

W

ENGINEERING

# INNOVATION

IN HEALTH

Developing technical solutions to pressing health challenges



# Co-development of Interdisciplinary Engineering Innovation in Health course by Engineering & Team Science Faculty to Accelerate Health Innovation from Bench to Bedside

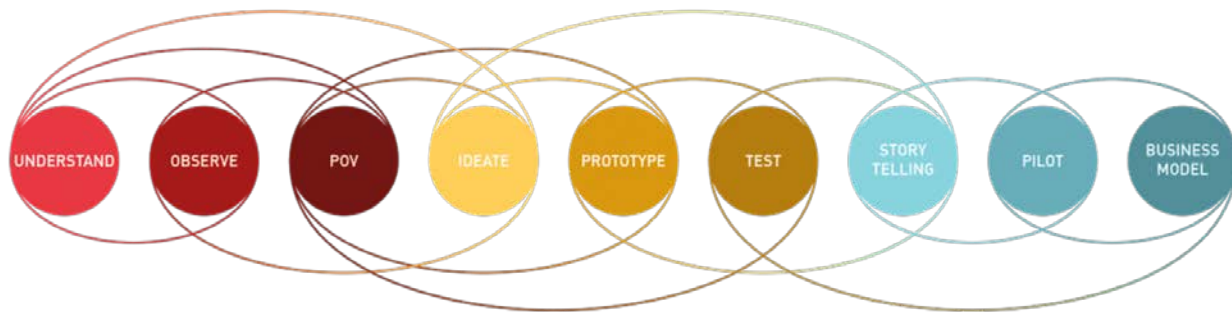
S Kang<sup>1</sup>, E Blakeney<sup>2</sup>, N Summerside<sup>2</sup>, B Zierler<sup>2</sup>, J Sprecher<sup>3</sup>, K Henrikson<sup>1</sup>,  
J Liu<sup>1</sup>, E Seibel<sup>1</sup>, and J Posner<sup>1</sup>

<sup>1</sup> Mechanical Engineering, University of Washington, <sup>2</sup> School of Nursing, University of  
Washington, <sup>3</sup>Institute of Translational Health Sciences, University of Washington



# Engineering Innovation in Health (EIH)

EIH promotes interdisciplinary collaboration between engineering & the health sciences with the **goal of developing technical solutions to pressing health challenges**



# EIH

BY THE

**NUMBERS**

2013–2018



**300+**

students enrolled



**140+**

clinical partners



**70/30**

percentages  
of undergraduate  
and graduate student  
participants



**100+**

projects introduced



**10+**

provisional patents



**9**

UW departments  
represented through  
student involvement



**5**

projects in early stage  
commercialization

## Partnering with ITHS Team Science faculty since Fall 2017

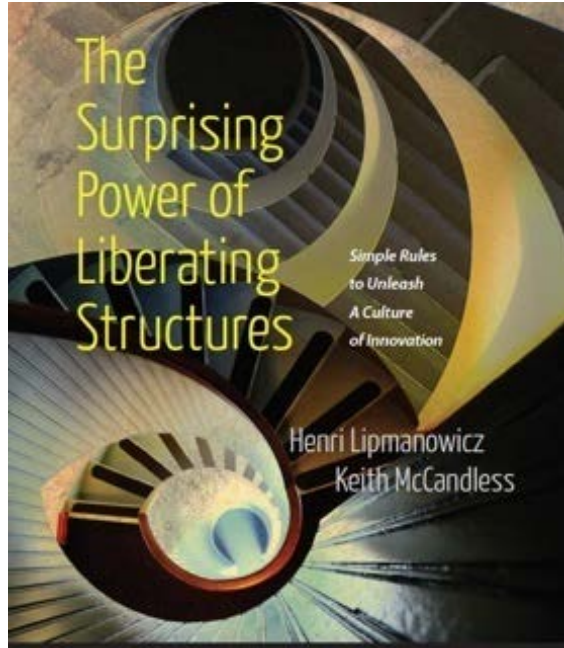
*“Throughout the program, we have learned that teams who function & communicate well **yield the best final product, are more satisfied with their work, & are more likely to stay together to continue their research.**”*

– Professor Jonathan Posner, EIH Teaching Faculty

- > Team Science team & the EIH teaching Team **co-develop & facilitate tailored team science training**
- > EIH faculty training at team science conferences, meetings, & workshops
- > Aim: accelerate health innovation from lab bench to bedside by improving team dynamics, communication, and program participant satisfaction



