

Annual Report for Period:07/2011 - 06/2012

Submitted on: 07/01/2012

Principal Investigator: Rover, Diane T.

Award ID: 0807051

Organization: Iowa State University

Submitted By:

Rover, Diane - Principal Investigator

Title:

E2020 Scholars: Advancing the NAE Vision

Project Participants

Senior Personnel

Name: Rover, Diane

Worked for more than 160 Hours: Yes

Contribution to Project:

Coordinated project planning and meetings. Co-leader of the Curriculum/Assessment Group. Participated in scholar review and selection. Participated in ENGR 110X and 210X.

Name: Shelley, Mack

Worked for more than 160 Hours: Yes

Contribution to Project:

Participated in project planning and meetings. Informed, guided and conducted project assessment and evaluation activities.

Name: Mickelson, Steven

Worked for more than 160 Hours: Yes

Contribution to Project:

Participated in project planning and meetings. Co-leader of the Community Group. Facilitated and guided E2020 learning community and course development. Contributed to project evaluation.

Name: Bruning, Monica

Worked for more than 160 Hours: Yes

Contribution to Project:

Participated in project planning and meetings. Co-leader of the Scholarship Group. Co-coordinator for the cohort program. Facilitated the first-year cohort experience. Managed the scholarship application, review, and selection process.

Name: Castleberry, Paul

Worked for more than 160 Hours: No

Contribution to Project:

Team member and co-leader of the Community Group with co-PI Mickelson. This responsibility aligns with his position in the College of Engineering as Learning Communities Coordinator.

Name: Johnson, Joel

Worked for more than 160 Hours: Yes

Contribution to Project:

Team member and co-leader of the Scholarship Group with co-PI Bruning. This responsibility aligns with his position in the College of Engineering as director of the Engineering Scholarship Program. Member of the E2020 scholarship selection committee.

Name: Brumm, Tom

Worked for more than 160 Hours: Yes

Contribution to Project:

Team member and co-leader of the Curriculum/Assessment Group with PI Rover. This responsibility aligns with his appointment in the College as director of assessment. Participated in project planning and meetings.

Post-doc

Graduate Student

Name: Martinez, Nico

Worked for more than 160 Hours: No

Contribution to Project:

Through 2011: Graduate student working with diversity programs. Member of the E2020 scholarship selection committee.

Name: Joines, Amy

Worked for more than 160 Hours: No

Contribution to Project:

2009-10: Student director of the Engineering Leadership Program. Member of the E2020 scholarship selection committee.

Name: Laingen, Mark

Worked for more than 160 Hours: Yes

Contribution to Project:

Participated in project planning and meetings. Co-coordinator of E2020 cohort program. Coordinator for the transfer cohort. Instructor for E2020 seminar courses. Sources of support for graduate assistantship include the college and an NSF STEP grant.

Undergraduate Student

Name: Williams, Ana

Worked for more than 160 Hours: Yes

Contribution to Project:

Student coordinator for cohort program and peer mentor for E2020 first-year cohort. This position is paid by the project.

Name: McLaurin, Elease

Worked for more than 160 Hours: No

Contribution to Project:

Summer 2010: E2020 peer mentor. Assisted with summer orientation for new students.

Name: Sevcik, Joshua

Worked for more than 160 Hours: Yes

Contribution to Project:

E2020 peer mentor for transfer student cohort. Supported by this project and an NSF STEP project.

Name: Mulloy, Patrick

Worked for more than 160 Hours: Yes

Contribution to Project:

E2020 peer mentor for transfer student cohort. Supported by this project.

Name: Klutzke, Brenda

Worked for more than 160 Hours: Yes

Contribution to Project:

E2020 scholar, peer mentor to new cohorts, and seminar teaching assistant.

Name: Mcguire, Ethan

Worked for more than 160 Hours: Yes

Contribution to Project:

E2020 scholar, peer mentor to new cohorts, and seminar teaching assistant.

Name: Nelson, Lauren

Worked for more than 160 Hours: No

Contribution to Project:

E2020 scholar and peer mentor to new cohort.

Name: Lundeen, Kurt

Worked for more than 160 Hours: No

Contribution to Project:

E2020 scholar and peer mentor to new cohort.

Name: Mally, Elizabeth

Worked for more than 160 Hours: No

Contribution to Project:

E2020 scholar and peer mentor to new cohort.

Name: O'Loughlin, Caitlin

Worked for more than 160 Hours: No

Contribution to Project:

E2020 scholar and peer mentor to new cohort.

Technician, Programmer

Name: Hill, Gloria

Worked for more than 160 Hours: No

Contribution to Project:

Through June 30, 2010: Assisted the PI with meetings, budgeting, and other project management activities.

Name: Stowe, Jane

Worked for more than 160 Hours: No

Contribution to Project:

Secretary for the Engineering Scholarship Program. Assists the director of the program.

Name: Spurlock, Cindy

Worked for more than 160 Hours: No

Contribution to Project:

Enrollment Services Office Coordinator. Assists team members with prospective student information.

Name: Prouty, Tina

Worked for more than 160 Hours: No

Contribution to Project:

Scholarship Program Coordinator. Assists the director with data management and analysis.

Name: Centeno-Diaz, Laura

Worked for more than 160 Hours: No

Contribution to Project:

Diversity Programs Coordinator. Member of the E2020 scholarship selection committee.

