Nurturing the Next Generation of Computer Science Professionals

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IUSE/PFE:RED #1623189

*The **Computer Science Professionals (CSP) Hatchery** will create a revolutionary learning environment by modeling the best practices of a software company work experience, layering nurturing aspects that promote ethical questioning, value diversity, and a focus on professional skills such as increased collaboration, communication, and teamwork.*

Partner for Success!


Foundational Values


Navigating Computer Systems


Intro to Version Control


Agile Development


Intro to Database System Usage


A Brief Intro to HCI


Technical Interviews, Jobs, and Careers


Current Topics in Computer Science


Secure Programming


Software Testing

Students
Advising
Faculty/Staff
Industry

Objectives

Culture of Engagement

Real-World Relevancy

VITaL
Vertically Integrated Teaching and Learning

Engaged/Shared Learning

Professional & Entrepreneurial Skills Complement Technical

Diversity for Mutual Gain

Ethical/Moral Infusion

Positive Agents of Change!

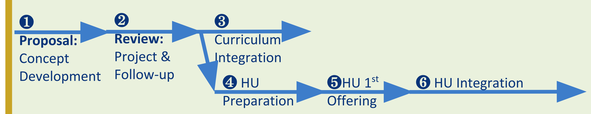
Knowledge, Skills, & Abilities

Through several meetings with industry representatives, we iteratively developed the KSA categories and desired outcomes shown below.

KSA Category	Desired Outcomes
Business	*Understanding how a company makes money and executes strategy*
Collaboration & Teams	*Working with people and groups to achieve a goal*
Entrepreneurship	*Organizes, manages, and assumes risks of a business or enterprise*
Professional	*A person engaged and qualified in the computing profession*
Research & Development	*Seeks innovation and improvement of products and processes*
Technical	*Practical knowledge and skills associated with the computing field*

Hatchery* Change Process

***Hatchery Units** (HUs) are one credit courses focused on skills relevant to computer science professionals and designed to rapidly adapt to the changing needs of industry. HUs are also a vehicle to diffuse social justice and equity through the curriculum.



Proposal
- Submission
- Project Review & Follow-up
- Industry Knowledge, Skills and Abilities (KSA) Evaluation
- *Concept Decision:*
  - Approve Development
  - Proposal Refinement
  - Defer Proposal

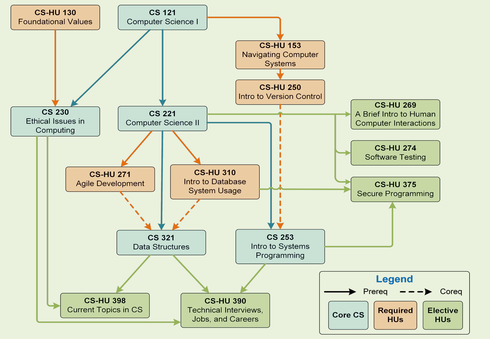
Development
- Syllabus
- Industry Participation
- Course Materials
- 1st Course Offering
- *Pilot Decision:*
  - Course Approval
  - Course Refinement
  - Defer Course Integration

Integration
- Course Refinement
- *Integration Opportunities:*
  - HU Content Threading
  - Capstone Integration

VITaL
Engaged/Shared Learning

Foundational Values
(Diversity & Social Justice)
Threaded Freshman to Senior Courses

Hatchery Curriculum Map



Next Steps

- Additional HUs planned 2019-2020
- Continue faculty HU instructional rotation
- Continue *"threading"* HU content in courses
- Evaluate *"KSA content"* in CS courses
- *"Capstone integration"* feasibility evaluation
- Examine students' social/emotional levels
- Research, Validation, and Publication
- Final assessment of program impact

Progress

- Approved 11 HU courses: 5 required, 6 elective
  - 5 delivered in 2017-2018; 3 in 2018-2019
  - 57 sections, 1584 students (Fa'17-Sp'19)
- *"Entrepreneurial Emphasis"* approved for Fall 2019
- 14 faculty have taught a HU (4 grant members)
- 4 Industry partners have taught a HU
- Faculty & industry partners - 2nd round interviews
- Student baseline and social network analysis
- 5 papers co-authored with other Universities
- Products to date: 15 conference presentations/papers, 1 book, and 3 websites