# Tailored Team Science training to student-clinician teams



[Liberatingstructures.com](http://Liberatingstructures.com)

- > Methods of enhancing how teams meet, plan, set goals, decide, & relate to each other
- > Little shifts can create big changes
- > Fosters inclusivity + psychological safety



# Tailored Team Science training to student-clinician teams

Fall  
Student-clinician team formation  
Needs finding

Team Agreement +  
Welcome Letter

## Team Agreement

In order to work effectively and efficiently we have outlined some basic tenants we have all agreed to follow. Throughout this project we will adhere to the following:

1. Attend meetings at agreed times
2. Meet all deadlines
3. Have a positive attitude
4. Do not ignore group communication
5. Be honest and willing to ask for help
6. Do not assume someone else is doing the work, communicate, take initiative!

## Welcome Letter

1. Who are we
2. Problem statement
3. Team agreement
4. Communication plan
5. Contingency plan
6. Team goals
7. Signed by all parties

**Welcome Letter**

Welcome to the Preceptor-Expanding Practice and team! As engineers, we are looking forward to both learning about and contributing to medical innovation throughout this project. In this letter we will introduce ourselves, briefly describe our experience and backgrounds, set up basic team structure to pursue this project for the whole year, we hope that this letter will be a useful resource and the start of a successful project.

**Team's need**

At this point in the design process, our understanding is that during winter, a patient's body may experience excessive pressure due to seasonal positioning and without alleviation of the pressure, patients may experience complications such as ulcers. Additionally, due to the limitations in also a cancer. We understand that these risks are preventable but there is no commonly applied solution. There is a need for a preventative engineering solution that addresses these issues and is not subjected to prolonged recovery periods while in surgery. There are several options the first and of our design process will be to identify the most used and effective design to begin working towards an effective solution.

### Who we are

We are all from different cultures and backgrounds, but currently we are all students of the mechanical engineering (ME) or biomedical (BME) departments of our university. We will contribute their own strengths to a strong group foundation, and we intend on learning from each other as well. Our basic information is shown in the following table.

Name	Contact	Background	Example
Clara Oswald	oswald@iastate.edu	Undergraduate ME	Familiar with a mechanical design process, is taking a project from ideation to reality. Machine shop experience with CAD programming and engineering design software.
Alfonso			After being in the mechanical department for 4 years, Alfonso has a strong background in mechanical design and manufacturing. He has experience with CAD programming and engineering design software.

### Team Agreement

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6. Do not assume someone else is doing the work, communicate, take initiative!

### Communication

For communication between students, we will be in regular contact both digitally and in person. Students will meet together during the reserved class time and as often outside of class as necessary. Tentatively, students have determined entire groups' availability to be Monday, Wednesday and Friday from 3:30 to 5 pm, and will finally schedule weekly meetings in the Meff's building. For organization, students will keep all the files (assignments, meeting records, relevant papers, etc.) in a single centralized location (Google drive). Email will be our primary method for communicating with our clinical partner unless another method proves more convenient, and ideally students will meet in person at least once week with Dr. Rankiniker (because time and day depends on Dr. Rankiniker's schedule, this meeting time is not yet assigned).

### Contingency plan

We understand that there may be unforeseen circumstances that would require us to deviate from our above plan. We agree that we will all try our best to be present and prepared, and that scheduling will be flexible in order to accommodate individual contingencies and our need to meet. We expect that all team members will complete their portions of the project regardless of whole team availability, and that a single team member's temporary unavailability will not prevent our progress. If progress is restricted because of absence or regular distractions, this will be noted on peer evaluations. Distractions during meetings will be minimized by using electronic technology as research and communication tools only. We will discuss and set meeting goals (including outlining the minutes). This will help us, the students, stay on track towards goal completion. Work on each assignment will be collaborative, unless the students determine that the participation of all members is not necessary. In such cases, the work will be coordinated on a voluntary basis (to exploit everyone's strengths) or by negotiation. The students will attempt

to distribute the total work evenly among members. As of Autumn 2018, all of us plan on making the EBI course all year long.