Name: Darrow, Mary

Worked for more than 160 Hours: No

Contribution to Project:

Member of the E2020 scholarship selection committee. Contributed to the transfer cohort experience. This involvement aligns with her activities on an NSF STEP project.

Name: Anderson, Virginia

Worked for more than 160 Hours: No

Contribution to Project:

Starting fall 2010: Program assistant providing assistance with meetings, budgeting, and other project management activities.

Other Participant

Name: Jacobson, Doug

Worked for more than 160 Hours: No

Contribution to Project:

E2020 pillar group leader for Innovation. Contributed lectures/activities for the E2020 seminar courses. University Professor in Electrical and Computer Engineering.

Name: Kaleita, Amy

Worked for more than 160 Hours: No

Contribution to Project:

E2020 pillar group leader for Global Awareness. Contributed lectures/activities for the E2020 seminar courses. Professor in Agricultural and Biosystems Engineering.

Name: Rehmann, Chris

Worked for more than 160 Hours: No

Contribution to Project:

E2020 pillar group leader for Systems Thinking. Contributed lectures/activities for the E2020 seminar courses. Professor in Civil, Construction, and Environmental Engineering.

Name: Rollins, Derrick

Worked for more than 160 Hours: No

Contribution to Project:

Through fall 2009: participated with scholarship selection.

Name: Hartmann, Beth

Worked for more than 160 Hours: No

Contribution to Project:

E2020 pillar group leader for Leadership. Contributed lectures/activities for the E2020 seminar courses. Lecturer in Civil, Construction and Environmental Engineering.

Research Experience for Undergraduates

Organizational Partners

Sandy Jennings-Hammond

The project uses the services of the outside individual as a communications specialist for selected project needs.

3M

The 3M Corporation has financially supported the Engineering Leadership Program, which is the program after which the E2020 Scholars Program is being modeled. 3M wrote a letter of support for the grant and remains interested in the project.

Rockwell Collins

Rockwell Collins has financially supported the Engineering Leadership Program, which is the program after which the E2020 Scholars Program is being modeled. Rockwell Collins wrote a letter of support for the grant and remains interested in the project.

Other Collaborators or Contacts

Learning Communities Task Team (a college-wide committee comprised of advising staff and faculty from each department): Stakeholders in pillar module development.

Activities and Findings

Research and Education Activities: (See PDF version submitted by PI at the end of the report)

Findings: (See PDF version submitted by PI at the end of the report)

Training and Development:

The E2020 scholars, both first-year and transfer students, have participated in program activities to advance their academic and professional development. The students have completed course modules to develop their knowledge, skills and abilities in the four pillar areas.

Undergraduate peer mentors have been introduced to the NAE's vision for the engineer of 2020 and have facilitated scholar understanding and development.

The seminar course instructor, faculty leaders, and project team members have begun to explore, collect, and develop materials to support curriculum and assessment of the four pillar areas of the program.

Information is being shared with others, such as faculty and staff involved with learning communities in the college, leading to expanding the awareness and knowledge base of team members and collaborators.

Outreach Activities:

Refer to attachment (e.g., communications to various audiences, such as poster at the ISU CELT Teaching Poster Symposium).

Journal Publications

Books or Other One-time Publications

M. Bruning, D. Rover, and A. Williams, "Work in Progress: Developing Engineers for 2020 - An Innovative Curricular and Co-curricular Approach", (2011). conference proceedings, Published Collection: Proceedings 2011 ASEE/IEEE Frontiers in Education Conference

Bibliography: Bruning, M., D. Rover, and A. Williams. Work in Progress: Developing Engineers for 2020 - An Innovative Curricular and Co-curricular Approach. Proc. 2011 ASEE/IEEE Frontiers in

Web/Internet Site

URL(s):

<http://www.engineering.iastate.edu/e2020>

Description:

The E2020 website provides an overview of the project intended to inform prospective students as well as interested persons inside and outside the university. It also provides information about the E2020 scholarship and program and supports the application process.

Other Specific Products

Contributions

Contributions within Discipline:

Resources and materials are being identified, collected, and developed to teach students about engineering leadership, innovation and entrepreneurship, systems thinking, and global awareness. Instructional materials for two seminar courses were developed. An intranet repository has been created for internal project use by faculty and staff in engineering. This will continue to be expanded on as the project continues. Resources will also be made available to other engineering educators.

Contributions to Other Disciplines:

The curriculum and assessment resources will use and contribute to the larger body of knowledge in the four pillar areas. There are various leadership programs and initiatives on campus and in the education community. There is an entrepreneurship program in the College of Business and various activities across colleges. Global awareness and systems thinking are also important areas across disciplines.

Contributions to Human Resource Development:

The goal of this project is human resource development. Scholarships supported a cohort of undergraduate student scholars, including transfer students and underrepresented students. Peer mentors were trained, and along with the scholars, gained new knowledge, skills and abilities in the four pillar areas of the E2020 program. Faculty and staff also acquired new information about student development.

Contributions to Resources for Research and Education:

Information resources are under development to support teaching, learning and assessment in the four pillar areas of the project. E2020 team members will collaborate with similar efforts at other institutions, such as Purdue University's E2020 initiative.

