

# The future of STEM education: Preparing the next generation of faculty



## Challenge:

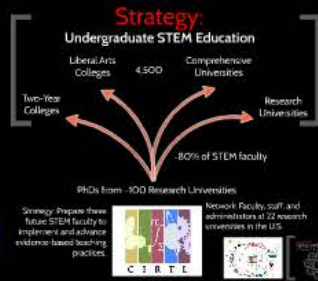
The challenge in undergraduate STEM education now lies less in knowing what works and more in getting people to use proven techniques.

-Fairweather 2008  
-PEAST 2012

Center for the Integration of Research, Teaching and Learning

### Mission Statement:

To develop a STEM faculty committed to implementing and advancing effective teaching practices for diverse student audiences as part of their professional careers.



## Bennett Goldberg

### CIRTL Core Ideas:

**Teaching as Research:** is the deliberate, systematic, and reflective use of research methods to develop and implement teaching practices that advance the learning experiences and outcomes of both students and teachers.  
⇒ STEM professor as change agent.

**Learning Communities:** bring together groups of people for shared learning, discovery, and generation of knowledge.  
⇒ Supports growth in teaching and learning.

**Learning through Diversity:** capitalizes on the rich array of experiences, backgrounds, and skills among STEM undergraduates and graduates-through-faculty to enhance the learning of all.  
⇒ Excellence and diversity are necessarily intertwined.

### CIRTL Outcomes:

#### CIRTL Outcomes - Early-Career Faculty

Participants are able to reflect on classroom settings, and to implement evidence-based teaching practices.

Programs help faculty build a professional network.

Programs support faculty career success.

Help faculty take personal ownership of their teaching practices.



#### Longitudinal study of outcomes

Participants later use what they learned to research, improve, and implement teaching practices in their own classrooms.

They had almost 50% more applied knowledge in their own classes.

Knowledge of research-based teaching practices improved.

- Developing instruction that is more student-centered
- Using active learning techniques, inquiry-based learning
- Encouraging student inquiry and problem-solving
- Encouraging student self-directed learning
- Using formative assessment

Participants also reported teaching practices that were more student-centered.

#### CIRTL Goal (2015-16)

2700 CIRTL Associates  
600 CIRTL Practitioners  
150 CIRTL Scholars

#### 2013 - NSF WIDER CFP

WIDER seeks to substantially increase the scale of application of highly effective methods of STEM teaching and learning in institutions of higher education by employing instructional materials and methods that have a convincing evidentiary basis of effectiveness.



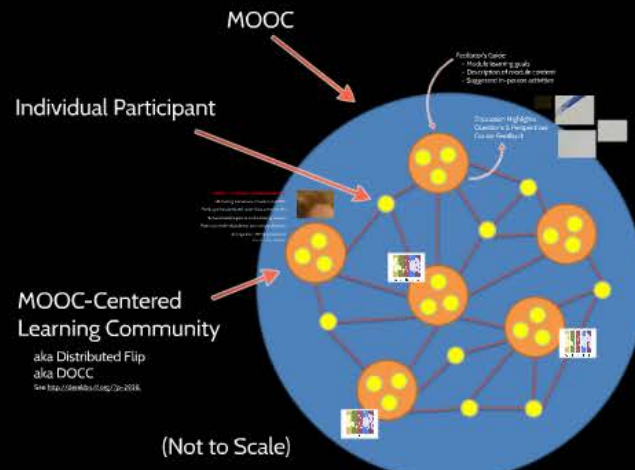
### Best aspects of the MCLC experience for participants?

- 52% Interacting with peers
- 83% Meeting and networking in teaching
- 79% Discussing course materials & assignments
- 72% Discussing teaching topics beyond the MOOC

To analyze: What effects did MCLC participation have on behaviors and outcomes in the MOOC?

Given what you've heard about the MOOC and its MCLCs, what predictions would you make for this experiment?

### MCLC Facilitator Survey (n=24)



## MOOCs as Networks of Local Learning Communities

An Experiment in Preparing Future Faculty



"An Introduction to Evidence-Based Undergraduate STEM Teaching"  
@CIRTLMOOC



## CIRTL MOOC Outcomes

Being in an MCLC increased your completion by 1.5-2.0 times, whether you intended to complete or not



• Postdocs completed at ~50%  
• Grad students completed at ~40%  
• Meeting large need of future faculty!

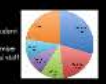
Group	Completed	Not Completed	Total
Postdocs	~50%	~50%	~100%
Grad students	~40%	~60%	~100%

### Metrics and Research Questions:

- Measurements:**
- Completion rates
  - Individual or Group participant
  - Intention to complete
  - Learning activities during course
- Questions:**
- Who were high completers and why?
  - Does being in a learning community affect completion?
  - Does intention impact actual completion?
  - Correlations among learning activities

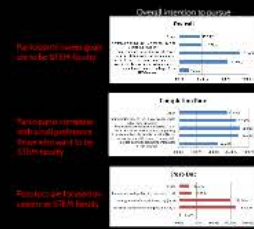
### CIRTL MOOC Participation

5908 Enrolled Students  
4009 Active Students  
566 Statements of Educational Accomplishment  
14% Completion Rate



What comes to mind when you hear the word "MOOC"?

MOOC as Course Replacement  
MOOC as Educational Outreach  
Something else?



\* The number of participants who watched at least one video was 2700. If they watched one video, they watched on average 20% of the videos, based on engagement.

\* The number of participants who completed one unit was 100. If they completed one unit, they completed 60% of the quizzes and watched 50% of lectures on average.

# The future of STEM education: Preparing the next generation of faculty



## Challenge:

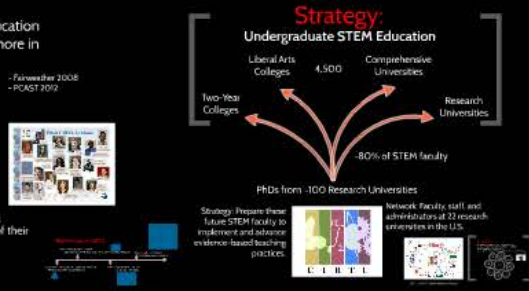
The challenge in undergraduate STEM education now lies less in knowing what works and more in getting people to use proven techniques.

