members will be meeting with scholarship recipients to receive feedback about what specific programmatic aspects would enhance their experiences at DMACC and prepare to enter a diverse workforce.

**Faculty Engagement**

Faculty leaders have established a mentoring committee to recruit, train and match faculty mentors with the ECSEL scholars. The team is exploring opportunities to engage mentors in ECSEL activities at KCC and ISU.

**Diversity and Inclusion Support**
The DMACC team is collaborating with DMACC’s Teaching and Learning Center on training opportunities. DMACC participates in an NSF INCLUDES grant (described below) that offers resources and pedagogy support for STEM faculty. A year 2 goal is to connect pre-engineering and computer science faculty with these resources.

CIRTL INCLUDES: Toward an Alliance to Prepare a National Faculty for Broadening Success of 2-Year and 4-Year STEM Students. (Award Number: 1649105) This project is led by the University of Wisconsin-Madison and leverages strategic partners across the country (including LSAMP). It proposes to build the foundation for a national cross-sector alliance to increase the learning, persistence, and completion of underrepresented group (URG) STEM undergraduates across the entire higher education landscape, and thereby to increase their contribution to the U.S. STEM enterprise. DMACC, KCC, ISU and IINSPIRE LSAMP are actively involved in developing strategic goal #2 which aims to expand and strengthen faculty preparation specifically for 2-year colleges, where many URG students have their first STEM undergraduate experience. More information is available at: https://nsf.gov/awardsearch/showAward?AWD_ID=1649105

**Evaluation and Research**

DMACC is prepared to complete the NSF S-STEM data reporting each semester now that scholarships have been awarded. The DMACC ECSEL team met with ISU evaluation and research team members to establish a qualitative research protocol for scholars. Plans are underway to connect scholars with the research team. In the coming year, DMACC will coordinate with ISU on a survey to examine opinions about activities, progress towards project objectives, and contextual factors (Fall 2017).

**Project Management and Coordination**

DMACC established an ECSEL leadership team with key representatives from engineering faculty, student services, institutional research, grants department, and administration to implement ECSEL grant objectives. The leadership team met regularly during Year 1 to establish marketing and scholarship procedures.

In addition to the executive team, two sub-committees were established to focus on scholar recruitment and selection and faculty mentoring. A staff member joined the executive team to work directly with ESCEL scholars and faculty mentors. The DMACC leadership organizational chart is attached.

DMACC representatives participated in a retreat with ISU and KCC teams to ensure institutional goals were aligned to accomplish our S-STEM goals.

**Broader Impacts**

DMACC is continuing to strengthen our ongoing transfer partnership with ISU’s College of Engineering. During Year 1 of the grant, DMACC enhanced our Associate of Science (AS) Degree to ensure a smooth pathway for transfer students interested in STEM to transfer to the College of Engineering. Semester-by-semester guides based on math placement scores were added to the pre-engineering website. Advising and marketing materials were updated. Transfer conferences and recruitment events were held in collaboration with our transfer partners. Sample materials are attached.
An outstanding collaborative partnership that stemmed from the ECSEL grant is the establishment of the Iowa Cyber Security Hub with the goal of increasing cyber security professionals to meet the future workforce needs in Iowa. This initiative is led by ISU and DMACC. One of the lead members is ISU co-PI Doug Jacobson. The presidents of both institutions signed a memorandum of understanding in July 2017.

Specific initiatives will include: development of marketing materials to recruit students into cyber security fields, middle school and high school cyber curriculum development, establishment of DMACC Cyber Security Career Academy, enhanced curricular articulation with DMACC focused AS degree to ISU BS degree, development of an AAS Cybersecurity Degree, and professional certificate as a gateway to an ISU Master Degree in Information Assurance.

News releases on the cybersecurity partnership are attached and online:
https://www.dmacc.edu/news/Pages/20170725.aspx

Kirkwood Community College Accomplishments

Scholarship Program Recruitment, Selection and Administration

In Year 1, KCC reviewed and implemented the scholarship selection criteria for the scholar and explorer level scholarships. The scholarship criteria are uploaded with this report. The KCC team collaborated with the Kirkwood Foundation to use their single scholarship application. The Kirkwood Foundation scholarship application process provided a list of potential ECSEL students. Faculty recruited potential ECSEL participants in STEM classes. One $2500 ECSEL scholarship was awarded in spring 2017 to a female computer science major on a transfer track.

