

Faculty Development in Improvement Science: Building Capacity and Expanding Curricula Across an Academic Health Center

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ABSTRACT

Background The ability of health professions faculty to design, teach, evaluate, and improve relevant curricula is vital for teaching improvement science (IS) skills to trainees.

Objective We launched a Foundational Improvement Science Curriculum (FISC) to build faculty competence in IS teaching and scholarship, and to develop, expand, and standardize IS curricula across one institution.

Methods FISC consisted of 9 full or half-day sessions over 10 months in 2015–2016 and 2016–2017 academic years. Each session required pre-work, including readings, Institute for Healthcare Improvement Open School modules, and personal improvement projects. Sessions included brief didactics, group activities, planning, and feedback on curriculum development. An evaluation strategy was employed, including pre- and post-program self-assessment, competency mapping, evaluations of didactics and overall program, and participant satisfaction.

Results Forty individuals from 23 academic programs voluntarily completed FISC, representing 20% of graduate medical education (GME) programs and 50% of primary GME programs in addition to undergraduate medical education (UME) and nursing programs. Median self-assessed competency scores (mid versus final score; scale 1–9, 9 high; $P < .05$ for all comparisons) improved over the course for all competencies for knowledge (3 versus 7), application (2 versus 7), curriculum design (2 versus 7), and scholarship (2 versus 5). Eighteen new or revised IS curricula were developed across GME, UME, and nursing programs.

Conclusions FISC offers a feasible model to enhance and support faculty development in IS and IS curriculum design.

Introduction

Improvement science (IS) is the foundational body of knowledge for systematic and rigorous efforts to redesign systems and processes to improve quality, enhance safety, and eliminate error, continuously emphasizing measurement and dissemination to ensure positive change.^{1–4} This field is increasingly recognized as essential for improving patient care and enhancing the care delivery system.^{5,6} The Accreditation Council for Graduate Medical Education (ACGME) mandates the teaching of quality improvement (QI) and articulation of patient safety-related competencies in residency training.^{7–9} Maintenance of Certification programs require activities based on IS principles.¹⁰ While articles have described methods to expand faculty QI capacity,^{11,12} to our knowledge, there have been no descriptions of programs that build faculty capacity through direct IS instruction

while enabling participants to develop IS curricula for learners simultaneously.

In 2014, Oregon Health & Science University (OHSU) began the Foundational Improvement Science Curriculum (FISC) to respond to accreditation requirements and institutional goals, build IS capacity at OHSU across health professions, standardize existing IS curricula, and create curricula in additional programs. FISC was designed to develop IS skills in faculty from multiple specialties and disciplines.

Methods

The development of FISC began in 2014 under the guidance of academic and health system leaders who selected the FISC faculty team. The FISC faculty team included a public health faculty member as program lead with 25 years of experience teaching IS, a physician faculty member lead for graduate medical education (GME), a physician faculty member lead for undergraduate medical education (UME), and a program manager. All faculty leads had experience teaching IS to graduate students, residents, and/or health professions faculty and leading IS work. Time constraints prevented a targeted needs assessment.

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Editor's Note: The online version of this article contains a detailed curriculum description, design principles and ground rules, and the survey used in the study.

BOX Foundational Improvement Science Curriculum Goals**Individual Competency in Improvement Science (IS)**

- Demonstrate knowledge of foundational concepts in IS
- Apply IS knowledge through improvement projects
- Create improvement science curriculum relevant to program
- Develop scholarly agenda in improvement science

Academic Program Goals

- Faculty and education leader participants will develop a relevant curricular application for their specific academic program(s), and develop capacity for project coaching through structured didactic and experiential learning activities (group and individual)
- Course participants will implement their own IS curriculum the following academic year

Oregon Health & Science University Goals

- Residents, fellows, and health professions students will learn and practice IS throughout their career
- Faculty are prepared to develop, implement, and evaluate foundational IS curricula
- Accreditation requirements related to IS will be met

What was known and gap

Health professions faculty must design, teach, evaluate, and improve relevant curricula to teach improvement science (IS) skills to trainees, but there is a lack of descriptions of programs that provide direct IS instruction while enabling participants to develop IS curricula for learners.