-Farrabee 2008  
-PCAST 2012

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### CIRTL Core Ideas:

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⇒ STEM professor as change agent

**Learning Communities**: bring together groups of people for shared learning, discovery, and generation of knowledge.  
⇒ Supports growth in teaching and learning

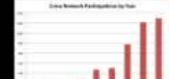
**Learning-through-Diversity** capitalizes on the rich array of experiences, backgrounds, and skills among STEM undergraduates and graduates-through-faculty to enhance the learning of all.  
⇒ Excellence and diversity are necessarily intertwined

### CIRTL Outcomes:

#### CIRTL Outcomes - Early Career Faculty

Participants use skills to better manage classroom settings, classroom management and delivery, classroom teaching, and delivery.  
Participants have been able to take their own ideas, take it back to their own institutions, and have been able to implement it in their own classrooms.

#### Growth in participation



#### Longitudinal study of outcomes

Participants have been able to take their own ideas, take it back to their own institutions, and have been able to implement it in their own classrooms.

#### CIRTL local (2010-14)

2700 CIRTL Associates  
600 CIRTL Practitioners  
150 CIRTL Scholars

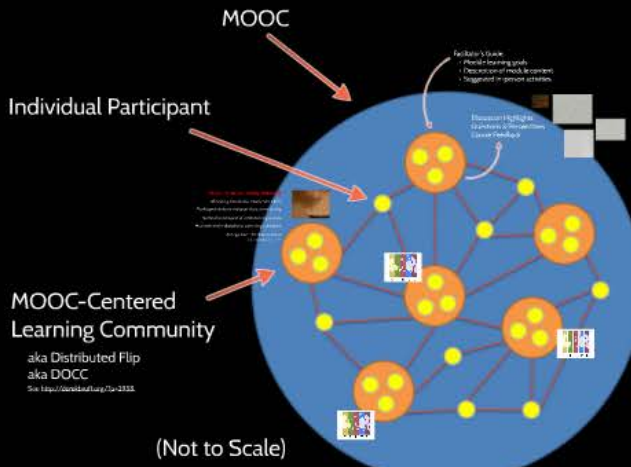
### Best aspects of the MCLC experience for participants?

- 95% Interacting with peers
- 84% Meeting others interested in teaching
- 72% Discussing course materials & assignments
- 71% Discussing teaching, research beyond the MOOC

To analyze: What effects did MCLC participation have on behaviors and outcomes in the MOOC?

Given what you've heard about the MOOC and its MCLCs, what predictions would you make for this experiment?

### MCLC Facilitator Survey (n=24)



## MOOCs as Networks of Local Learning Communities

An Experiment in Preparing Future Faculty



"An Introduction to Evidence-Based Undergraduate STEM Teaching" @CIRTLMOOC

## CIRTL MOOC Outcomes

Being in an MCLC increased your completion by 1.5-2.0 times, whether you intended to complete or not



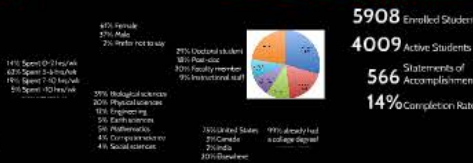
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Group	Completed	Not Completed
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### Metrics and Research Questions:

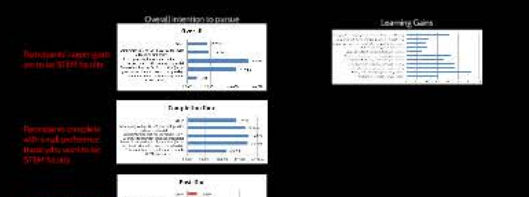
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### CIRTL MOOC Participation



What comes to mind when you hear the word "MOOC"?

MOOC as Course Replacement  
MOOC as Substantial Outreach  
Something else...



The number of participants who watched at least one video was 2100. If they watched one video, they watched an average 3.5 of the videos, based on regression.

The number of participants who completed one quiz was 1110. If they completed one quiz, they completed 65% of the quizzes and watched 51% of lectures on average.

# Challenge:

The challenge in undergraduate STEM education now lies less in knowing what works and more in getting people to use proven techniques.

