Expanding the Use of Active Learning

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Attempting to provide faculty with the motivation, guidance, and resources to integrate active learning in their classrooms presents several challenges. During this session, attendees will leave understanding successful strategies as well as lessons learned during efforts to expand active learning throughout a STEM college at a regional comprehensive university (using funds from a federal grant) as well as throughout the entire institution (as part of a SACS reaffirmation QEP). Examples of active learning across the disciplines will be discussed, as well as the resources needed to make the expansion of their use successful.

EXPANDING THE USE OF ACTIVE LEARNING THROUGHOUT OUR COLLEGE

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EVIDENCED-BASED TEACHING & LEARNING

Lilly Conference - Austin, Texas

Overview for session

- Active learning and evidence
- Faculty resistance
- STEM Center results
- Our QEP
- Ideation

“Active Learning”

“any instructional method that engages students in learning process”

“students do meaningful learning activities and think about what they are doing”

“involve students more directly in the learning process”

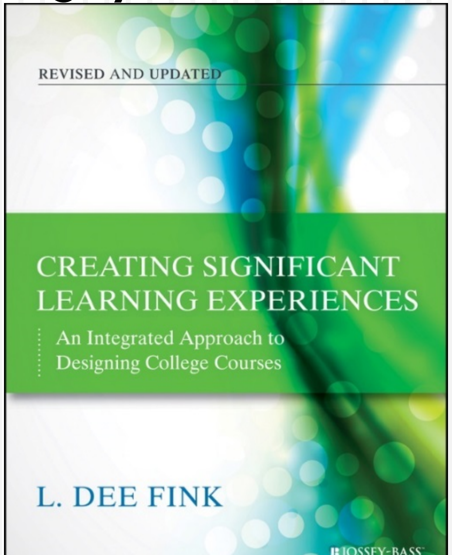
“as opposed to passively listening to an expert”

“student effort to actively construct their own knowledge”

“evidence-based instructional practices”

Contrasting views of Learning

Transmissionist	Constructivist
Lecturer: I know a lot about this topic, so I will transmit my knowledge to you by telling you about it.	Facilitator: I know a lot about this topic, so I will create situations and present learning challenges to you so that you construct your own knowledge structure.



Active learning increases student performance in science, engineering, and mathematics

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To test the hypothesis that lecturing maximizes learning and course performance, we metaanalyzed 225 studies that reported data on examination scores or failure rates when comparing student performance in undergraduate science, technology, engineering, and mathematics (STEM) courses under traditional lecturing versus active learning. The effect sizes indicate that on average, student performance on examinations and concept inventories increased by 0.47 SDs under active learning (n = 158 studies), and that the odds ratio for failing was 1.95 under traditional lecturing (n = 67 studies). These results indicate that average examination scores improved by about 6% in active learning sections, and that students in classes with traditional lecturing were 1.5 times more likely to fail than were students in classes with active learning. Heterogeneity analyses indicated that both results hold across the STEM disciplines, that active learning increases scores on concept inventories more than on course examinations, and that active learning appears effective across all class sizes—although the greatest effects are in small ($n \leq 50$) classes. Trim and fill analyses and fail-safe n calculations suggest that the results are not due to publication bias. The results also appear robust to variation in the methodological rigor of the included studies, based on the quality of controls over student quality and instructor identity. This is the largest and most comprehensive metaanalysis of undergraduate STEM education published to date. The results raise questions about the continued use of traditional lecturing as a control in research studies, and support active learning as the preferred, empirically validated teaching practice in regular classrooms.

constructivism | undergraduate education | evidence-based teaching | scientific teaching

225 studies in the published and unpublished literature. The active learning interventions varied widely in intensity and implementation, and included approaches as diverse as occasional group problem-solving, worksheets or tutorials completed during class, use of personal response systems with or without peer instruction, and studio or workshop course designs. We followed guidelines for best practice in quantitative reviews (*SI Materials and Methods*), and evaluated student performance using two outcome variables: (*i*) scores on identical or formally equivalent examinations, concept inventories, or other assessments; or (*ii*) failure rates, usually measured as the percentage of students receiving a D or F grade or withdrawing from the course in question (DFW rate).

The analysis, then, focused on two related questions. Does active learning boost examination scores? Does it lower failure rates?