Student Experience Planning and Implementation

The ECSEL student experience continues to be developed as proposed and aligned with project goals. The KCC team supported the spring 2017 ECSEL scholar by providing transfer guidance and mentoring a computer science honors project. The scholar completed the project and has successfully transferred to the computer science program at the University of Iowa.

Faculty Engagement

During year 1, KCC team members:
- Promoted the ECSEL program at bi-annual math/science department retreats, and
- Sent curriculum materials to advisors at ISU to initiate the update of transfer articulation for Kirkwood computer science and engineering courses.

KCC faculty were also involved with various activities related to the ECSEL student experience, including updating engineering curriculum and facilities, co-advising the Kirkwood STEM-Club, mentoring Kirkwood student teams for programming and robotics competitions, and supervising and mentoring a scholar’s honors project.

Diversity and Inclusion Support

The KCC team is collaborating with their campus IINSPIRE (Iowa, Illinois, Nebraska) LSAMP program to recruit diverse students and share programming, information and resources as
appropriate. For example, at the IINSPIRE Alliance annual conference, team members from KCC, as well as ISU and DMACC, participated in a half-day workshop on pedagogy, “Building Capacity on Your Campus.” The workshop addressed how to build capacity on campus to make systemic changes aimed at increasing success and graduation rates of domestic students of color. Online, web-based resources were assembled at the NSF SERC (Science Education Resource Center, Carleton College) IINSPIRE web portal, https://serc.carleton.edu/lsamp/workshops/feb2017/index.html. The SERC web portal is a repository with numerous resources related to evidence-based, inclusive teaching practices.

Evaluation

Evaluation activities including providing information for NSF S-STEM data reporting. Data were collected, uploaded and submitted for spring 2017. KCC is prepared to complete S-STEM data reporting each semester. In the coming year, KCC will coordinate with ISU on a survey to examine opinions about activities, progress towards project objectives, and contextual factors (Fall 2017), as well as on research activities.

Project Management and Coordination

During year 1, the following organizational units participated in ongoing planning and implementation for the ECSEL project: Math/Science Department, Foundation, Finance, Institutional Research, Advising, Administration, Industrial Technologies Department, and Business & Information Technology Department. Additional administrative support for the ECSEL project was provided with a new staff member in the Math/Science Department, who duties include assisting the PI with project management and reporting.

KCC team members participated in a retreat with ISU and DMACC teams held on the DMACC campus in May 2017 to coordinate cross-institutional planning.

The KCC team is developing a webpage and other marketing materials for future recruitment efforts.

Broader Impacts

The ECSEL project has contributed to efforts to strengthen transfer pathways in areas of the grant between KCC and Iowa’s three public universities. KCC is working on a formal articulation process for computer science and engineering classes between Kirkwood and ISU; finalizing an articulation agreement for computer science courses with UNI; and maintaining current articulation agreements for computer science and engineering with UI.

3) What opportunities for training and professional development has the project provided?

Various training and professional development activities were provided for and/or undertaken by team members, faculty, staff and students involved in project activities.
Professional development activities for ECSEL scholars are part of the student experience, as described in the respective ISU, DMACC and KCC sections of this report. Scholars have participated in program activities to advance their academic and professional development.

Several project team members attended education conferences during the year, not only representing and disseminating the project but also using programming for professional development, e.g., FIE, ECEDHA, WEPAN, and ASEE.

Five graduate research assistants have been involved with research and other project activities at ISU. The identity research team included these graduate students:

Kelly Cunningham, M.A. (ISU): Doctoral Candidate – Applied Linguistics & Human Computer Interaction
Ronnia Estes, B.S. (ISU): Masters Student – School of Education
MacKenzie Sissel, B.S. (ISU): Masters Student – School of Education

These students, supervised and mentored by Dr. Sarah Rodriguez, assisted with the identity study by composing protocol questions, setting up infrastructure for data collection and management, analyzing transcript and reflections data, and preparing conference and publication materials.