### Team goals

Our primary goals are to develop a better understanding of this project's current need and the engineering design process in the context of medical innovation. For this purpose in particular, we will facilitate narratives with the project and begin to formulate and design potential solutions that we agree that our design ideas have high potential for success, and we will need to have a concrete plan for further development.

### Deliverables for this quarter:

- Definition of need found, beginning of quarter
- Background Research, beginning of quarter
- Market Analysis, beginning of quarter
- Hypothesis formulation, upper mid-beginning of quarter
- Business proposal submission, mid-quarter
- First solution pitch, end of quarter

### Final remarks

As a team, we are looking forward to working with a clinical partner in order to learn about and contribute to resolving a medical challenge, and we are excited to take part in a project that will eventually become a product.

Sincerely,

Clara Oswald

Jack LaRocca

Alfonso

Shaylin

David Rankiniker

October 9, 2018

*Clara Oswald*  
*Jack LaRocca*  
*Alfonso*  
*Shaylin*  
*David Rankiniker*

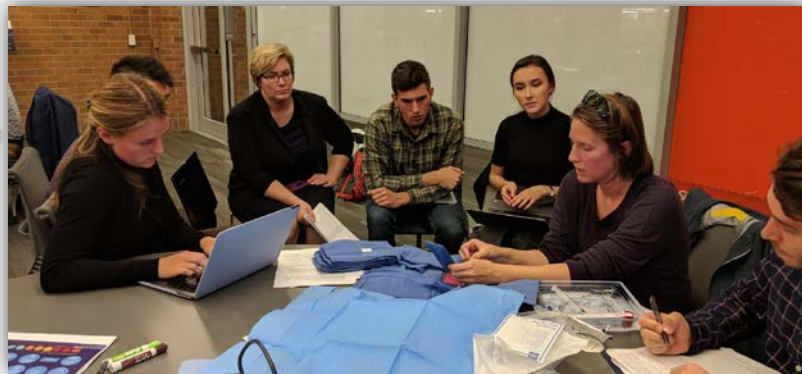
# Tailored Team Science training to student-clinician teams

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Welcome Letter

Structured initial  
meeting with clinical  
partners

Introductions, review  
Welcome Letter, stakeholder  
mapping exercise, need  
statement, action items to  
follow up on



Meeting with the clinical partner(s)  
Diving into the challenge

1 Introduce yourselves! (15 min)  
Students should bring a short bio and a copy of the welcome letter to the meeting. Clinicians should bring a copy of the challenge and any relevant information.

2 Review the challenge and ask questions! (15 min)  
Clinical partners present their challenge and answer questions. Students should take notes on the challenge and current solutions. Students should take photos of the challenge and solutions.

4 Mapping of clinical stakeholders and your design team  
Stakeholders are people or groups of people who are impacted by or affected by the challenge. They can be internal or external to the team. Map out who is currently involved with or affected by the challenge and who you think should be involved. Consider how they are connected. Take a photo of your stakeholder map here. Be sure to include how they are connected.

5 Need Statements (15 min)  
Using the lists above, craft three potential need statements. A need statement (problem) is (population) to (outcome).

PROBLEM	POPULATION	OUTCOME

6 Action Items  
Generate a list of action items to follow up on. Consider how you can expand on the need statements from the prior page. Consider how you can expand on the statements (see example on slides).

7 Diving Further  
Clinical partners should be able to answer about this challenge! Students should be able to answer about this challenge! Consider how you can expand on the statements (see example on slides).



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Structured initial  
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Giving/Receiving  
feedback,  
assumptions/biases

## Peer Critique

Through peer critiques, we learn to appreciate one another's work and to improve our own work.



### Be Kind

All comments should focus on the work not the person.  
There should never be sarcasm or put downs.  
The comments can be challenging but the recipient should feel that the feedback is about the work and how it can be better.



### Be Specific

Comments should identify exactly what needs to be worked on (like a set of instructions) which we can take away and use or do.



### Be Helpful

If the comments don't benefit the work, don't share it.  
Every piece of feedback is there to help improve the work.