Contributions Beyond Science and Engineering:

Conference Proceedings

Special Requirements

Special reporting requirements: None

Change in Objectives or Scope: None

Animal, Human Subjects, Biohazards: None

Categories for which nothing is reported:

Any Journal

Any Product

Contributions: To Any Beyond Science and Engineering

Any Conference

Annual Report for Year 4
E2020 Scholars
NSF S-STEM Program
Award #0807051



2011-12 Findings, Products, and Contributions

The activities of the project led to several results and outputs during year four. These are highlighted below.

E2020 Scholars Program Visual Identity

The E2020 Scholars Program graphical icon depicts the pillars of the program:



- Star: leadership
- Arrow: System thinking
- Exclamation: Innovation
- Circle: Global awareness

It continues to be used in program communications, giving the program and scholars a distinctive visual identity. E2020 t-shirts for the scholars were designed with the icon in 2011. The letterhead for the project memos used by scholars also includes the icon, as shown below.



Project Memorandum

E2020 Scholars

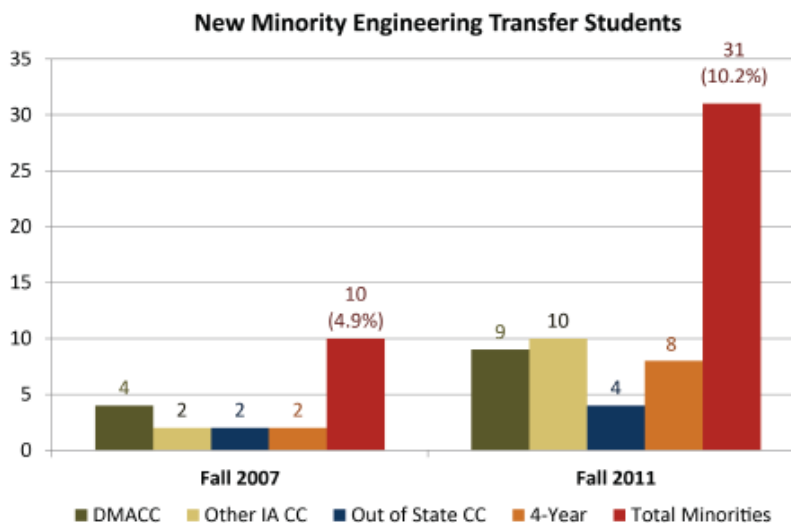
The first scholarships were awarded for a cohort entering fall 2009, i.e., 2009-10. A total of three rounds of scholarships have been awarded. The table below lists the number of scholarships anticipated in the grant proposal and the actual number of scholarships awarded for these cohorts. The lower number of transfer scholarships awarded vs. proposed in 2009 and 2011 was due to smaller applicant pools.

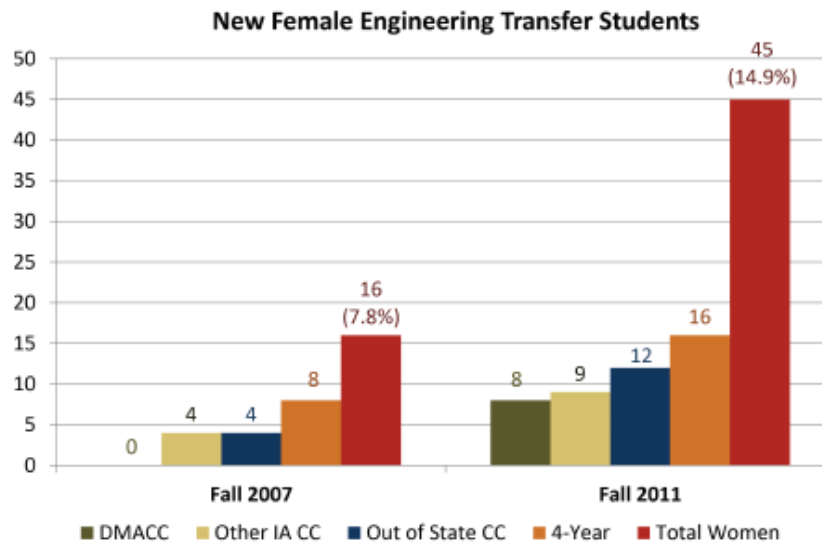
Cohort	Number of Scholarships - Proposed			Number of Scholarships - Awarded		
	First Year	Transfer	Total	First Year	Transfer	Total
2009-10	12	13	25	14	8	22
2010-11	11	12	23	12	14	26
2011-12	11	11	22	16	9	25
Total	34	36	70	43	31	73

The table below summarizes the number of applicants and scholars for the 2009, 2010, and 2011 cohorts.

	Total	First Year Students			Transfer Students		
		All	Women	Minority	All	Women	Minority
2009-10							
Applicants	208	189	52	28	19	1	1
Scholars	22	14	4	5	8	0	0
2010-11							
Applicants	195	173	35	15	22	5	0
Scholars	26	12	7	4	14	5	0
2011-12							
Applicants	269	243	51	38	26	5	6
Scholars	25	16	7	3	9	2	0
Total							
Scholars	73	42	18	12	31	7	0

A majority of ISU transfer students come from Iowa community colleges. Minority student enrollment in STEM at community colleges in Iowa is a challenge due to the demographics of the state. However, a positive trend was reported in a recent study by the SEEC Project (M. Darrow, "Engineering Transfer Students: Voices from the Sidelines of the Engineering Playing Field," Ph.D. Dissertation, Iowa State University, June 2012). From 2007 to 2011, the numbers/percentages of minority and female engineering transfer students from Iowa community colleges increased, as shown in the graphs below.