- Fairweather 2008
- PCAST 2012

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### Brief History of CIRTl





# What CIRTL Is About



College of Idaho



Ain Shams Univ., Cairo



University of Illinois Urbana-Champaign



Ball State University



Purdue University



Pacific Northwest National Laboratory



The Ohio State University



North Carolina State University



Lawrence University



University of Maryland Eastern Shore



University of Wisconsin - Rock County



Grand Valley State University



UW - Madison



University of Dubuque



University of Louisville



Augustana College



Madison Area Technical College



Tufts University



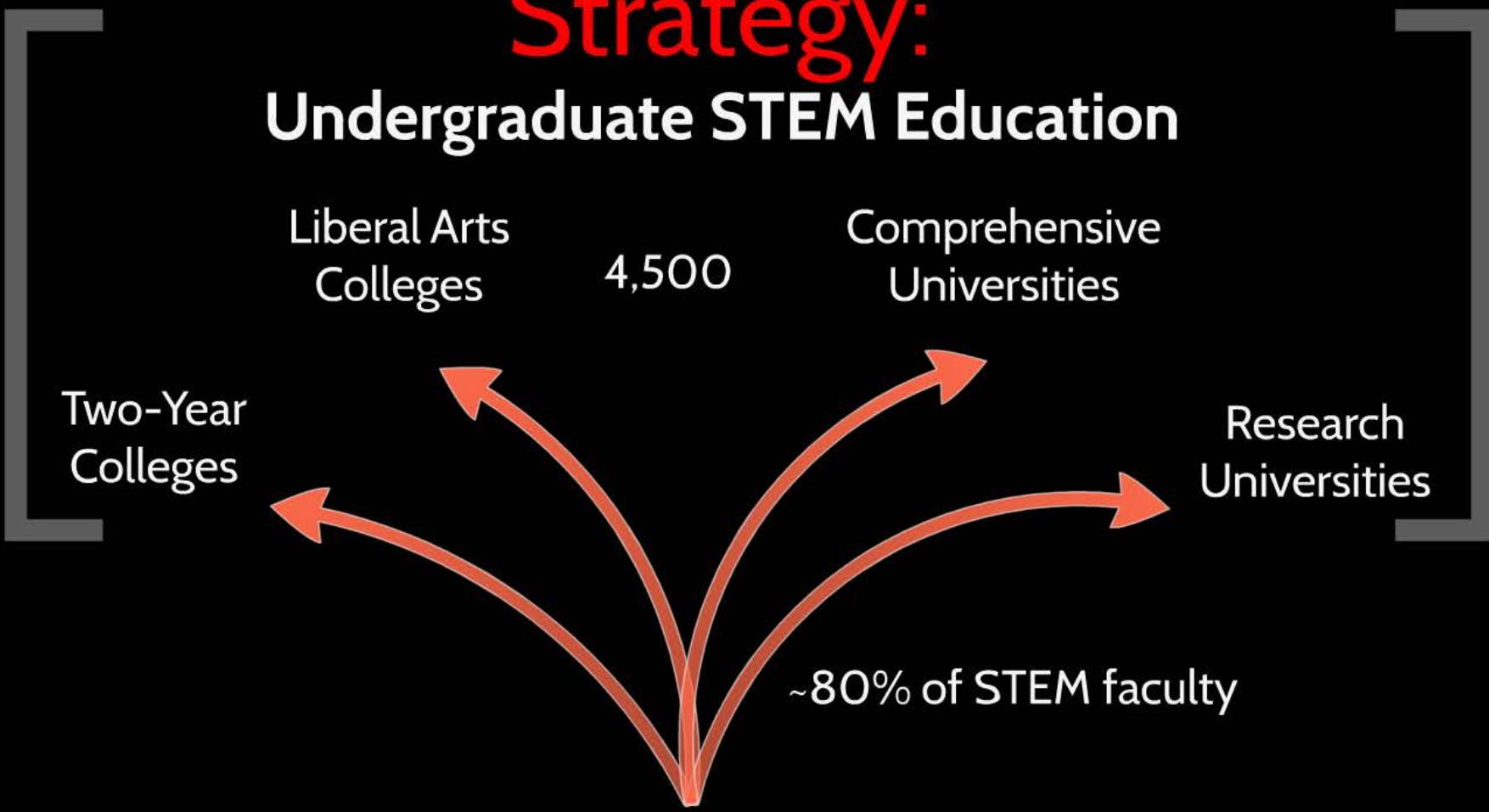
Pacific University of Oregon

[www.cirtl.net](http://www.cirtl.net)

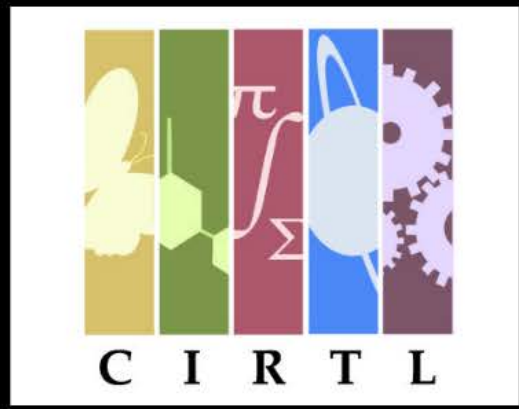


# Strategy:

## Undergraduate STEM Education



Strategy: Prepare these future STEM faculty to implement and advance evidence-based teaching practices.



Network: Faculty, staff, and administrators at 22 research universities in the U.S.



> 20% of US STEM PhD Production



# CIRTL Core Ideas:

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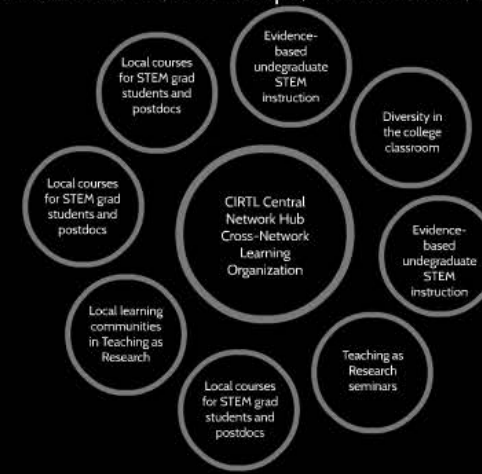
# Network: Faculty, staff, and administrators at 22 research universities in the U.S.



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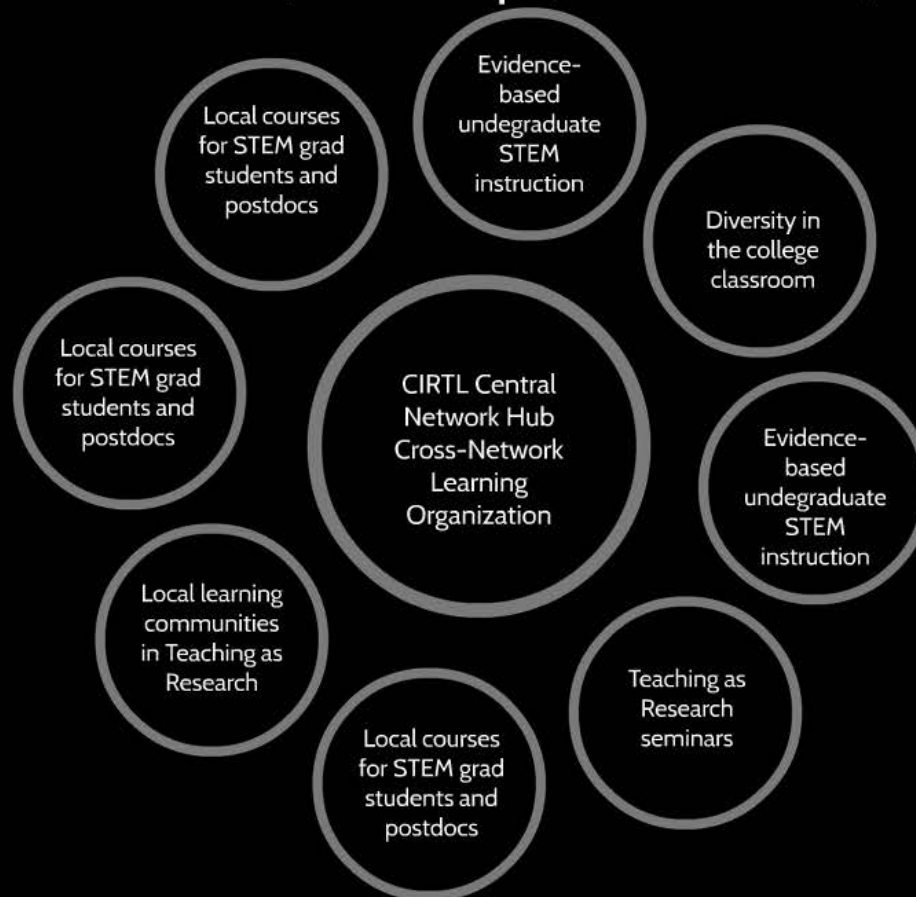
## Network Design:

- Central hub with resources, organization, governance
- Local Learning Communities at every Network institution
- Common student learning outcomes!
- Cross-network courses, workshops, coffee-hours, etc.