What is new

A Foundational Improvement Science Curriculum to build faculty competence in IS teaching and scholarship, and to develop, expand, and standardize IS curricula across the institution.

Limitations

Survey instruments were not tested for validity; participants were volunteers with IS expertise at a single institution, limiting generalizability.

Bottom line

An institution-wide faculty development program to build IS skills and new curricula resulted in a significant increase in IS curricula as well as increased perception of IS skills among faculty and staff participants.

Goals were articulated based on 10 years of IS teaching experience in OHSU residency programs in family medicine, pediatrics, internal medicine, and preventive medicine (BOX).¹³ Recruitment occurred through academic and program leaders in OHSU Schools of Medicine and Nursing. Participants were nominated or volunteered, and adjusted their schedules to participate. In describing the curriculum, “participant” is used to refer to individuals who participated in FISC, while “faculty” refers to FISC teaching faculty.

The FISC program was designed to be experiential, include project-based learning, be relevant across disciplines, and provide an introduction to IS fundamentals, resources, and scholarship. FISC guided participants in IS curriculum development through didactics, hands-on experience, simulations, online modules, and peer coaching.^{14–16} The program consisted of 9 full or half-day sessions during regular work hours over 10 months for a total of 55 contact hours (more information provided as online supplemental material).¹⁷

Each session required pre-work by participants, including readings and Institute for Healthcare Improvement Open School modules.¹⁸ Occasional guest speakers provided participants with resources for data collection and linked sessions to improvement opportunities at OHSU. Participants received hands-on experience using improvement methodologies by conducting a 3-month personal improvement project (PIP)¹⁹ focused on changing individual behaviors (such as recreation or nutrition) using the

iterative plan-do-study-act cycles of the Model for Improvement.²⁰ Throughout the program, participants used change concepts, applied core tools of improvement, and provided feedback and coaching to each other in the design of their respective curricula and PIPs.²¹ Additionally, participants identified best practices to teach and coach foundational IS across levels of learners and assess learner competencies and milestones related to IS.

Reflecting current best practices in educational design,²² the FISC faculty team articulated 4 achievable competencies for participants aligned with academic program and OHSU goals. Competency maps were developed to demonstrate participants’ developmental process (adapted from the Dreyfus model of skill acquisition⁷) that offered a visual illustration of gains in knowledge, expertise, and application in practice (FIGURE 1).²³ Participants self-assessed their competency progress using the maps at 3 points: baseline, mid-program, and completion. Assessments were scored on a 9-point scale, with 1 rated as novice with little awareness of the competency and 9 reflecting mastery capable of evaluation and improvement. At the mid- and end points of the curriculum, participants self-assessed skills with a 19-question survey on a 5-point Likert scale (provided as online supplemental material). Participant satisfaction was evaluated after each session regarding pre-work, group activities, faculty, and curriculum, in addition to mid- and end of program evaluations using a 5-point Likert scale. The competency, curricular skills, and satisfaction surveys were developed by FISC faculty without further testing.

Faculty debriefed after each session with observations on individual participant accomplishments and