# Tailored Team Science training to student-clinician teams



Team Agreement +  
Welcome Letter

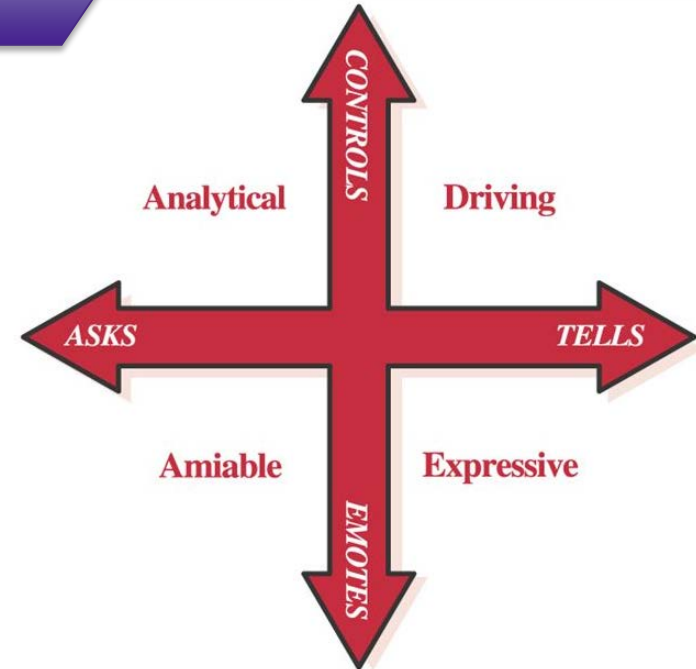
Structured initial  
meeting with clinical  
partners

Giving/Receiving  
feedback,  
assumptions/biases

Personality Style  
Inventory

Inner: Expand  
understanding of your own  
personal/social style

Outer: Enhance  
effectiveness in working  
with other styles



# Tailored Team Science training to student-clinician teams



Team Agreement +  
Welcome Letter

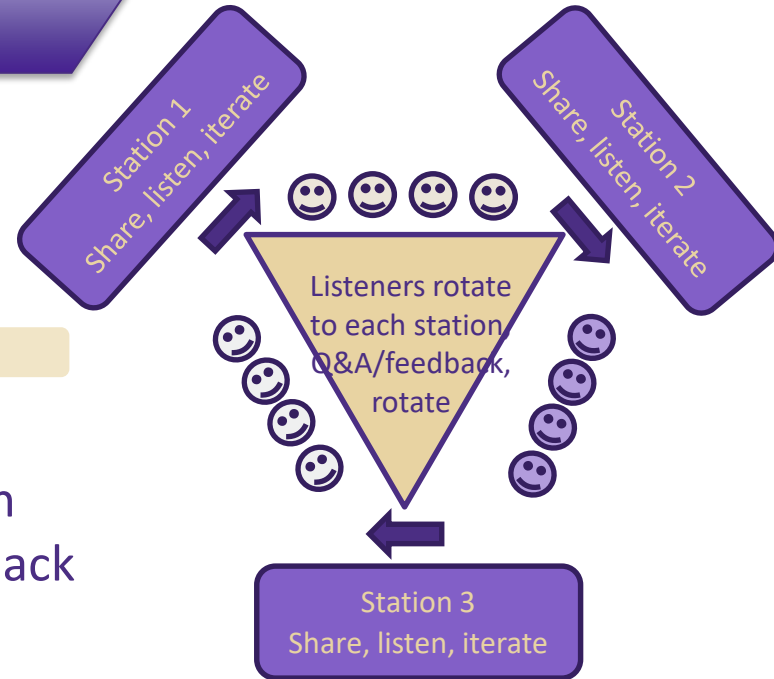
Structured initial  
meeting with clinical  
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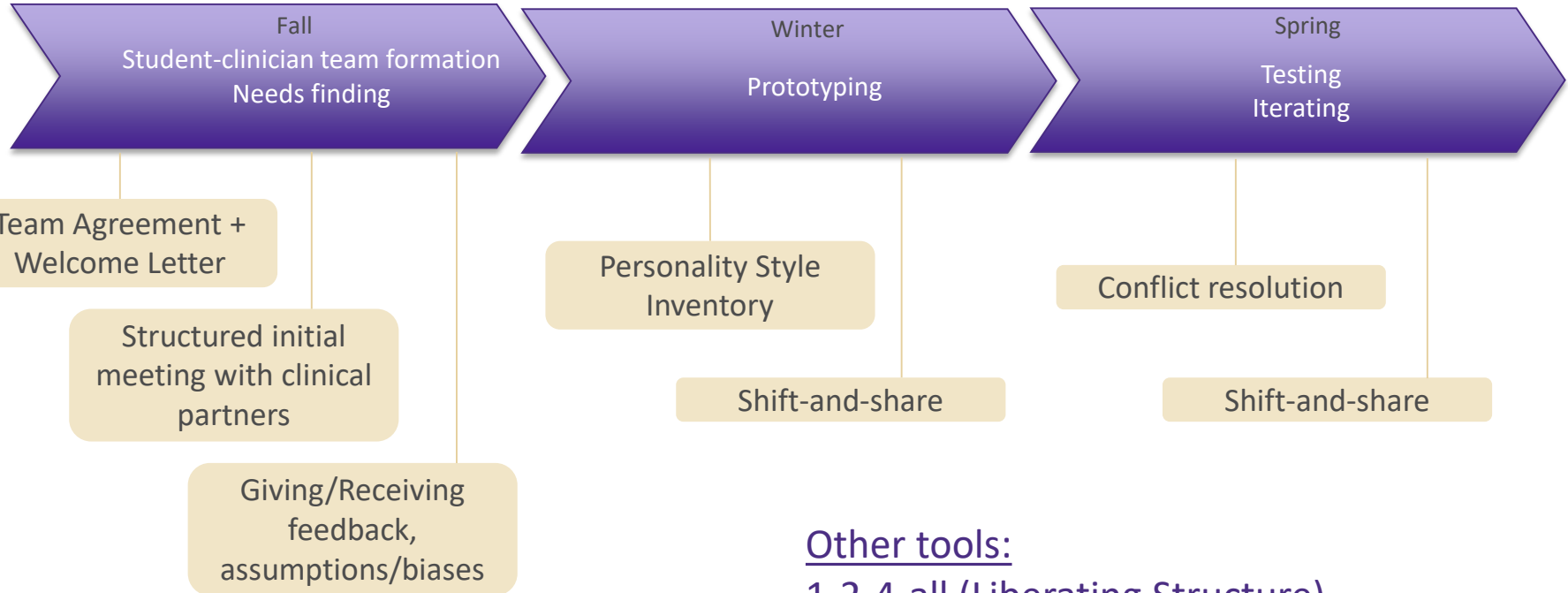
Personality Style  
Inventory