In the cohort tables below, “T” in the “Cohort” column indicates a transfer student. The “Grad Date” column is the expected term (Fall, Spring, Summer) and year of graduation.

Retention in each of the cohorts is high and exceeds university averages:

- 2009 cohort:
 - 18 of 21 entering scholars remain in the program.
 - 86% 3rd year retention in engineering
 - 95% retention at ISU
 - One scholar died in a car accident in fall 2010.
- 2010 cohort:
 - 24 of 26 entering scholars remain in the program.
 - 92% 2nd year retention in engineering/technology
 - 100% retention at ISU
- 2011 cohort:
 - 25 of 25 entering scholars remain in the program.
 - 100% 1st year retention in engineering
- Overall: 73 scholars were originally admitted in the E2020 Program. 67 of 72 scholars remain in the program, giving an overall retention of 93% in the program.

2009 Cohort				
Cohort	First Name	Last Name	Major	Grad Date
0910	Moses	Bomett	ECON	
0910	Alexander	Carr	Aer E	S13
0910	Sterling	DeLoatch	HIST	
0910T	Anthony	Escher	M E	S12
0910T	Patrick	Flaherty	M E	F12
0910	Alicia	Fleege	M E	S13
0910	Lizette	Jimenez	Ch E	S13
0910T	Christopher	Jolley	C E	Su12
0910T	John	King	Ch E	F11
0910	Brenda	Klutzke	M E	S13
0910	Samuel	Kruger	Deceased 10/8/10	
0910	Todd	Lyon	Cpr E	S13
0910	Benjamin	Magstadt	E E	S13
0910T	Ethan	McGuire	Ch E	S12
0910	Donathan	Morgan	E E	S13
0910	Ryan	Page	P CS	S13
0910	Karly	Rager	Con E	F14
0910	Andrew	Rondon	Con E	F13
0910T	Eric	Schulte	C E	S13
0910T	Jeffrey	Smith		
0910T	Mathew	Titus	M E	S12
0910	Justin	Wenger	Con E	S13

2010 Cohort				
Cohort	First Name	Last Name	Major	Grad Date
1011	Christina	Anderson	IND D	S14
1011T	Taylor	Anderson	S E	S13
1011T	Andrew	Beougher	E E	F12
1011T	Rebecca	Briesmoore	C E	S13
1011	Carrie	Demmon	EL ED	
1011T	Paul	Dobbie	M E	S13
1011	Tyler	Fox	I E	S14
1011T	Jake	Freebolin	M E	S13
1011T	Edwin	Geerdes	M E	S13
1011	Ryan	Gilsdorf	IND D	S14
1011	Tyler	Jones	M E	S14
1011T	Andrew	Judkins	Aer E	S13
1011T	Kurt	Lundeen	M E	S13
1011T	Elizabeth	Mally	C E	S13
1011T	Hannah	McCuddin	Psych	
1011T	Margaret	Mishler	I E	F12
1011	Lauren	Nelson	Ch E	S14
1011	Alexandra	Olivares	BSE	S14
1011	Caitlin	O'Loughlin	C E	S14
1011T	Brittney	Pavel	Aer E	S14
1011	Michael	Rosenthal	Con E	S14
1011	Mark	Sanocki	M E	S14
1011	Samantha	Sauerbrei	Ch E	S14
1011T	Jeremy	Sprecher	BSE	F12
1011	Jasmine	Stovall	C E	S14
1011T	Benjamin	Swenson	Con E	S14

2011 Cohort				
Cohort	First Name	Last Name	Major	Grad Date
1112T	Jonathan	Bauer	M E	S13
1112T	James	Boddie	S E	S13
1112	Tyler	Bouslog	A E	S15
1112	Conrad	Brendel	C E	S15
1112T	Nicole	Cullen	Cpr E	S14
1112	Adrian	Gordon	Ch E	S15
1112	Erin	Hallisey	M E	S15
1112	Courtney	Johnson	Ch E	S15
1112	Lisa	Keierleber	C E	S15
1112T	Joseph	Kopacz	M E	S13
1112	Catherine	Krezowski	C E	S15
1112	Tyler	Langel	M E	S15
1112	Rachel	Lieser	Ch E	S15
1112	Christian	Lopez	Aer E	S15
1112T	Mark	Maloney	Aer E	S14
1112	Mark	Mendick	M E	S15
1112	Andrew	Modjeski	Aer E	S15
1112	Theresa	Ohms	M E	S15
1112	Alexander	Peck	Cpr E	S15
1112T	Alex	Pettit	Ch E	S13
1112T	Sara	Scheiding	I E	F13
1112T	Alex	Stauffacher	E E	S13
1112T	Joshua	Volsen	E E	S13
1112	Erika	Weimer	Ch E	S15
1112	Christopher	Whitmore	Mat E	S15

E2020 Seminar Courses

ENGR 110X is the one-credit seminar course taken by scholars during the second semester of their first year in the program. ENGR 210X is the one-credit seminar course taken during fall and spring semesters of the second year. 110X introduces students to each of the four pillars over twelve weeks. A three-week learning format is used for each pillar. The first week introduces the students to knowledge content related to the pillar. The second week focuses on the students developing basic skills related to the knowledge they learned in week one through an active learning activity. During the third week, students are asked to demonstrate their ability to apply their new knowledge and skills to a real-world problem related to that pillar and to present their findings to the rest of the class. The class uses team-based learning methods to maximize the student learning experience. The knowledge, skills, and

abilities (KSA) format used in this class is used for each of the four pillar sessions. Peer mentor sessions are interspersed with the class sessions to promote student-peer mentor interaction.