## Network Design:

- Central hub with resources, organization, governance
- Local Learning Communities at every Network institution
- Common student learning outcomes!
- Cross-network courses, workshops, coffee-hours, in-person meetings



### Common Learning Outcomes

Outcome	Assessment	Assessment
1. Apply scientific knowledge to solve problems	1. Apply scientific knowledge to solve problems	1. Apply scientific knowledge to solve problems
2. Communicate effectively	2. Communicate effectively	2. Communicate effectively
3. Collaborate effectively	3. Collaborate effectively	3. Collaborate effectively
4. Demonstrate critical thinking skills	4. Demonstrate critical thinking skills	4. Demonstrate critical thinking skills
5. Demonstrate problem-solving skills	5. Demonstrate problem-solving skills	5. Demonstrate problem-solving skills
6. Demonstrate research skills	6. Demonstrate research skills	6. Demonstrate research skills
7. Demonstrate writing skills	7. Demonstrate writing skills	7. Demonstrate writing skills
8. Demonstrate leadership skills	8. Demonstrate leadership skills	8. Demonstrate leadership skills
9. Demonstrate global awareness	9. Demonstrate global awareness	9. Demonstrate global awareness
10. Demonstrate ethical behavior	10. Demonstrate ethical behavior	10. Demonstrate ethical behavior



# CIRTL Outcomes:

## CIRTL Outcomes – Early-Career Faculty

Participants use skills in other than classroom settings.

Lab supervision, mentoring, and advising  
Outside academia working with clients

-Benbow, Byrd and Connolly 2011  
-Connolly et al. 2012

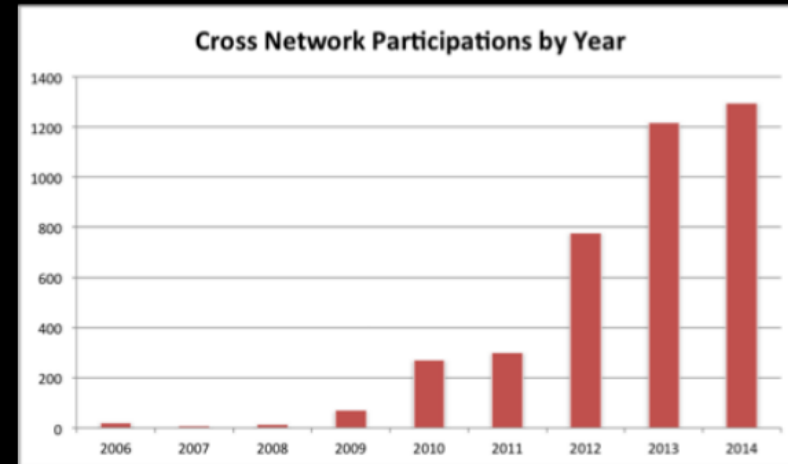
Programs help those looking for academic jobs.

Sense of readiness for academic jobs  
Apply for a wider range of positions  
Knowledgeably discuss teaching in job interviews

Programs support early career success.

Begin quickly in new positions  
Fostered fast starts in research programs  
- faster to first grant

## Growth in participation



## Longitudinal study of outcomes

Participants later use skills and concepts known to improve student learning.

-Benbow, Byrd and Connolly 2011  
-Connolly et al. 2012

76% had found ways to apply gained knowledge and skills in their early careers.

In order of frequency of response, participants report:

- Delivering instruction that increases student engagement (e.g., through active learning techniques, inquiry-based learning)
- Outcomes-based design; learning goals in course planning
- Methods of ongoing assessment aligned with learning goals.
- Ways to include diverse student perspectives

Participants cite integrating teaching and scientific research as valuable currently.

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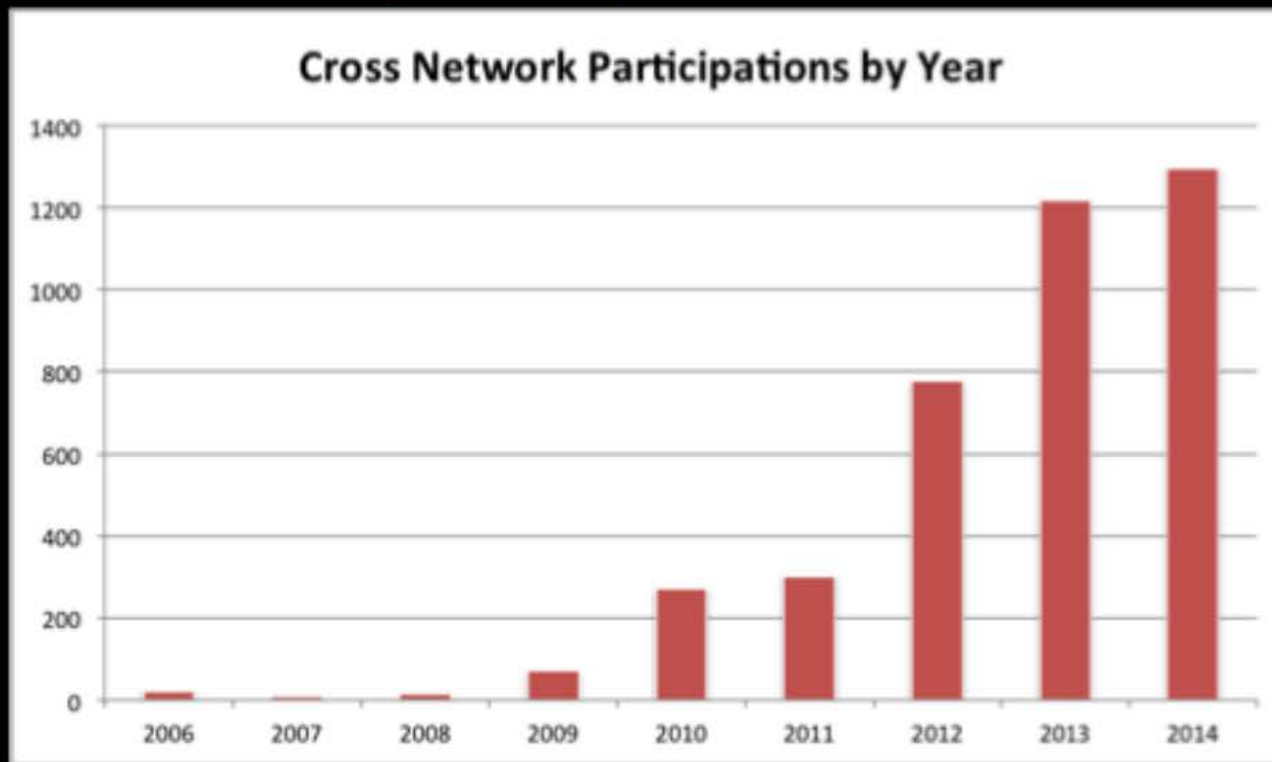
nes:

ulty

5.

and Connolly 2011  
2012

## Growth in participation



of outcomes

CIRTL Goal (2015-16)

cepts

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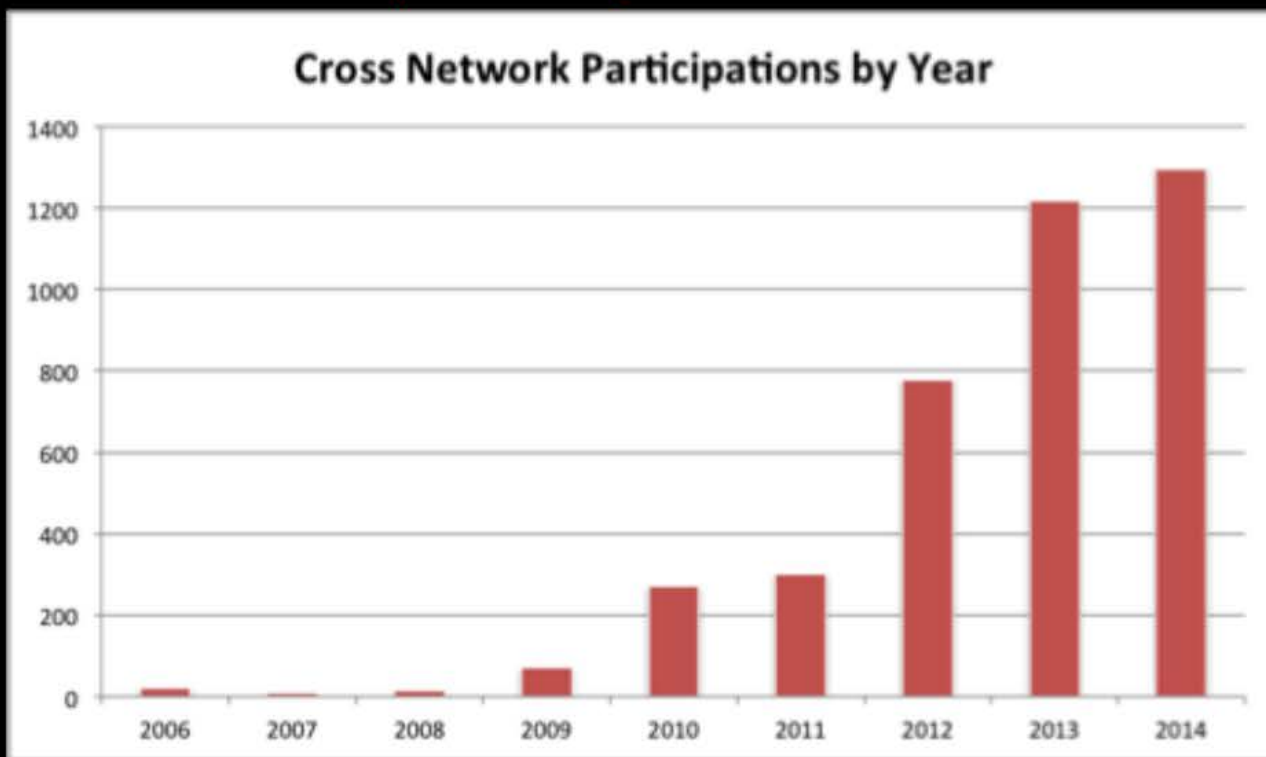
Connolly 2012

# Faculty

# Growth in participation

Settings.

Benbow, Byrd and Connolly 2011  
Connolly et al. 2012



# Quality of outcomes

concepts  
learning.

-Benbow, Byrd and Connolly 2011  
-Connolly et al. 2012

gained  
early careers.

participants report:

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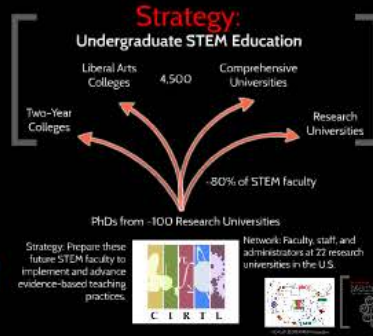
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### CIRTL Outcomes:

**CIRTL Outcomes - Early-Career Faculty:** Participants use different methods than classroom settings. Participants are using teaching practices that improve student learning. Programs help those looking for academic jobs. Programs help those looking for academic jobs. Programs help those looking for academic jobs.



### Longitudinal study of outcomes:

Participants later use 8.8x as many concepts known to improve student learning. 76% had found ways to apply general knowledge and skills in their early careers. Evidence of frequency of inquiry, participant research. Delivery of instruction that increases student engagement. Strong evidence of teaching practices that improve learning. Outcomes used to design learning goals, increase planning. Methods of ongoing assessment, alignment with learning goals. Plans to include diverse student perspectives. Participants also integrating teaching and/or research in their university.