Shift-and-share

Iterative design  
review + feedback



# Tailored Team Science training to student-clinician teams



## Other tools:

1-2-4-all (Liberating Structure)

PolLEV.com (live polling)

CATME.com (peer evaluation)

## Method: surveys administered to EIH cohorts

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- > Survey about experience working in EIH project team in order to improve course content about effective teamwork
  - EIH cohort surveyed Fall 2017 (baseline year, no TS implementation)
  - EIH cohort surveyed Fall 2018 (after TS implementation)
- > Preliminary comparison of results shown

**Goal: Improve team dynamics, communication, & program participant satisfaction**

# Self-efficacy before and after participating in EIH

2. Based on your **past experiences** working on group projects or teams (prior to enrolling in EIH), please rate how capable you are (in general) to...

1 (not at all capable)    2    3 (neither capable nor incapable)    4    5 (very capable)    N/A

2a Speak up in team meetings                       

Speak up in team meetings

Effectively contribute in team meetings

Recognize team member's strengths

Resolve conflicts with peers and other collaborators

Advocate for multiple points of view

Have your voice heard in meetings

Collaborate with team members with different working styles

Clarify language differences across disciplines/backgrounds

7. Based on your **current experience** working this term with your EIH project team, please rate how capable you are to...

1 (not at all capable)    2    3 (neither capable nor incapable)    4    5 (very capable)

7a Speak up in team meetings

# Psychological safety and beliefs about EIH project team

**8. Based on your current experience working this term with your EIH project team, please rate your agreement with the following statements:**

	1 (strongly disagree)	2	3	4	5 (strongly agree)
8a Our project team has been successful working together	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Our project team has been successful working together