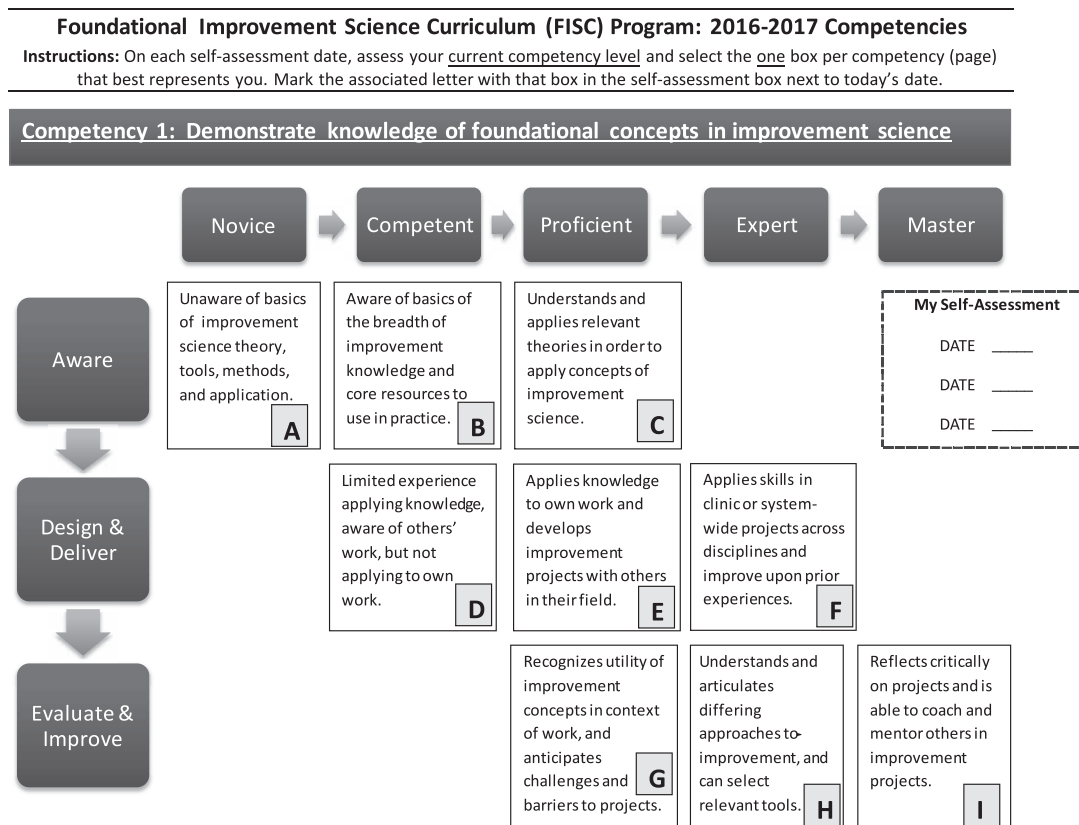


FIGURE 1
FISC Competency Map Example

overall curriculum delivery. Synthesis of these multiple sources informed real-time improvements for each cohort and curriculum improvements for cohort 2.

Statistical analysis of change in competency was performed using Wilcoxon signed rank test and paired *t* test for self-assessment of FISC curricular components in Microsoft Excel 2016.

Costs for the program were incurred for FISC faculty time (total of 0.4 full-time equivalent [FTE] among 3 faculty members), program manager time (0.2 FTE), and supplies and catering (approximately \$6,500 per year). Facility space and continuing medical education fees were not incurred. The schedule was available early to allow participants to address conflicts and avoid clinical impacts (eg, patient rescheduling).

All evaluation protocols were approved by the OHSU Institutional Review Board.

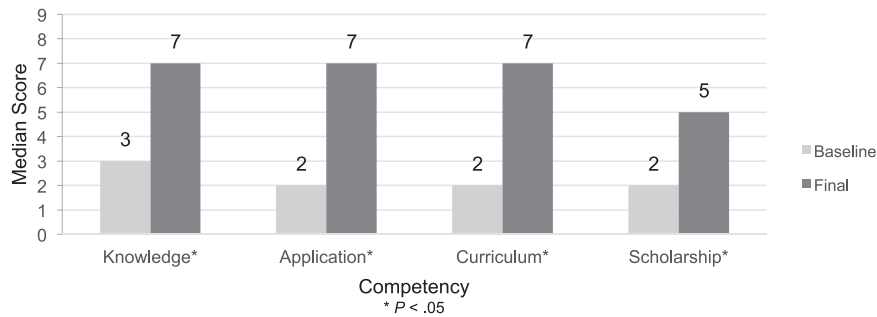
Results

Participants

Forty individuals from 23 academic programs completed FISC over 2 years (2015–2016 and 2016–2017; TABLE 1). This represents 50% of GME programs in primary specialties at OHSU with a

range of program sizes, from internal medicine with 90 residents to neurological surgery with 20 residents. Additional participants included faculty from UME, GME fellowships (3 to 10 fellows per program), and nursing programs. Participants represented multiple academic ranks, including assistant professor (45%, 18 of 40), associate professor (23%, 9 of 40), professor (10%, 4 of 40), and other (23%, 9 of 40). “Other” participants included educational leaders (associate/assistant medical education deans), program coordinators, nurse managers, and chief residents, who partnered with GME faculty.