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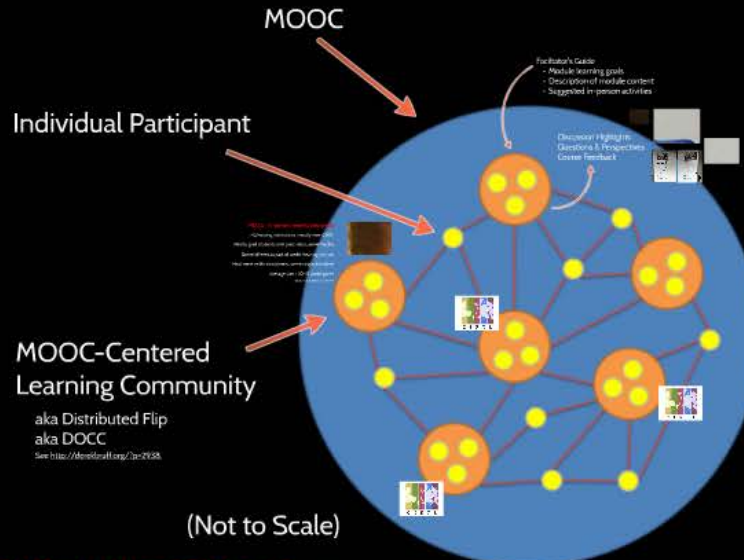


of the MCLC or participants? were involved in teaching material assignments beyond the MOOC

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### MCLC Facilitator Survey (n=24)



## MOOCs as Networks of Local Learning Communities

An Experiment in Preparing Future Faculty



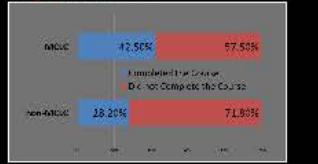
"An Introduction to Evidence-Based Undergraduate STEM Teaching" @CIRTLMOOC



## CIRTL MOOC Outcomes

Neda Deshpande  
Chris Deslaugas

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- Meeting large need of future faculty!

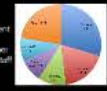
Category	Completed	Not Completed
Overall	104 (42.5%)	142 (57.5%)
Postdoc	51 (50%)	51 (50%)
Grad Student	53 (40%)	80 (60%)

### Metrics and Research Questions:

- Measurements:**
- Completion rates
  - Individual or Group participant
  - Intention to complete
  - Learning activities during course
- Questions:**
- Who were high completers and why?
  - Does being in a learning community affect completion?
  - Does intention impact actual completion?
  - Correlations among learning activities

### CIRTL MOOC Participation

5908 Enrolled Students  
4009 Active Students  
566 Statements of Accomplishment  
14% Completion Rate



61% Female  
39% Male  
24% Prefer not to say

18% Spent 0-2 hrs/week  
42% Spent 3-6 hrs/week  
19% Spent 7-10 hrs/week  
3% Spent 10+ hrs/week

39% Biological sciences  
23% Physical sciences  
12% Engineering  
5% Earth sciences  
5% Mathematics  
4% Computer science  
4% Social sciences

73% United States  
2% Canada  
2% India  
20% Elsewhere

73% Doctoral student  
18% Post doc  
20% Faculty member  
9% Instructional staff

What comes to mind when you hear the word "MOOC"?

- MOOC as Course Replacement
- MOOC as Educational Outreach
- Something else...



The number of participants who watched at least one video was 3100. If they watched one video, they watched on average 35% of the videos, based on regressions.

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MICHIGAN STATE  
UNIVERSITY

Henry (Rique) Campa



Robert (Bob) Mathieu  
Katherine (Kitch) Barnicle



Derek Bruff



Bennett Goldberg

# MOOCs as Networks of Local Learning Communities

*An Experiment in Preparing Future Faculty*



"An Introduction to  
Evidence-Based  
Undergraduate  
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@CIRTLMOOC

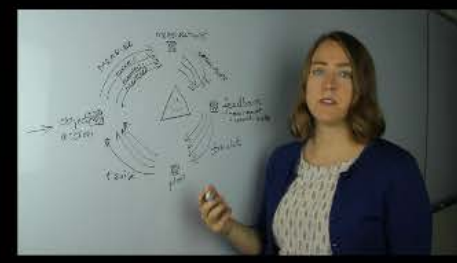
**course**era



1 - Principles of Learning  
Derek Bruff  
Vanderbilt U.



2 - Learning Objectives  
Stephanie Chasteen  
U. Colorado - Boulder



3 - Assessment  
Angela Little  
U. California - Berkley



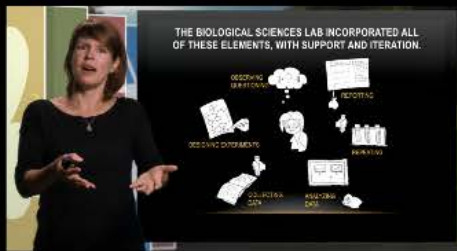
4 - Cooperative Learning  
Rique Campa  
Michigan State U.



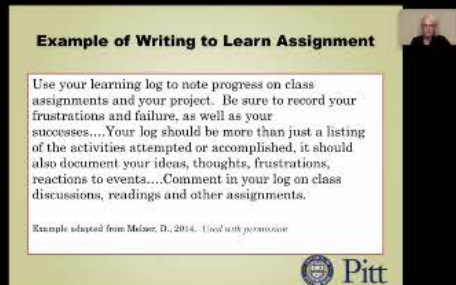
5 - Peer Instruction  
Bennett Goldberg  
Boston University



6 - Lecturing  
Derek Bruff  
Vanderbilt U.



7 - Inquiry-Based Labs  
Cynthia Brame  
Vanderbilt U.



8 - Writing to Learn  
Janet Littrell  
U. Pittsburgh



9 - Problem-Based Learning  
Rique Campa  
Michigan State U.



10 - Inclusive Teaching  
Trey Mack  
Vanderbilt U.



11 - Student Motivation  
Derek Bruff  
Vanderbilt U.



Intros & Outros  
Trina McMahon, UW-Madison  
Derek Bruff, Vanderbilt U.



# MOOC

## Individual Participant

## MOOC-Centered Learning Community

aka Distributed Flip  
aka DOCC

See <http://derekbruff.org/?p=2938>.