ENGR 210X provides more in-depth investigation into the pillars. The fall semester seminar is split into two seven-week periods, one for the leadership pillar and another for systems thinking. The spring semester seminar is split between the innovation and global awareness pillars. Each seven-week period is designed to address a pillar through the KSA model introduced in ENGR 110X. The first two weeks are dedicated to introduction of new knowledge; the next three weeks focus on skills development and team building; and in the last two weeks, the team applies the pillar in the context of a specific problem.

Faculty pillar leaders have written specific pillar student learning outcome statements and developed initial pillar-specific learning modules and assessment methods for addressing the student learning outcomes.

The intention is to use the seminar courses to develop learning experiences to be integrated into the first year experience or other engineering courses for all engineering students. One avenue for integration is in learning community programming. During spring 2012, the first of a series of workshops centered on E2020 pillars was held for Engineering Learning Community coordinators and peer mentors. The E2020 Leadership Pillar Workshop with LCTT was organized by Paul Castleberry (LCTT chair) and designed by Beth Hartmann, E2020 Faculty Leader; part 1 was held on February 9 and part 2, on March 8.

E2020 Project-Based Independent Study

After completing the ENGR 110X and 210X seminar series, and beginning in the third year of the program, scholars continue to develop a deeper understanding of the pillars through capstone-like experiences using project-based learning. During year 4 of the E2020 project, the project-based learning experience was developed, and the first cohort of E2020 scholars began independent study experiences with faculty mentors. The project-based independent study assignment is included in an appendix.

As part of project management and communications skills development, scholars report their progress several times during the year. A memorandum format for reporting progress was used. An excerpt of a memo submitted spring 2012 is shown below.



Project Memorandum

Date: April 16, 2012
To: Diane Rover and Mark Laingen
From: Alex Carr
Subject: Update for E2020 Project

I am writing to keep you up to date on the progress that has been made on my E2020 project since our last correspondence in February. To recap, my project is focused on the potential to use wind turbines to capture electricity during the descent profile of an airplane. This process would improve overall efficiency by replacing the fuel consuming auxiliary power unit (APU) cell and reducing aircraft weight. Two other aerospace engineering students and I have been working with Professor Paul Durbin and Matthew Nelson as advisors. This project incorporates the E2020 pillars for innovation and systems thinking. Innovation is crucial since we are using turbines in a new way. The system thinking aspect is important for incorporating our project into an already complicated system.

Progress

Since February, we finished making our model. This involved sending the plans to be made using a 3D

Undergraduate Research

As described in the assignment in the appendix, students may select a research project for their capstone experience. The story of E2020 scholar Joe Kopacz serves as an example of early student engagement through research, first- and second-year learning experiences, and synergistic project activities. In the NSF STEP project that is complementary to the E2020 Program, the SEEC Project promoted community college student participation in the ISU BioMaP (Biological Materials and Processes) REU, which was one of the first at ISU to involve community college students (<http://www.cbe.iastate.edu/research/undergraduate-research/>). The BioMaP REU Program is directed by Monica Lamm, a professor in Chemical and Biological Engineering. During summer 2011, twelve students from across the nation and three from Mexico spent their summer with the program. BioMaP consists of a variety of projects with topics ranging from nanovaccines, drug and gene delivery, to clinical trials with an artificial pancreas. Through research and activities, the goal of the program is to provide students with a graduate school experience and create a desire for lifelong learning. One of the students participating was Joseph Kopacz from Scott Community College, Davenport, Iowa. Joe participated in the Engineering Admissions Partnership Program (a SEEC program for incoming transfer

students) and transferred to ISU as an E2020 Scholar in fall 2011; he is now a senior in mechanical engineering. Joe is pictured in the photo below, standing on the left.



(<http://innovate.engineering.iastate.edu/2011/09/20/students-travel-from-across-the-nation-for-biomap-reu-summer-program/>)

Publications and Presentations

Results of the survey administered to the 2009 and 2010 cohorts to obtain feedback on their experiences are given in the following report:

Geisinger, B. and Ryder, A. E2020 Scholars Evaluation Survey for Students in ENGR 110X and ENGR 210X: Evaluation Report. Research Institute for Studies in Education (RISE), Iowa State University. December 2011.

The survey report has been disseminated and reviewed internally. Several results are given **in the Evaluation Findings section**.

The E2020 Program was presented at the ASEE/IEEE Frontiers in Education Conference in fall 2011:

Bruning, M., D. Rover, and A. Williams. Work in Progress: Developing Engineers for 2020 – An Innovative Curricular and Co-curricular Approach. Proc. 2011 ASEE/IEEE Frontiers in Education Conf. October 2011.