Our project team has a climate of collaboration and trust

I felt comfortable giving my team members feedback

I felt comfortable receiving feedback from my team members

Team members on my project had a high level of mutual trust

I had a desire to know my teammates on a personal level

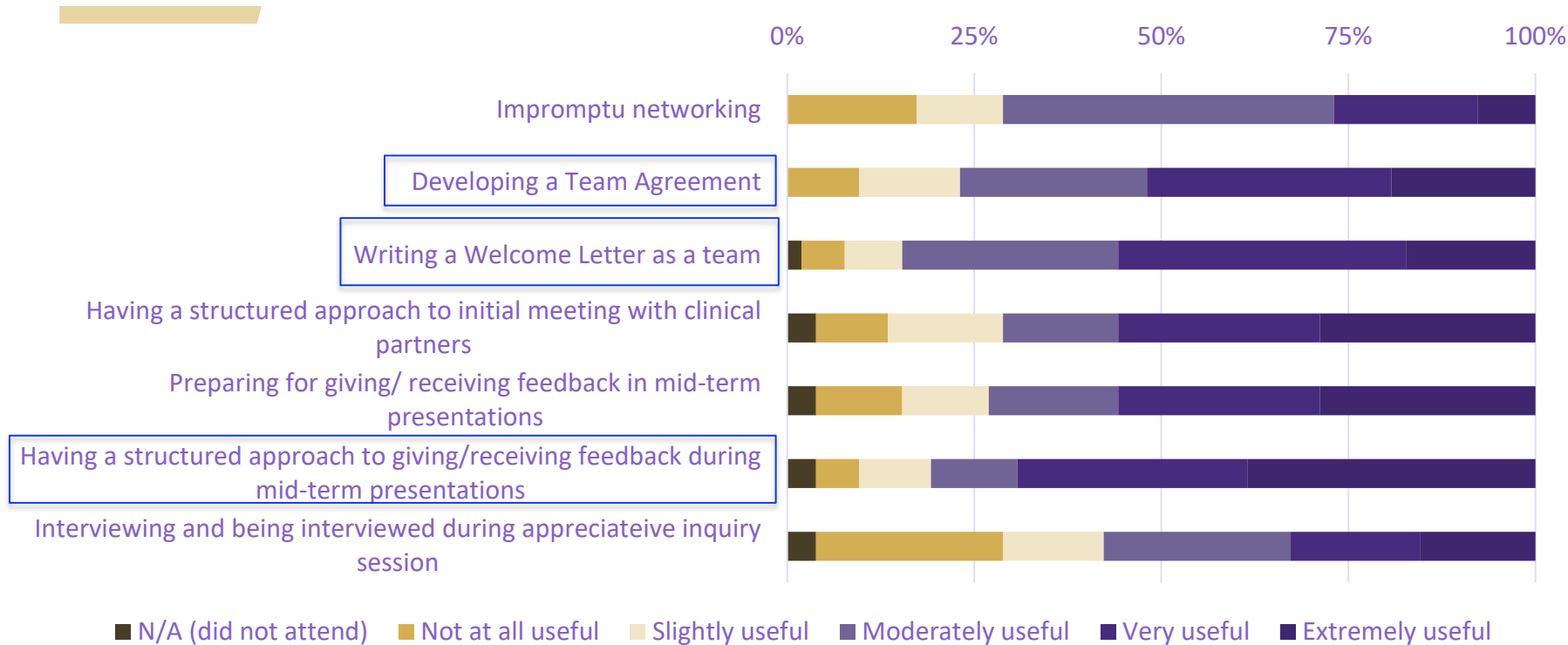
Having a successful project was a priority for me