(Not to Scale)

**MCLCs - in-person, weekly, interactive**  
>45 hosting institutions, mostly non-CIRTL  
Mostly grad students and post-docs, some faculty  
Some offered as part of credit-bearing courses  
Most were multi-disciplinary, some single discipline  
Average size = 10-12 participants  
Source: CIRTL Institute Survey 2014



- Facilitator's Guide
- Module learning goals
  - Description of module content
  - Suggested in-person activities

Discussion Highlights  
Questions & Perspectives  
Course Feedback



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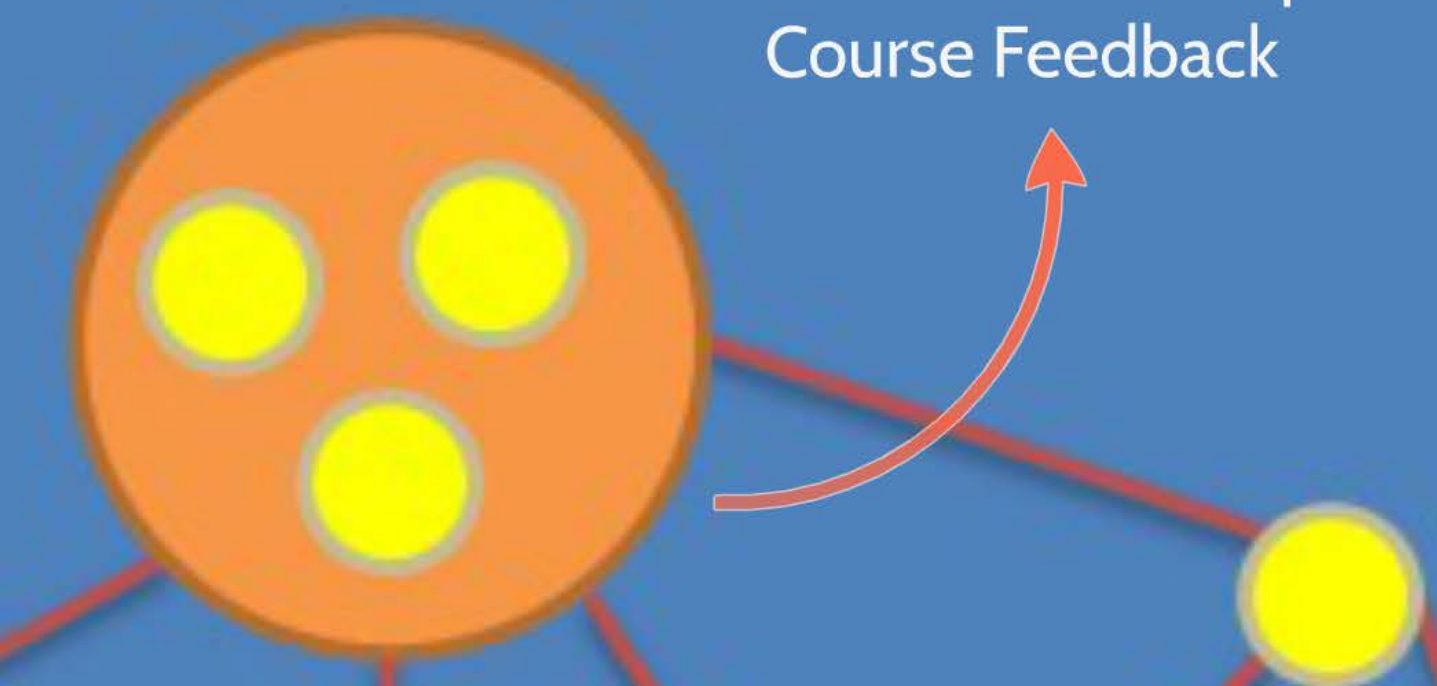
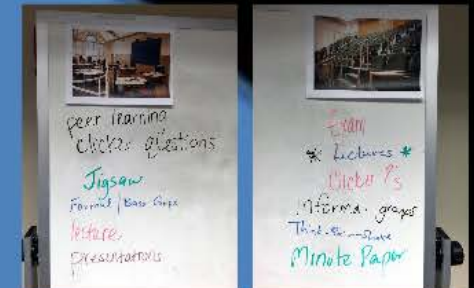
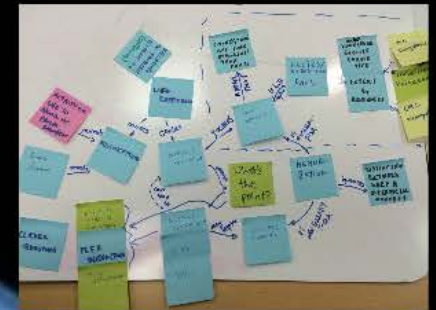
Source: MCLC Facilitator Survey (n=24)



# Facilitator's Guide

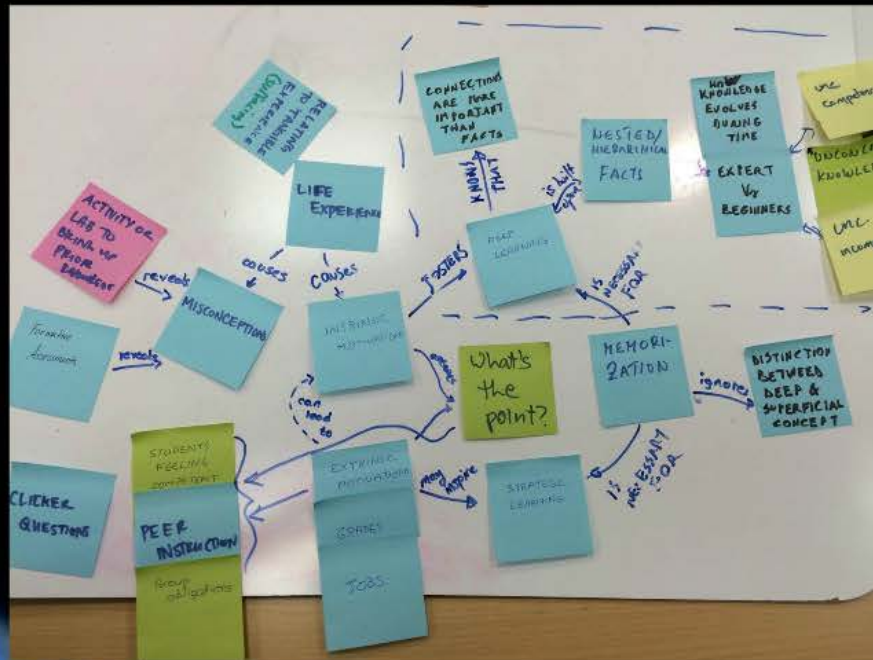
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# S ctives