Results

The overall mean effect size for performance on identical or equivalent examinations, concept inventories, and other assessments was a weighted standardized mean difference of 0.47 (Z = 9.781, $P << 0.001$)—meaning that on average, student performance increased by just under half a SD with active learning compared with lecturing. The overall mean effect size for failure rate was an odds ratio of 1.95 ($Z = 10.4$, $P << 0.001$). This odds ratio is equivalent to a risk ratio of 1.5, meaning that on average, students in traditional lecture courses are 1.5 times more likely to fail than students in courses with active learning. Average failure rates were 21.8% under active learning but 33.8% under traditional lecturing—a difference that represents a 55% increase (Fig. 1 and Fig. S1).

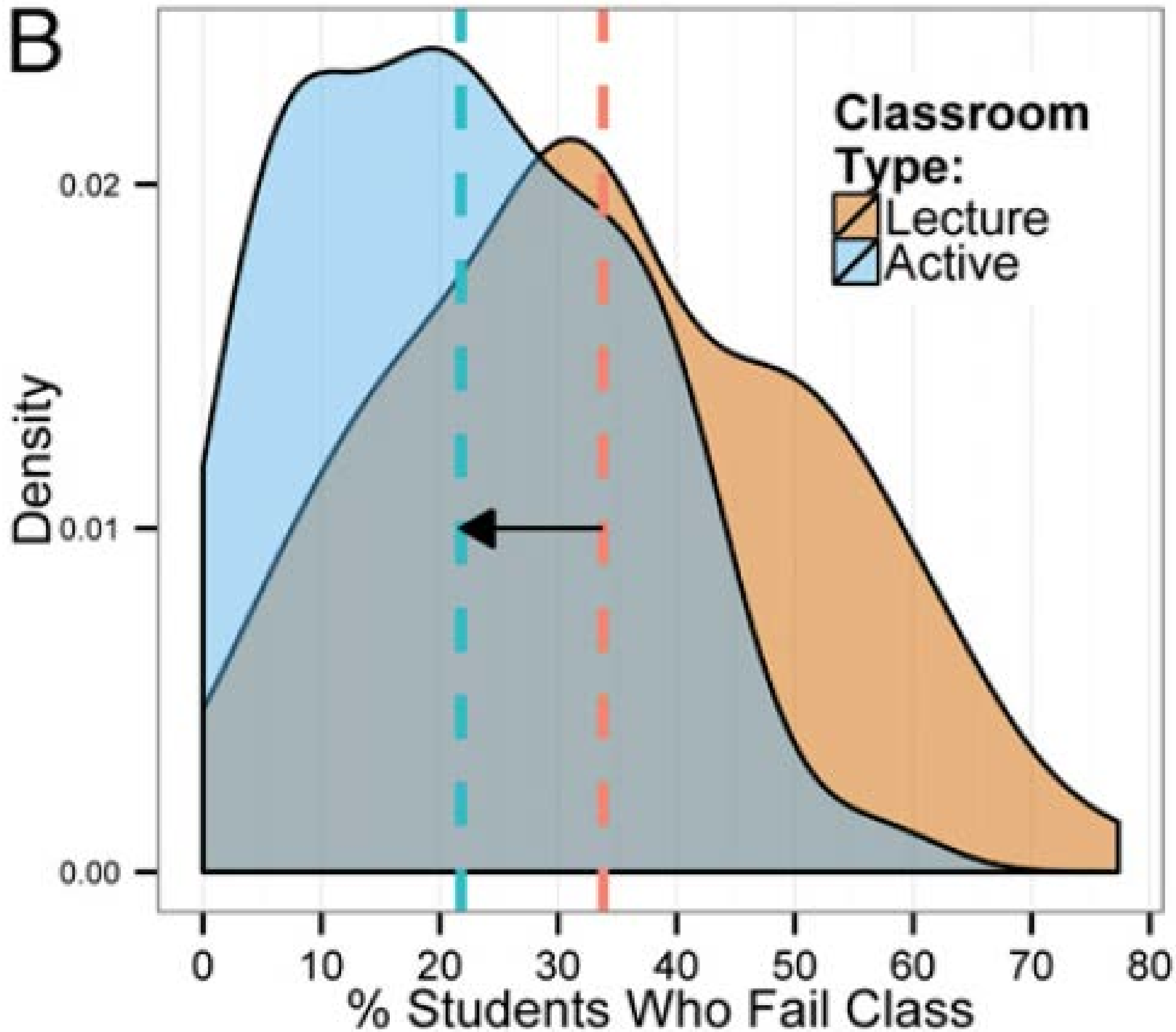
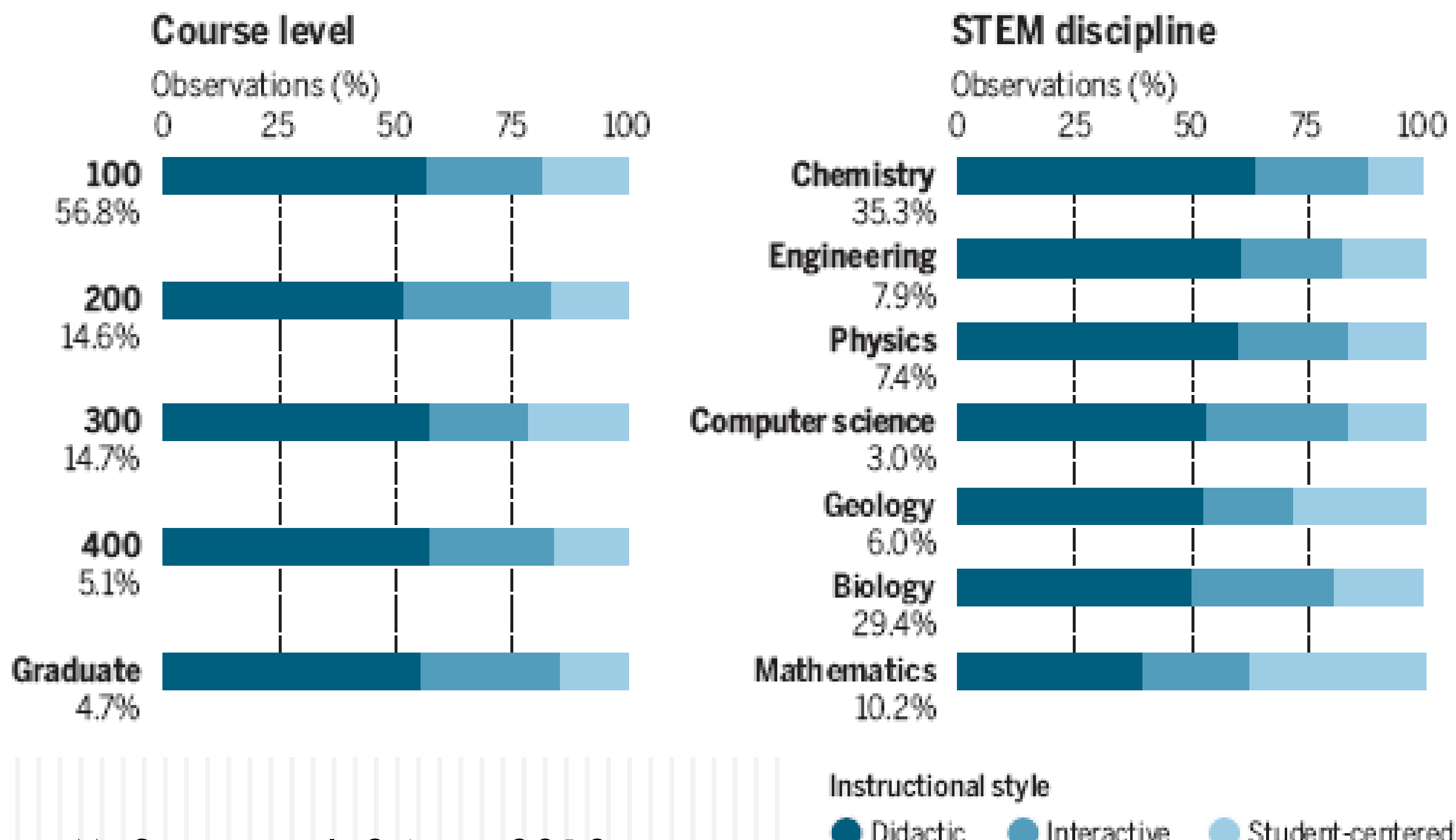