The lead peer mentor for the E2020 Program presented a poster at a campus event in spring 2012:

Williams, A., Bruning, M., Rover, D., Laingen, M., Mickelson, S., Brumm, T., & Shelley, M. E2020 Scholars Program. Teaching Poster Symposium. Iowa State University Center for Excellence in Learning and Teaching. April 2012.

Evaluation Findings

Based on the E2020 Student Scholar Survey administered in 2011, student feedback on the program was very positive, with 100% of student respondents in the 2009 entering cohort and 89% of student respondents in the 2010 entering cohort agreeing (indicating either *Somewhat agree* or *Strongly agree*) that their involvement in the E2020 program was a positive experience. Additionally:

- 89% of the 2009 entering cohort and 72% of the 2010 entering cohort reported that E2020 is a good fit for their career interests.
- 100% of the 2009 cohort and 81% of the 2010 cohort responded that they have grown as a person through their E2020 experiences.
- 79% of the 2009 cohort and 85% of the 2010 cohort reported that E2020 helped them feel better prepared to succeed in college.

The survey indicated that the four pillars continue to provide a strong framework for the E2020 Program. Students in their comments expressed that the pillars had expanded their perspective on the field of engineering, given them a greater appreciation for the complexity of engineering, and allowed them to see common threads across their classes. Student evaluations of E2020 faculty and staff were also very positive. When asked if program coordinators and faculty were helpful, not a single student disagreed.

Student comments on the E2020 Scholar Survey from both cohorts as well as transfer and freshman students also indicated the unique academic and social support provided by the program as well as fellow students, faculty, and staff. Students noted that the four pillars provided them with skills and perspectives that would be valuable in further study as well as in achieving their career goals. Students indicated that the emphasis on leadership, systems thinking, entrepreneurship, and global awareness served to broaden their perspectives on the field of engineering. One student summarized the E2020 Program experience, saying:

The ability to work with other students in different engineering disciplines on topics that are universal to all engineers will have a big impact and importance in my future endeavors as a successful engineer. Also the coordinators and my fellow scholars are amazing people!

Four S-STEM program goals were articulated for E2020:

1. Improved educational opportunities for students:
To what extent do students demonstrate progress on E2020 learning outcomes?
2. Increased retention of students to degree achievement:
Do scholarship support, E2020 relevance to students, and learning community engagement increase retention?
3. Improved student support programs at institutions of higher education:
What is the benefit of complementary NSF STEP grant activities?

4. Increased numbers of well-educated and skilled employees in technical areas of national need:
What is the result of the E2020 focus and the concurrent goal of the NSF STEP grant to increase the number of engineering graduates?

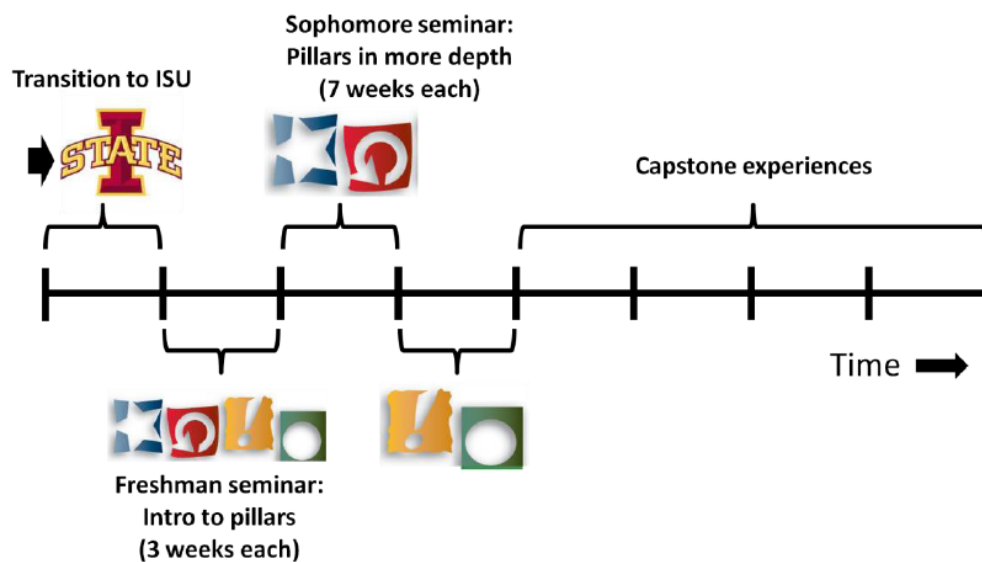
Findings reinforce that progress is being made toward achieving these four goals.

Appendix: Project-Based Independent Study Assignment

During the first two years of the E2020 program, scholars were introduced to the four pillars of the program:

1. leadership
2. systems thinking
3. innovation and entrepreneurship
4. global awareness and understanding

As shown in the figure below, early experiences with the pillars were provided in the freshman (first year) and sophomore (second year) seminars.



Beginning in the third year of the program, scholars will continue to develop a deeper understanding of the pillars through capstone-like experiences using project-based learning (PjBL).