Another graduate student, supervised and mentored by Dr. Doug Jacobson, assisted the PI team with scholar programming and project communications:
Megan Reiman, B.S. Computer Engineering (ISU): Doctoral Student – Computer Engineering and Information Assurance

4) How have the results been disseminated to communities of interest?

The news articles, publications, presentations and websites listed in the Products section support communication and dissemination to various audiences. The launch and goals of the project have been communicated through several channels. Following the announcement of the award in fall 2016, there were news releases by ISU and the College of Human Sciences. A College of Engineering news article also appeared in April 2017 highlighting the ECSEL cohort. These are linked at the project website (https://ecsel.ece.iastate.edu/about/news/), appeared in social media feeds such as via Twitter, and are attached. The project was disseminated to local and professional communities, including the spring Engineering College Industrial Advisory Council poster session (by Mina and Zambreno), the spring ECE graduate student poster session (by Megan Reiman), and the 2016 IEEE/ASEE Frontiers in Education Conference (by Mina and Rover) (see attached poster and paper).

Year 1 data collection by the identity research team resulted in the preparation of one conference proposal to the American Educational Research Association. The American Educational Research Association (AERA), a national research society, strives to advance knowledge about education, to encourage scholarly inquiry related to education, and to promote the use of research to improve education and serve the public good. The AERA conference is international in scope and is one of the world’s largest convenings focused on education with 14,000+ attendees each year. Presence at this conference is essential for broad dissemination of this project’s findings.

5) What do you plan to do during the next reporting period to accomplish the goals?

Plans for year 2 are aligned with the project objectives and logic model. Activities described in this report for year 1 will continue to be implemented. A complete cycle of scholarship recruitment and selection will be conducted at each institution. Elements of the ECSEL student experience will continue to be put in place and fully implemented at each institution.

Evaluation activities for year 2 will consist of (1) a survey with team members at ISU, DMACC and KCC to examine opinions about activities, progress towards project objectives, and contextual factors (Fall 2017), (2) coordination with the research team to prepare and conduct a survey or focus group with ISU ECSEL scholars to examine their experiences in the program (Spring 2018), (3) management of the S-STEM student tracking data (Fall 2017, Spring 2018), and (4) development of an evaluation of broader impacts, including a review of departmental records, influence on pre-college students who attend activities with ECSEL scholars or within ECE, and impact of the cyber security program.

Section 4: Impact

1) What is the impact on the development of the principal discipline(s) of the project?

Through the ECSEL project, the three institutions are influencing the pathways into and through ECSE disciplines via the implementation of a scholarship program and student experience, emphasizing leadership development and professional development. Key activities in the student experience include scholarship cohort meetings, faculty and peer mentoring, service learning projects (e.g. participating in “Taking the Road Less Traveled (TRLT)” sessions offered through WISE program), outreach activities (e.g. promoting TRLT outreach through departmental seminars), and networking trips (e.g. attending the Grace Hopper Conference).

The project is expected to improve diversity and inclusion in ECSE programs, leveraging and enhancing support for women and other students from underrepresented groups. Two complementary research studies are also underway to explore how diverse students in ECSE develop and sustain their engineering identities, and to understand how the learning environment can support diverse students to seek out ECSE programs and to persist in completing ECSE degrees. These studies will not only inform and improve project activities, but will also allow us to better influence student success and department culture, through the establishment of a community of practice for ECSE faculty to support inclusive teaching, student mentoring, and understanding of student success. Ultimately the goal is to advance knowledge and support adaptation by others, and towards this goal the larger ECSE education community is being reached through collaboration and networking.

Coordination of these key activities (both the student experiences as well as models and studies) across the three institutions is expected to enhance transfer student success.

2) What is the impact on other disciplines?

There is an extensive collaboration between the ECSE and education communities within this project. Education and social science researchers at ISU are collaborating with project leaders and
conducting research students to advance knowledge in their fields and improve understanding of STEM student success.