At the start of the program, 60% (24 of 40) of participants reported prior exposure to curriculum design, adult learning, learner assessment, and competency development. Despite this, 73% (29 of 40) self-reported level of expertise as novice or competent. More than 90% (38 of 40) of participants reported lower levels of expertise in designing an IS curriculum or teaching IS concepts. Less than half of participants (43%, 17 of 40) reported prior faculty development or continuing education on IS, and 58% (23 of 40) reported no prior scholarly work in this area.

**FIGURE 2****Change in Improvement Science Competencies Across FISC Program (n = 31)**

Note: Competency scoring ranged from 1 (novice/aware) to 9 (master/able to evaluate and improve). See FIGURE 1 for an example of a competency map.

Seventy percent (28 of 40) of participants reported that elements of an IS curriculum existed in their academic program as readings, didactics, individual projects, or team-based projects. Only 10% (4 of 40) reported performing structured evaluations of their IS-related curriculum prior to FISC.

Program Outcomes

After 2 iterations of FISC there were 20 program initiatives, compared to only 4 prior to FISC (TABLE 1). The 20 initiatives included partnership efforts that

crossed specialties (eg, cardiology and cardiothoracic surgery) or multiple programs within a department (eg, obstetrics and gynecology residency program and family planning fellowship program). Satisfaction with the FISC program was very high across both cohorts, with 100% of respondents (n = 35) indicating either satisfied or very satisfied overall. All curricular products developed by FISC participants were reviewed by the FISC faculty team using a standardized rubric, and all demonstrated gains in knowledge and scholarship by participants.

TABLE 1**Programs With Improvement Science Curricula**

Improvement Science Curricula Before FISC (Date of Launch)	Improvement Science Curricula After FISC, as of 2017
Family medicine (2006)	Anesthesiology residency
Pediatrics (2011)	Cardiovascular medicine fellowship
Preventive medicine (2013)	Cardiovascular surgery fellowship
Internal medicine (2014)	Dermatology residency
	Family medicine residency
	Internal medicine residency
	Neonatology fellowship
	Nephrology fellowship
	Neurological surgery residency
	Nursing: Doctor of Nursing Practice program
	Obstetrics and gynecology residency
	Obstetrics and gynecology family planning fellowship
	Ophthalmology residency
	Otolaryngology residency
	Pediatrics critical care fellowship
	Pediatrics hematology oncology fellowship
	Pediatrics residency
	Preventive medicine residency
	Undergraduate medicine program
	Urology residency

Abbreviation: FISC, Foundational Improvement Science Curriculum.

TABLE 2

Curriculum Component Change in Self-Assessment Scores

As a Result of Participating in FISC, I Am Now Better Able to:	Midyear Self-Report (Average, n = 37)	Final Self-Report (Average, n = 35)	P Value
Design curricula	3.97	4.51	.001
Design an improvement science curriculum	4.30	4.66	.013
Design a competency-based curriculum	3.86	4.40	.001
Teach improvement science	3.84	4.29	.011
Design competency assessment	3.51	4.20	.001
Design competencies for improvement science	4.11	4.37	.22
Design clinical improvement projects	3.94	4.40	.005
Do improvement projects in practice	3.84	4.46	.001
Use data for improvement in clinical practice	3.81	4.26	.011
Teach systems thinking	3.65	4.20	.007
Teach about patient safety and adverse events	3.81	4.20	.08
Teach about working in teams	3.86	4.31	.044
Teach communication skills	3.62	4.17	.016
Teach about using data and evidence for improvement	3.78	4.29	.004
Teach the Model for Improvement/PDSA cycles	4.11	4.63	.001
Teach Lean principles and tools (Kaizen, etc)	3.46	3.63	.30
Conduct scholarly work in improvement science	3.65	4.14	.012
Coach learners in improvement science	3.81	4.26	.009
Assess learners' level of knowledge	3.62	4.26	.001

Abbreviations: FISC, Foundational Improvement Science Curriculum; PDSA, plan-do-study-act.