Prince and Felder have broadly defined project-based learning as follows:

Project-based learning begins with an assignment to carry out one or more tasks that lead to the production of a final product—a design, a model, a device or a computer simulation. The culmination of the project is normally a written and/or oral report summarizing the procedure used to produce the product and presenting the outcome.

(“Inductive Teaching and Learning Methods: Definitions, Comparisons, and Research Bases,”
Journal of Engineering Education, 2006)

Project-based learning facilitates independent and interdependent learning and a deeper understanding of the material. Through their E2020 PjBL experience, scholars will develop self-directed learning skills.

Scholars will demonstrate the following abilities:

- Project management
- Teamwork
- Written and oral communications
- Research, analysis, and reasoning
- Understanding and integration of at least two E2020 pillars

Scholars will be expected to:

- a. Complete a project under the guidance of a faculty mentor, selected by the scholar.
- b. Propose a project within the parameters described below.
- c. Enroll in independent study credit to earn at least one credit per semester for the PjBL experience.
- d. Provide project updates, presentations, and a report to the E2020 Program.

Project Parameters

Type of Project

... You will select one of these areas for your project.

1. Research-oriented project: creating knowledge
2. Education-oriented project: sharing knowledge
3. Service-oriented project: applying knowledge

The expectations for each type of project are similar. The impact of each is different. For a research project, you will take an open-ended technical question and investigate it. You will create a solution. For an education project, you will develop an innovation for a course. You will share a new experience with other students. For a service project, you will identify a societal problem and approach it through service learning. You will apply your expertise to meet a need. Browse through these materials to get started and learn more about each type of project:

- Undergraduate research at Iowa State: <http://www.undergradresearch.iastate.edu/>
- Hot courses, article in *ASEE PRISM* magazine: http://www.prism-magazine.org/summer11/feature_01.cfm
- Service learning at Iowa State: <http://www.celt.iastate.edu/ServiceLearning/>
- EPICS service learning: <https://engineering.purdue.edu/EPICS/>

Collaboration

You are encouraged to work as part of a group on your project. You might form a group having E2020 scholars. You might join a group and be the only E2020 scholar, for example, if you work with a research group or with a student organization. You may also pursue a project as an individual, however, you will be required to identify specific collaborators.

E2020 Pillars

Remember that your project is a learning experience for you to develop a deeper understanding of the pillars. It should incorporate at least two of the pillars. You will propose how to accomplish this based on your project, your faculty mentor's interests, consultation with E2020 faculty and staff, etc.

Proposal

The scope and pace of your project depends in part on your level as a scholar. Some of you are graduating soon, and you will need to propose a plan that you can finish in that timeframe. Some of you have another couple of years in the program and may plan accordingly. Your first deliverable will be a project proposal.

Here are several resources you might find helpful:

- eHow article (simple but applicable): http://www.ehow.com/print/how_8273095_develop-proposal-undergraduate-research-project.html
- Book, *Doing Your Undergraduate Project* (preview chapter available online, a copy of the book will be available to scholars): <http://www.uk.sagepub.com/books/Book225695>
- EPICS resources (very specific to their service learning course but a good reference): <https://engineering.purdue.edu/EPICS/Resources/Forms/index.html>

Independent Study Examples

Scholars have various options to take independent study credit to satisfy the E2020 program requirement. A few examples are given below. There are many possibilities, and you are encouraged to create an experience that complements and leverages your current courses and/or co-curricular activities. You should include a description of your proposed independent study plan in your project proposal.

First, look at the courses offered by your department. You should find an independent study course, often numbered 490 (e.g., ChE 490, IE 490, etc.). There is also an ENGR 490. You will need to follow your department procedures for enrolling in 490.

Second, depending on your interests, you might consider taking 490 credit as follows:

- Complete a separate project for 490 only.
- Add (or add to) a project in a regular course, possibly using the course instructor as your faculty mentor.
- Add something to your senior design project.
- Add something to your honors project.

- Add something to your paid undergraduate research project.
- Add a project to your study abroad experience.
- Add something to a design competition team you are involved with (e.g., ISU Power Pullers, Steel Bridge Team, Solar Car Team, etc.).
- Use (or add to) a project for a student organization such as Engineers Without Borders.
- Create another plan.

The 490 credit will account for your participation in the E2020 Program. It formalizes your PjBL experience. As appropriate, you may also need to consider your faculty mentor's expectations.

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2011-12 Activities

Project Goals and Objectives

The E2020 Scholars Program has provided scholarships for cohorts of undergraduate engineering students within the college's established learning community infrastructure, giving specific attention to the aspirations and attributes of the National Academy of Engineering's (NAE) vision for the engineer of 2020. The project has outlined a set of student development and learning opportunities consistent with the NAE vision. Four E2020 outcomes were identified: leadership, global awareness and understanding, systems thinking, and innovation and entrepreneurship. These outcomes are being integrated into curricular and co-curricular activities. E2020 scholars participate in a learning community, and the four pillar areas of leadership, global awareness, systems thinking, and innovation are introduced in a one-semester first-year seminar and reinforced in a two-semester second-year seminar. These seminars supplement the regular program of study for engineering students. The scholarship program is expected to promote student engagement and development centered on these E2020 outcomes.