Building effective relationships with my team members was a priority for me

I was comfortable showing gaps in my knowledge with my team

Communication with my team members outside of class was easy

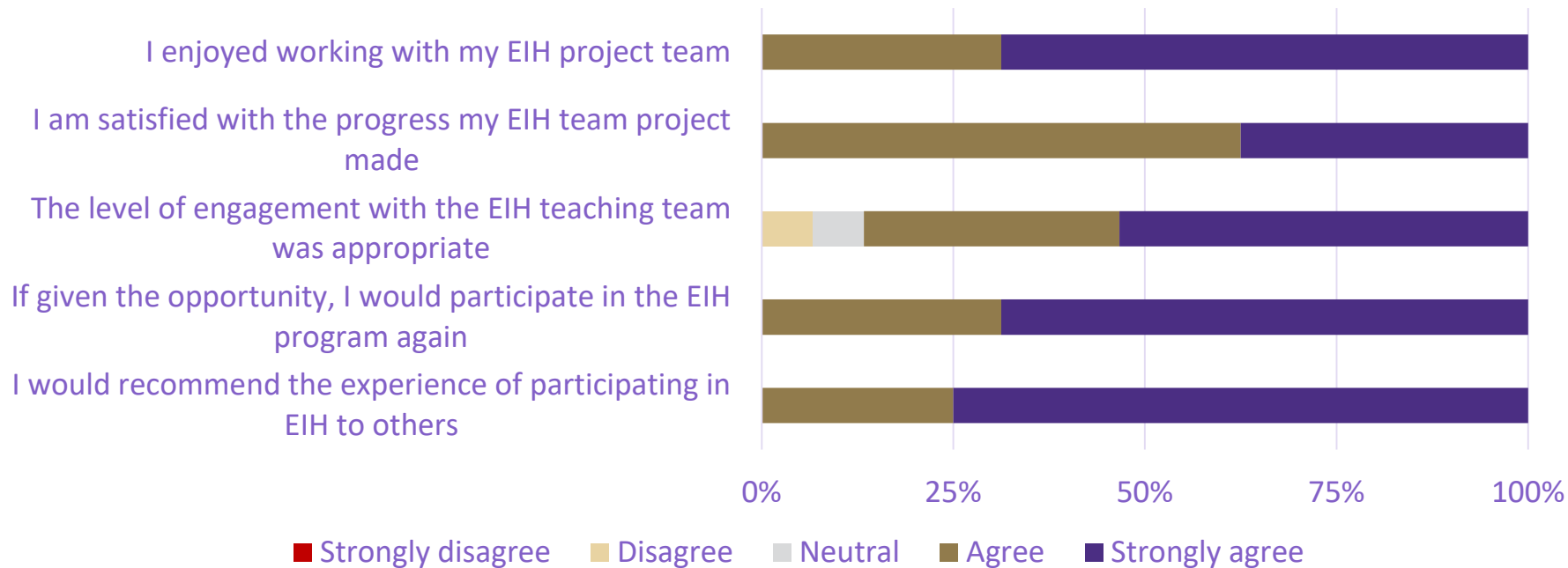
# Usefulness of Team Science modules



*“The **Welcome Letter** was useful for laying foundations for team dynamics and team expectations. It also helped the clinician get on-board with meeting the team and understanding course/project expectations.” – EIH student, 2018*



# Clinical partner experience with EIH



\*only results after TS implementation shown

*“Great class and example of a great interaction between the medical community and the engineering school.” – EIH clinical partner, Fall 2018*

# Summary

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- > **Co-development of EIH program by Engineering & Team Science Faculty**
  1. Tailored team science training to student-clinician teams
  2. Self-efficacy before & after EIH: Large improvements in collaborating with team members with different working styles & recognizing team members' strengths
  3. Psychological safety: improved climate of collaboration & trust among project teams
- > **Areas of continued improvement**
  - Time management and conflict resolution



# Outcomes

	Avg 2013-2018	2019 (after TS)
Provisional patents filed	2	5
Prototyping funds raised	\$1000-\$2000	\$12,000+
Participating teams in UW innovation and entrepreneurship challenges	1-2	4
Startups formed	1	3-4



# EIH Teaching Team



Jonathan Posner, PhD  
Professor, Mechanical and  
Chemical Engineering  
Adjunct, Family Medicine



Jonathan Liu, PhD  
Associate Professor,  
Mechanical Engineering  
Adjunct, Pathology



Eric Seibel, PhD  
Research Professor,  
Mechanical Engineering  
Adjunct, Bioengineering



Kat Steele, PhD  
Associate Professor,  
Mechanical Engineering



Soyung Kang, PhD  
Lecturer, Mechanical  
Engineering



Brenda Zierler, PhD, RN, FAAN  
Professor, School of Nursing



Erin Blakeney, PhD, RN  
Research Assistant  
Professor, School of Nursing



Jennifer Sprecher  
Director, Lean Performance  
ITHS



Nicole Summerside, MHA  
School of Nursing

## Other team members:

- Per Reinhall (ME)
- Keith Chan (Radiology)
- Ken Myer (Foster School)
- David Tan (Foster School)
- Katrina Henrikson (ME)

UNIVERSITY *of* WASHINGTON

**ITHS**

Institute of Translational Health Sciences  
ACCELERATING RESEARCH. IMPROVING HEALTH.

# Thank you!

For more info, visit [eih.uw.edu](http://eih.uw.edu)  
or email [soyoungk@uw.edu](mailto:soyoungk@uw.edu)

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