Figure 1B, Freeman et al, PNAS 2014

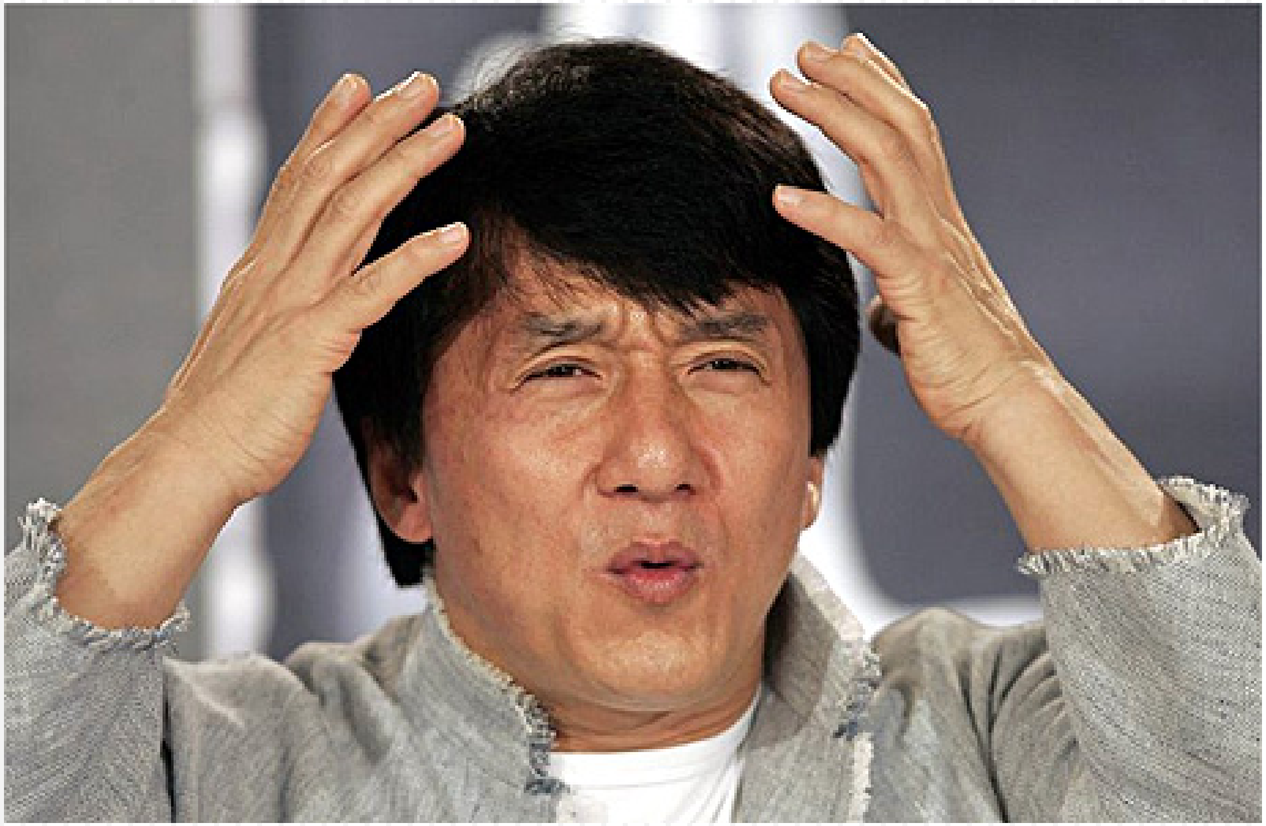
SCIENCE EDUCATION

Anatomy of STEM teaching in North American universities

Lecture is prominent, but practices vary



M. Stains et al, *Science* 2018



Why does faculty practice not match the evidence?

Overview for session

- Active learning and evidence
- **Faculty resistance**
- STEM Center results
- Our QEP
- Ideation

Shadle et al. International Journal of STEM Education (2017) 4:8
DOI 10.1186/s40594-017-0062-7

International Journal of
STEM Education

RESEARCH Open Access

Faculty drivers and barriers: laying the groundwork for undergraduate STEM education reform in academic departments

Susan E. Shadle*, Anthony Marker and Brittnee Earl

Abstract

Background: Calls to improve student learning and increase the number of science, technology, engineering, and math (STEM) college and university graduates assert the need for widespread adoption of evidence-based instructional practices in undergraduate STEM courses. For successful reforms to take hold and endure, it is likely that a significant shift in culture around teaching is needed. This study seeks to describe the initial response of faculty to an effort to shift teaching norms, with a long-term goal of altering the culture around teaching and learning in STEM. While the effort was envisioned and led at the institutional level, dialog about the proposed change and actions taken by faculty was emergent and supported within departments.

Results: Faculty identify a variety of barriers to proposed changes in teaching practice; however, faculty also identify a variety of drivers that might help the institution alter teaching and learning norms. Analysis of faculty responses reveals 18 categories of barriers and 15 categories of drivers in faculty responses. Many of the barrier and driver categories were present in each department's responses; however, the distribution and frequency with which they appear reveals departmental differences that are important for moving forward with strategies to change teaching practice.