The E2020 Scholars Program is pursuing the goals of the S-STEM program through four objectives:

- Provide opportunities like the Engineering Leadership Program to greater numbers of students and create learning outcomes consistent with the E2020 vision.
- Engage students in new learning opportunities through cohorts and communities focusing on E2020 concepts.
- Use E2020 scholarships in coordination with programs developed in a related NSF STEP grant, i.e., the SEEC Project (www.engineering.iastate.edu/seec/).
- Use the E2020 focus in coordination with the NSF STEP grant to prepare more graduates to fulfill the NAE and college vision.

The E2020 Scholars Program was designed to leverage two effective programs in the College of Engineering at the time of the proposal: the Engineering Scholarship Program and the Engineering Leadership Program. The E2020 project benefits from the application of successful, research-based practices, alignment with national recommendations, institutional and team strengths, and expert evaluation.

The program proposed to select 25 scholars during year one for students entering Fall 2009, split approximately evenly between incoming freshmen students and transfer students; 23 scholars during year two for students entering Fall 2010; and 22 scholars during year 3 for students entering Fall 2011.

Project Management and Communications

The project team held meetings monthly to plan, review strategies and progress, and share information. These team members include faculty members Diane Rover, Steve Mickelson, Mack Shelley, Monica Bruning, and Tom Brumm; staff members Joel Johnson and Paul Castleberry; and graduate student Mark Laingen. The team also includes Andy Ryder, an evaluator from ISU's Research Institute for Studies in Education (RISE).

Each pillar area is led by a faculty member outside of the PI team:

- Leadership: Beth Hartmann, Lecturer, Civil, Construction and Environmental Engineering
- Innovation/entrepreneurship: Doug Jacobson, University Professor, Electrical and Computer Engineering
- Systems thinking: Chris Rehmann, Professor, Civil, Construction and Environmental Engineering
- Global awareness: Amy Kaleita, Associate Professor, Agricultural and Biosystems Engineering

The faculty leaders group actively worked with project team members throughout the year. They met for planning and review purposes every semester and held a planning retreat during the summer.

Data entry at the NSF S-STEM Scholarship Reporting Site was completed through spring 2012. This additional reporting requirement is met by using project funds to support data collection and formatting by RISE and ISU's Office of Institutional Research.

A Sharepoint intranet site continues to be used as a tool to maintain and share project information, such as meeting minutes, documents, readings, curriculum materials, pillar documents and resources, scholarship applications, etc.

The E2020 Program website, <http://www.engineering.iastate.edu/e2020>, has been maintained with various scholar and program information; a more extensive update is underway during summer 2012.

Each new class of E2020 Scholars has been announced through college and/or department news. Another release is written for E2020 Scholars to use in their local newspapers to announce their acceptance into the program and receipt of an E2020 scholarship.

The E2020 Scholars Program is conducted alongside an NSF STEP-funded project, SEEC: <http://www.eng.iastate.edu/seec/>. All but a few E2020 team members are also SEEC team members. SEEC project funds designated for curriculum development have been used to support the faculty leaders and instructor (graduate student Laingen) to develop and teach the E2020 seminar courses.

Scholarships

The College of Engineering scholarship office administers the E2020 scholarships and works with the university's financial aid office to make awards to students. The College of Engineering has committed to shared financial obligations for the 2009, 2010, and 2011 scholar cohorts.

Cohort and Community Development

The scholars in the 2011 cohort began their affiliation with the E2020 Program during summer orientation. They attend an introductory one-on-one meeting to acquaint them and their families with the program and expectations. The E2020 Program provides scholars an opportunity to develop a community of practice with other scholars, upper-class peer mentors, and engineering faculty who share a common interest in developing competence related to the four pillars. The program builds on ISU's strong Learning Community initiative by requiring that the scholars participate during their first semester/year in a degree program specific learning community (e.g., Mechanical Engineering Learning Community) or a thematic learning community (e.g., Women in Science and Engineering Learning Community). During the scholars' first and second years, the E2020 Learning Community meets regularly and complements a student's primary learning community. Scholars learn about the four pillar areas in a one-credit seminar course during their second semester and in another one-credit seminar course during fall and spring semesters of the second year. More information on the courses is available **in the Findings section of this report.**

A social activity to bring all three cohort groups together was brainstormed by peer mentors and scholars; two events were arranged, one in fall 2011 and another in spring 2012. About 20 students participated in each event. Students gathered for the fall event are shown in the photo below.



Evaluation

Evaluation is led by co-PI Mack Shelley in coordination with Andy Ryder, a research and evaluation scientist from RISE. The evaluators facilitate all evaluation activities involving students as the primary contact with the Office for Responsible Research and the ISU Institutional Review Board.

As in preceding years of the project, a process evaluation was based on participation by the evaluators in E2020 meetings and in related meetings, including ISU's NSF-funded SEEC project. Interactions during year 4 with the PI and co-PIs for E2020 indicate that project planning and implementation and group coordination continue to proceed well.

A survey was administered to the 2009 and 2010 cohorts prior to fall 2011 to obtain feedback on their experiences during their second and first years, respectively, of the E2020 program. Results of the survey are summarized **in the Findings of this report**. The survey has been updated to administer to all three cohorts (2009, 2010, and 2011) before fall 2012. Additionally, interview and focus group protocols have been developed to collect data regarding program impacts from E2020 Scholars upon graduation from Iowa State University and the E2020 Program.