The project may potentially impact other faculty as they can be assisted with leveraging ECSEL project activities as building blocks for the broader impacts expected in their disciplinary research grants. In this manner, faculty participation in ECSEL will help not only the project/students but also the researcher, the targeted audience, and other stakeholders. Faculty participants will potentially enhance the competitiveness of their research grants.

3) What is the impact on the development of human resources?

As a scholarship program, a primary goal of the ECSEL project is human resource development. Scholarships will be supporting cohorts of undergraduate student scholars, including transfer students and students underrepresented in ECSE disciplines. The project emphasizes student development, as well as opportunities for graduate research assistants working on the project. The Training and Professional Development section of this report highlights some of these opportunities.

The research studies will also impact student and faculty development, e.g., understanding the how ECSE students overcome barriers, make choices, and persist along their educational and career paths. A faculty team member has already reflected that working with scholars has already increased their awareness of diversity and inclusion issues as they relate to the classroom environment.

4) What is the impact on physical resources that form infrastructure?

At Iowa State University, interactions with the first cohort of ECSEL scholars quickly revealed that a sense of place / belonging would be enhanced through a designated workspace for scholars. Working with the leadership in the Department of Electrical and Computer Engineering, we were able to renovate a previous graduate student research lab into a designated activity room for ECSEL scholars, which has since become a central meeting space, open lab, and project space for organizational activities.

5) What is the impact on institutional resources that form infrastructure?

Another potential broader impact of the project is institutional strategic planning that enhances the visibility of engineering education research and the capacity to conduct such research. The ECSEL and RIDE projects have brought attention to and reinforced engineering education research collaborations at ISU. These high impact projects reflect both the college's new strategic research area in engineering education and the university's new visionary theme of global citizen and workforce development. As part of the development of the college's new strategic plan, the following new research area on engineering education has been defined.

**Engineering Education: Strengthening Student Success and Inclusion.** Engineering education is evolving to ensure successful graduates have acquired a combination of highly flexible technical expertise, creativity, an appreciation of societal needs, and the ability to function in an inclusive, collaborative global landscape. Engineering educators harness techniques known to enhance student engagement and learning to improve educational outcomes. These can be achieved through the use of evidence-based pedagogical approaches such as project- or problem-based learning and the use of new technologies including blended online learning tools and interactive classroom technologies. Engineering educators aim to be engaged in fostering an interest in, and an appreciation of, engineering in the K-12 arena to help sustain and grow the
pipeline of diverse students. Focus areas: Student engagement in large enrollment classes, problem based learning, inclusive teaching and mentoring, pedagogy, flipped and hybrid instruction, broadening participation, mastery based assessment, creativity in engineering, developing the T-shaped engineer, engineering for K-12.

6) What is the impact on information resources that form infrastructure?

The ECSEL team has been partnering with diversity programs on campus including WISE, LEAD (multicultural students in engineering) and student organizations such as Digital Women and SWE. Specifically, WISE activities have been an influential model for the ECSEL student experience, and WISE program staff have been directly involved with project planning and activities. Examples of program collaboration between WISE and ECSEL are evident in the project activities described in this report.

Opportunities for ECSEL team leaders to interact with admissions, financial aid, advising, and scholarships leadership at the three institutions has created opportunities for information exchange that would most likely not have occurred in the absence of this project.

The program materials, websites, assessment tools, and assessment data are information resources to support faculty, staff, students, and evidence-based practices. The web-based SmartSheet platform allows for online reporting and compilation of data for easy access, tracking, and management. All data reported by the three institutions in SmartSheet is compiled in worksheets (spreadsheets) that can be accessed and formatted to meet assessment and reporting needs. Included in SmartSheet is a student database for each of the institutions that allows project directors to track student participation, persistence in ECSE disciplines, graduation, and placement.

7) What is the impact on technology transfer?

Nothing to report.

8) What is the impact on society beyond science and technology?

Project outcomes will have a longer-term impact on industry, the economy, and ultimately their products and services through workforce development. The ECSEL program is creating a student-centered, inclusive learning environment that is attractive to diverse students. With the goal of increasing the percentages of female enrollment, retention, and graduate rate, these cohorts will broaden participation and will help in diversifying the ECSE workforce.