Challenges

- Ingrained biases and comfort zones
- Building industry, student, faculty, and advising *buy-in and participation*
- *Logistics:* scheduling, integration and threading, advising, and communication
- New course development
- Modifying existing courses to reinforce Hatchery and KSA concepts – *"Threading"*
- Maintaining survey response rate and willingness to provide feedback on beliefs and experiences
- Using survey and interview data to identify and address ongoing challenges

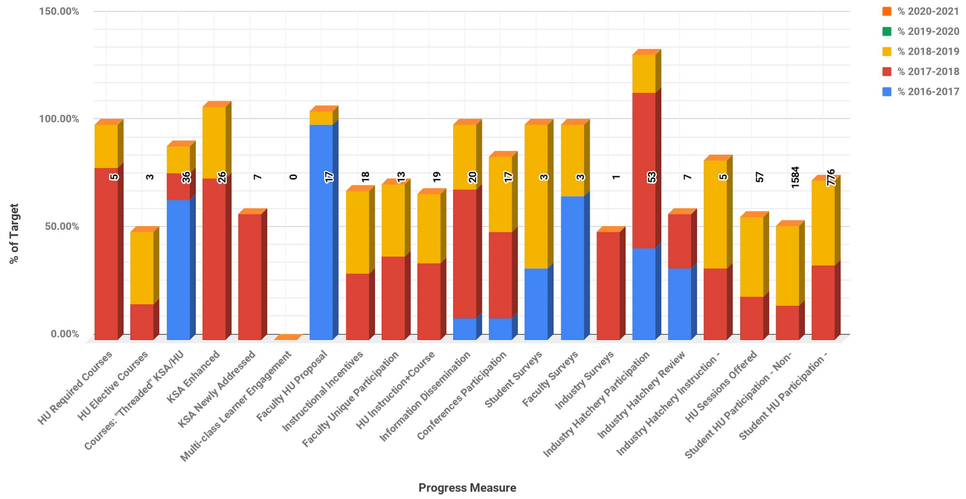
"...every bit of computer science touches and affects society. We have to be careful what our tools do to people!..."

"...That's just the way the world is! If [under-represented groups] can't handle that, I can't help them..."

Revised: May 2019

Computer Science Professionals Hatchery "Measures of Success"

Boise State University (NSF sponsored IUSE/PFE:RED #1623189)