Table 2 Categories of faculty-identified barriers for STEM education change

Barrier category	Description of category	Example faculty comments
Time constraints	Faculty is currently over-committed and does not have time to take on any more initiatives; working capacity is limited and involvement must be prioritized given other commitments	1) The amount of time available to "think about teaching" in a department where almost all of us are teaching in overload situations is not currently tenable; 2) There is limited time, so as more time is spent developing teaching materials less time is spent in other activities critical to one's success as a faculty member
Instructional challenges	Inability to cover necessary content if EBIPs are used, inability to manage EBIPs and assessment in large enrollment courses, classroom space is not conducive to EBIPs due to fixed furniture or layout	1) Covering essential content in the face of decreased number of credits in the curriculum; 2) Course size limits many teaching practices (meaningful assessment in a class of 278 that does not swallow me whole)
Loss of autonomy	Perceived loss of autonomy in the classroom or over content; concern that one will be forced to use "one-size-fits-all" approaches with an increasing top-down management style	1) Force faculty to teach and assess all the same way, may not be best for their style; 2) Less individual control of content and methods
Resistance to change	No reason to change current practices; currently engaged in other changes (do not want to change more things); is resistant to change in general	1) I already get high teaching reviews, for purposes of the university promotional process; 2) I don't want to have to change my teaching style
Insufficient assessment methods and processes	Concern about how the administration will assess teaching effectiveness; concern about how faculty will assess learning in their classroom and/or determine if EBIPs result in improved student learning	1) Developing knowledge of meaningful assessment; 2) Emphasis on student evaluations as single measure
Inadequate resources	Lack of resources needed to explore and adopt EBIPs (e.g., teaching assistants to help in the classroom or with grading, materials, adequate learning spaces)	1) Resource requirements for change deplete limited pool; 2) Change needed in resources - infrastructure
Conflicts with institutional rewards/priorities	The tenure and promotion criteria are misaligned with the proposed initiative, research output carries more weight than teaching-related duties, and/or there is little incentive to focus more effort on teaching	1) Not so beneficial to me personally, in that teaching is not in my experience a strong criterion for obtaining tenure and promotions; 2) There is no reward for investing more in teaching
Student resistance	Students resist EBIPs; this might impact end-of-course evaluations	1) A population of students will be resistant to change; 2) Students don't always evaluate change or "new" things in a positive or constructive way (and evaluations impact promotion and tenure)
Current culture is unsupportive	Department, institution, or higher ed. culture does not support pedagogical exploration, deviations from traditional lecture, and/or communities of practice	1) No current culture of experimentation; 2) We don't currently discuss as a department teaching practices

Second literature example

JOURNAL OF RESEARCH IN SCIENCE TEACHING VOL. 44, NO. 1, PP. 85–106 (2007)

Obstacles to Instructional Innovation According to College Science and Mathematics Faculty

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Received 29 September 2004; Accepted 27 June 2005

Abstract: Numerous studies have documented the infrequent use of learner-centered instruction in college science and mathematics classrooms and its negative effects on undergraduate learning and motivation. The present research deepened understanding of why. Specifically, an Internet survey was constructed that explored obstacles, supports, and incentives for instructional innovation in the classroom and was sent out to college science and mathematics faculty of Louisiana. Results revealed that colleges generally were perceived to assign little or an indeterminate weight to instruction in personnel decision making. Faculty members generally have little training in pedagogy; but when they do, they are more likely to consult sources of instructional innovation and consider teaching an important part of their professional identities. Data concerning the most common sources of instructional innovation information are presented. Several suggestions are made for institutional reform that if enacted might contribute to systemic improvement in the quality of instruction undergraduates receive. J Res Sci Teach 44: 85–106, 2007

Our data

Interested in using more active learning techniques? Y 74%

If not interested, why not? 38% already using

16% does not fit my course/discipline

14% not enough time

7% AL does not work

7% misunderstanding AL

Barriers (n=130):

24% No time for development

15% students not ready/able

8% not enough time in class

22% classes too large

15% no major barriers

8% classroom not designed for it

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The STEM Center at SHSU

Funded by a 2017 IUSE award from NSF, the STEM Center is a faculty-led, STEM student-focused program which:

1. Improves preparation of incoming STEM students
2. Provides research opportunities at early stages
3. Increases the use of active learning by STEM faculty

Summer 2018: MoSI for 25 STEM faculty

a diverse group from CoSET
no compensation for attendance
minigrants available to 10 of the attendees
stipends, support

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The 2019-24 QEP at SHSU

Several "pockets" of active learning used on campus

-- STEM faculty
-- CoBA faculty
-- Humanities faculty

Realizing an opportunity for expanding active learning throughout more than just one college, several faculty members submitted a proposal to have this as the focus of the QEP.