Note: Curriculum component self-assessment scored on 5-point Likert scale (strongly agree, agree, neutral, disagree, strongly disagree). Bold P values are < .05.

FISC Participant Outcomes

FIGURE 2 summarizes the median changes across the 4 competency domains for FISC participants with complete data (n = 31). Participants reported gains across all FISC competencies with the largest gains in IS application (9-point scale, novice to master; median score 2 midyear versus 7 final; $P < .05$) and IS curriculum (2 versus 7, $P < .05$).

Gain in knowledge was further evident in self-assessment results on 16 of 19 curricular items (5-point scale, strongly agree to strongly disagree) related to designing, teaching, coaching, and assessing IS curricula (TABLE 2). Across both cohorts, substantial self-reported gains were observed (TABLE 2).

While development of a scholarly agenda in IS was an overall FISC program goal, products of scholarship were not tracked during this study as most faculty focused on developing a curriculum and delayed scholarship until they had experience with curriculum implementation.

Discussion

The findings from FISC demonstrate gains across the 4 FISC competencies, meeting the goals of expanding faculty knowledge in IS while developing IS curricula

for various levels and types of learners. All participants developed or enhanced an IS curriculum, greatly advancing the capacity of the institution to deliver relevant content to learners. The program was well received by participants from a wide range of specialties and disciplines. However, this program was not continued after the second year due to funding constraints.

Several factors contributed to the program's success, including GME leadership buy-in and active participation in the first cohort, iterative FISC program design, and unplanned participant collaborations that organically emerged during the program. The requirement to periodically self-assess facilitated reflection on accomplishments as well as identified knowledge gaps. The PIP served as a valuable activity across all participants given varying levels of IS knowledge and expertise, while providing robust opportunities for peer learning and applying the Model for Improvement. Organic partnerships included a program director with a program manager from a single residency program, multiple participants who taught residents and fellows in a single department, and collaborations among small fellowships that clinically interacted (eg, cardiology and cardiothoracic surgery).

Teaching a core set of knowledge and skills while simultaneously allowing faculty to build a curriculum that was relevant to the needs and restraints of their learners offers an alternative approach to expanding faculty development. Single program examples of IS continue to grow^{12,24–27} and demonstrate knowledge gains for participants (eg, QIKAT-R²⁸). Faculty development programs offering coaching and advancement of scholarship also exist but require travel and per person costs.²⁹

Our findings are limited by the volunteer nature and small cohort of individuals from 1 large institution with existing IS faculty expertise, which limits generalizability to smaller institutions. At the individual level, as shown in previous use of competency mapping,¹⁷ some participants demonstrated substantial progress, while others did not. There is a potential issue of self-report bias here, leading to either under- or over-reporting of attainment. The survey instruments were not tested for validity evidence, and there may have been varied interpretation of the questions by respondents. As there was no correction for multiple associations, some of the improvements in self-assessed skills may be spurious. While all participants had departmental support, FISC did not provide additional funding to offset potential loss of clinical revenue or compensate individuals for their time. While the FISC program seeded a small cohort of faculty with IS skills and knowledge by self-report, we did not do formal knowledge testing or long-term follow-up for durability of IS skills and curriculum implementation.

Next steps include follow-up with faculty participants on implementation of their curricula and further examination of achievement of the competencies within programs.

Conclusions

An institution-wide faculty development program to build IS skills and new curricula, which used didactics, interactive sessions, coaching, and self-assessed competency mapping, resulted in a large increase in IS curricula as well as increased perception of IS skills among faculty and staff participants.

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