Products

Conference	Year	Location	Type	Product Title	Authors
ASEE - American Society for Engineering Education	2017	Columbus, Ohio	Paper	Talking about a Revolution: Overview of NSF RED Projects	Dr. Susan M. Lord (USD) Dr. Edward J. Berger (Purdue) Dr. Nadia N. Kellam (ASU) Dr. Ella Lee Ingram (Rose-Hulman) Dr. Donna M. Riley (VT) Dr. Diane T. Rover (ISU) Dr. Noah Salzman (BSU) Prof. James D.Sweeney (OSU)
IUSE/PFE:RED - Revolutionizing Engineering Departments	2017	Arlington, Virginia	Poster Session	Nurturing the Next Generation of Computer Science Professionals	RED Grant Team
IEEE - Frontiers in Education (FIE)	2017	Indianapolis, Indiana	Panel	Influencing Culture and Curriculum Via Revolution	Dr. Kelly Cross (University of Illinois) Dr. Marina Miletic (UNM) Tiago Forin (Rowan) Dr. Mani Mina (Iowa State) Dr. Amit Jain (BSU) Dr. Elsa Villa (UTEP) Dr. Lisa McNair (Virginia Tech) Dr. Ella L. Ingram (Rose-Hulman)
RESPECT - Research on Equity & Sustained Participation in Engineering, Computing, & Technology	2018	Baltimore, Maryland	Panel Discussion	Revolutionizing the Culture of Computer Science	Dr. Noah Salzman (BSU) Dr. Don Winiecki (BSU) Dr. Venkat N. Gudivada (ECU) Dr. Junhua Ding (ECU) Dr. Bojan Cukic (UNCC) Dr. Celine Latulipe (UNCC) Dr. Ann Q. Gates (UTEP) Dr. Sarah Hug (UTEP)
AERA - American Educational Research Association	2018	New York City, NY	Conference Presentation	Identifying gender differences in undergraduate Computer Science students: Women aren't so different	Dr. Carl Siebert Kathleen Mullen Dr. Noah Salzman
AERA - American Educational Research Association	2018	New York City, NY	Conference Presentation	The Computer Science Professionals Hatchery	Dr. Noah Salzman Dr. Tim Andersen Dr. Amit Jain Dr. Don Winiecki Dr. Dianxiang Xu Dr. Carl Siebert
CoNECD - Collaborative Network for Engineering and Computing Diversity	2018	Crystal City, VA	Paper	The Computer Science Professionals' Hatchery at Boise State University: Incorporating Inclusion, Diversity and Social Justice into the Computer Science Curriculum	Dr. Don Winiecki Dr. Noah Salzman Dr. Tim Andersen Dr. Amit Jain Dr. Dianxiang Xu
CNSF - Coalition for National Science Funding	2018	Washington, DC	Poster Session	Nurturing the Next Generation of Computer Science Professionals	Dr. Amit Jain
ASEE - American Society for Engineering Education	2018	Salt Lake City, Utah	Paper	The Computer Science Professional's Hatchery	Dr. Amit Jain Dr. Noah Salzman Dr. Don Winiecki
IUSE/PFE:RED - Revolutionizing Engineering Departments	2018	Alexandria, Virginia	Presentation	Portable concept: Hatchery Unit	Dr. Tim Andersen
IUSE/PFE:RED - Revolutionizing Engineering Departments	2018	Alexandria, Virginia	Presentation	Incorporating Focused Professional Skills, and Inclusion, Diversity & Social Justice into the Computer Science Curriculum	Dr. Don Winiecki
HICCS - Hawaii International Conference on System Sciences	2019	Maui, HI	Paper	The Hatchery: An Agile and Effective Curricular Innovation for Transforming Undergraduate Education	Dr. Tim Andersen Dr. Amit Jain Dr. Noah Salzman Dr. Don Winiecki Dr. Carl Siebert
RESPECT - Research on Equity & Sustained Participation in Engineering, Computing, & Technology	2019	Minneapolis, MN	Paper	Teaching Professional Morality and Ethics to undergraduate CS students through Cognitive Apprenticeships & Case Studies: Experiences in CS-HU 130 'Foundational Values'	Dr. Don Winiecki Dr. Noah Salzman
PSA - Pacific Sociological Association	2019	Oakland, CA	Paper	Influencing Inclusion, Diversity, and Social Justice in Undergraduate Computer Science: Knowledge, Hegemonic Power, Performance, and Uncertainty of the Status of Membership Status	Michelle Fretwell Erika Abbott Dr. Noah Salzman Dr. Don Winiecki
ASEE - American Society for Engineering Education	2019	Tampa, FL	Abstract	The Computer Science Professional's Hatchery	Dr. Amit Jain Dr. Noah Salzman Dr. Don Winiecki
ASA - American Sociological Association	2019	New York, NY	Paper	Peer Networks Built Around Common Experiences Stabilize Other Things Too: The Durability of Hegemonic Bias in Undergraduate Computer Science Education	Michelle Fretwell Erika Abbott Dr. Noah Salzman Dr. Don Winiecki

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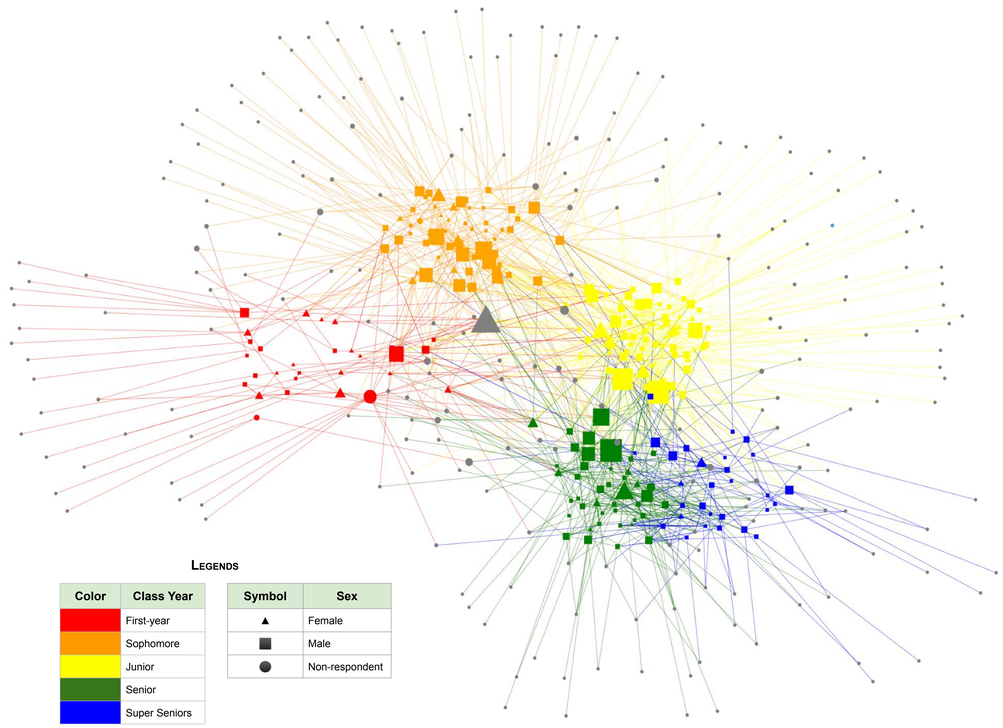
Assessing Community in an Undergraduate Computer Science Program Using Social Network Analysis