There will be several opportunities for faculty to learn more about the integration of active learning in their classrooms, along with resources to ensure effective integration.

The 2019-24 QEP at SHSU

Opportunities for faculty:
-- more MoSIs each summer for novices
-- ACUE's course on Effective Teaching Practices
-- 2-year fellowships for those wanting to take a deep dive

Resources:
-- mini-grants
-- travel funds to workshops
-- faculty learning communities
-- active learning library for digital resources
-- classroom redesign

Three Stages on the Pathway to Becoming an Expert on Active Learning

	Active Learning Summer Institutes (ALSI)	ACUE's Course in Effective Teaching Practices	Active Learning Teaching Fellowships (ALTF)
	from those who are novices with active learning to expert practitioners →		
Target Audience	Those new to active learning, perhaps new to teaching. Later years may see second version, one for repeat users.	Faculty with some experience, those willing to learn more in order to affect change in their classrooms and their students.	Faculty who want a long-term examination of a particular active learning technique or strategy, are willing to implement it on a large scale and serve as peer mentor.
Curriculum	Diversity and its importance; exposure to several evidence-based active learning techniques and strategies; methods of assessment	Set by ACUE: 25 modules in five units: course design, productive learning, active learning, higher order thinking, and assessment.	Comprehensive literature review; in-depth analysis of best practices; course redesign; full implementation, assessment and adjustment.
Scope	Held three times each summer, equivalent of one week.	Fall and Spring semesters	Two academic years; the second year is spent as a peer mentor for the next cohort
Scale	60 faculty per summer	20-30 faculty per year	14-18 faculty per cohort
Compensation	$500 per faculty member plus stipend for facilitators	$1000 per faculty participant plus programming costs	One course release per year
Expectations of participants	Integrate at least one active learning techniques into their curriculum the following fall semester.	Service on selection committees (for TIGs and travel minigrants), assistance with assessment of active learning in classrooms.	Active Learning Teaching Fellows will serve as ambassadors to their college and deparment, helping to recruit more colleagues.

	Flexible Interventions available each year		
	Teaching Innovation Grants	Travel to Workshops	Faculty Learning Communities
	faculty at all levels of experience with active learning will be encouraged to apply		
Target Audience	Faculty (or group of faculty) interested in either redesigning a course or integrating active learning in a particular course or sequence of courses.	Faculty willing to attend workshops or teaching seminars; faculty presenting results of active learning experience at teaching conferences	Faculty interested in applying active learning to a particular setting; faculty wanting to focus attention on a particular active learning technique.
Curriculum	Spend one summer developing course materials for use in the following Fall or Spring	Attendance at workshops or conferences to learn a particular technique and/or disseminate results	Cohorts of faculty discussing best practices for implementing active learning in particular settings such as online courses, graduate courses, large sections, core courses; a reading or writing group.
Scope	Minigrants available each summer	Throughout each year	Cohorts will spend a semester or more
Scale	up to 20 per year	up to 25 per year	6-8 FLCs each year, 5-10 faculty per cohort
Compensation	$2000 plus benefits and supplies	None	None
Expectations of participants	Participants are required to submit materials to repository of active learning materials, share experience with SHSU faculty	Participants are required to share experience with SHSU faculty (Teaching & Learning Conference, Faculty Learning Community, etc.)	Cohort leaders will report to QEP Director the conclusions of each FLC

The 2019-24 QEP at SHSU

Anticipated barriers to optimal involvement from faculty:

-- initiative fatigue

-- adverse impact on teaching evaluations

-- not rewarded in tenure/promotion/merit process

-- don’t see the benefits (why waste the time)

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Collect and share your ideas using…

Enter your barrier and idea

https://goo.gl/forms/0gPhyhCo8BKbdn6x2

Google FORMS

QUESTIONS RESPONSES

Overcoming_Faculty_Barriers-Lilly19

ideas from session participants to lower faculty barriers to implementing evidence-based student-focused active learning methods

Barrier you identified *

Short answer text

Idea for lowering barrier *

Long answer text

If you wish to receive participant responses, enter your email here:

Short answer text

MEMBER THE TEXAS STATE UNIVERSITY SYSTEM

Questions?