Legends

Color	Class Year
	First-year
	Sophomore
	Junior
	Senior
	Super Seniors

Symbol	Sex
▲	Female
■	Male
●	Non-respondent

Significance of Differences by Class Year

	1st Year	2nd Year	3rd Year	4th Year	5th Year or more
n	29	59	74	43	29
Mean	**5.21**	**7.97**	**10.12**	**12.02**	**8.69**
Standard Deviation	3.79	4.92	5.58	6.01	5.42
Median	4	8	10	12	9
Min	1	1	1	1	1
Max	16	21	27	28	20
Skew	1.17	0.56	0.69	0.56	0.26
Kurtosis	0.52	-0.3	0.25	0.43	-1.16

Differences in Degree By Class Year

	1st Year	2nd Year	3rd Year	4th Year
2nd Year	2.419 0.031*			
3rd Year	4.246 0.000*	2.186 0.041*		
4th Year	5.167 0.000*	3.455 0.002*	1.624 0.1305	
5th Year or more	2.610 0.023*	0.603 0.5467	-1.117 0.2931	-2.315 0.034*

Top number indicates pairwise z-Test value, bottom number is adjusted p-value based on Benjamini-Hochberg correction

*indicates significance (p<0.05)

Difference in Degree by Gaming

	Non-Gamer	Gamer
n	303	157
Mean	**4.43**	**8.55**
Standard Deviation	4.72	5.88
Median	2	8
Min	1	1
Max	27	28
Skew	1.86	0.79
Kurtosis	3.46	0.33

Differences in Degree by Department Employment Status

	Non-Employee	Employee
n	424	36
Mean	**5.29**	**12.33**
Standard Deviation	4.8	8.41
Median	3	11.5
Min	1	1
Max	21	28
Skew	1.12	0.35
Kurtosis	0.3	-1.15

Differences in Degree by Gender

	Male	Female
n	184	47
Mean	**9.11**	**9.49**
Standard Deviation	5.56	6.23
Median	9	9
Min	1	1
Max	28	27
Skew	0.71	0.71
Kurtosis	0.37	0.05

Differences in Degree by White/Non-White

	Non-White	White
n	40	194
Mean	**10.07**	**8.95**
Standard Deviation	5.34	5.68
Median	10.5	8
Min	1	1
Max	21	28
Skew	0.02	0.83
Kurtosis	-1.05	0.62

Highlights:

- Identify institutional practices and social dynamics that produce ***'super-connectors'***
- Hypothesize that connected students are more likely to persist when they encounter setbacks or adversity
- Students in higher grade levels have more densely populated networks
- Significant connectedness variation, ranging from 1 to 28 connections
- Analyses of variations in connectedness can expose factors that could help explain lower completion rates
- Teaching assistants and tutors are typically well connected and important for building connections across grade levels

Conclusions:

- No meaningful differences in the connectedness of *male versus female* students, *white versus non-white* students, or *traditional versus non-traditional* students
- Significant differences in the connectedness of several subgroups:
  - *Students' connectedness increases through the four years*
  - Students in their fifth year or more of studies tended to be less connected than traditional seniors
- Students who identified themselves or their peers as *gamers tended to have significantly more connections* than their non-gaming classmates
- Quantitatively demonstrates the *importance of teaching and learning assistants* in creating community in the CS department
  - These individuals have an outsized impact in building connections in the undergraduate CS community and further support the value of peer tutors
- *Lack of connections for students can help to diagnose the overall feeling of 'non-belongingness' in CS*