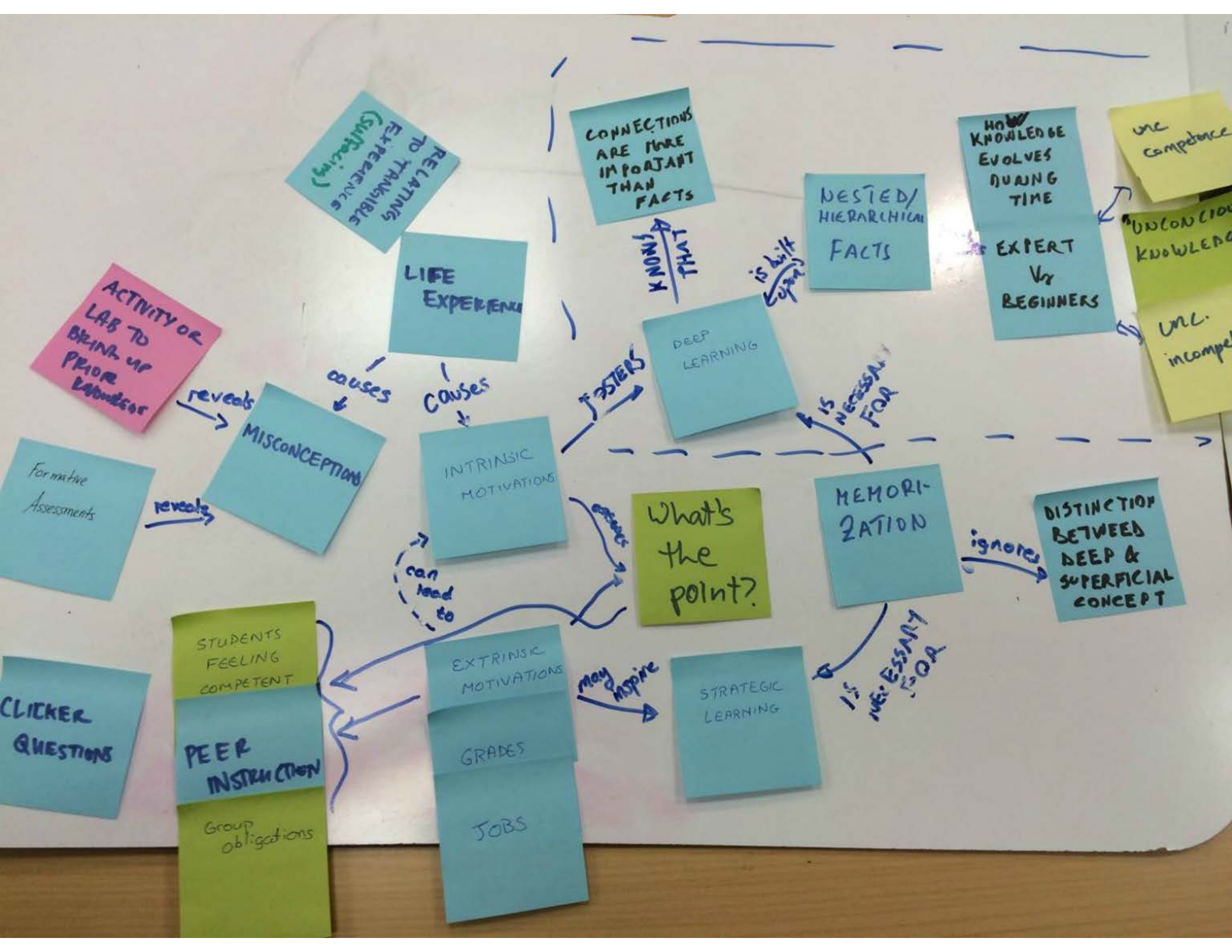
II How does error in GPS measurements made on clear day compare to GPS measurements made on a rainy day?  
 stormy cloudy  
 a. higher <sup>than</sup> on clear day  
 b. lower <sup>than</sup> on clear day  
 c. same? about the same?



peer learning  
 clicker questions  
 Jigsaw  
 Formal / Base Grps  
 lecture  
 presentations



Exam  
 \* Lectures \*  
 Clicker ?'s  
 informal groups  
 Think-Pair-Share  
 Minute Paper



CONNECTIONS ARE MORE IMPORTANT THAN FACTS

NESTED/HIERARCHICAL FACTS

HOW KNOWLEDGE EVOLVES DURING TIME  
EXPERT vs BEGINNERS

unc. competence  
UNCONCIOUS KNOWLEDGE  
unc. incomp.

KNOW THAT  
is built upon  
DEEP LEARNING

IS NECESSARY FOR

MEMORIZATION

DISTINCTION BETWEEN DEEP & SUPERFICIAL CONCEPT

LIFE EXPERIENCE

INTRINSIC MOTIVATIONS

What's the point?

MISCONCEPTIONS

ACTIVITY OR LAB TO BRING UP PRIOR KNOWLEDGE

Formative Assessments

EXTRINSIC MOTIVATIONS  
GRADES  
JOBS

STUDENTS FEELING COMPETENT  
PEER INSTRUCTION  
Group obligations

CLICKER QUESTIONS

STRATEGIC LEARNING

IS NECESSARY FOR

STRAINING TO TRACKABLE EXPERIENCE SURFACING

causes

causes

FOSTER

reveals

reveals

can lead to

may inspire

ignores

is built upon



peer learning  
clicker questions

Jigsaw

Formal / Base Grps

lecture

presentations



Exam

\* Lectures \*

Clicker ?'s

informal groups

Think-Pair-Share

Minute Paper

W/ Essay  
10-0A



Exam  
Lectures \*  
Clicker ?'s  
normal groups

II

How does error in GPS measurements made on clear day compare to GPS measurements made on a rainy day?  
stormy  
cloudy

a. higher <sup>than</sup> on clear day  
b. lower <sup>than</sup> on clear day  
c. same <sup>about the</sup>



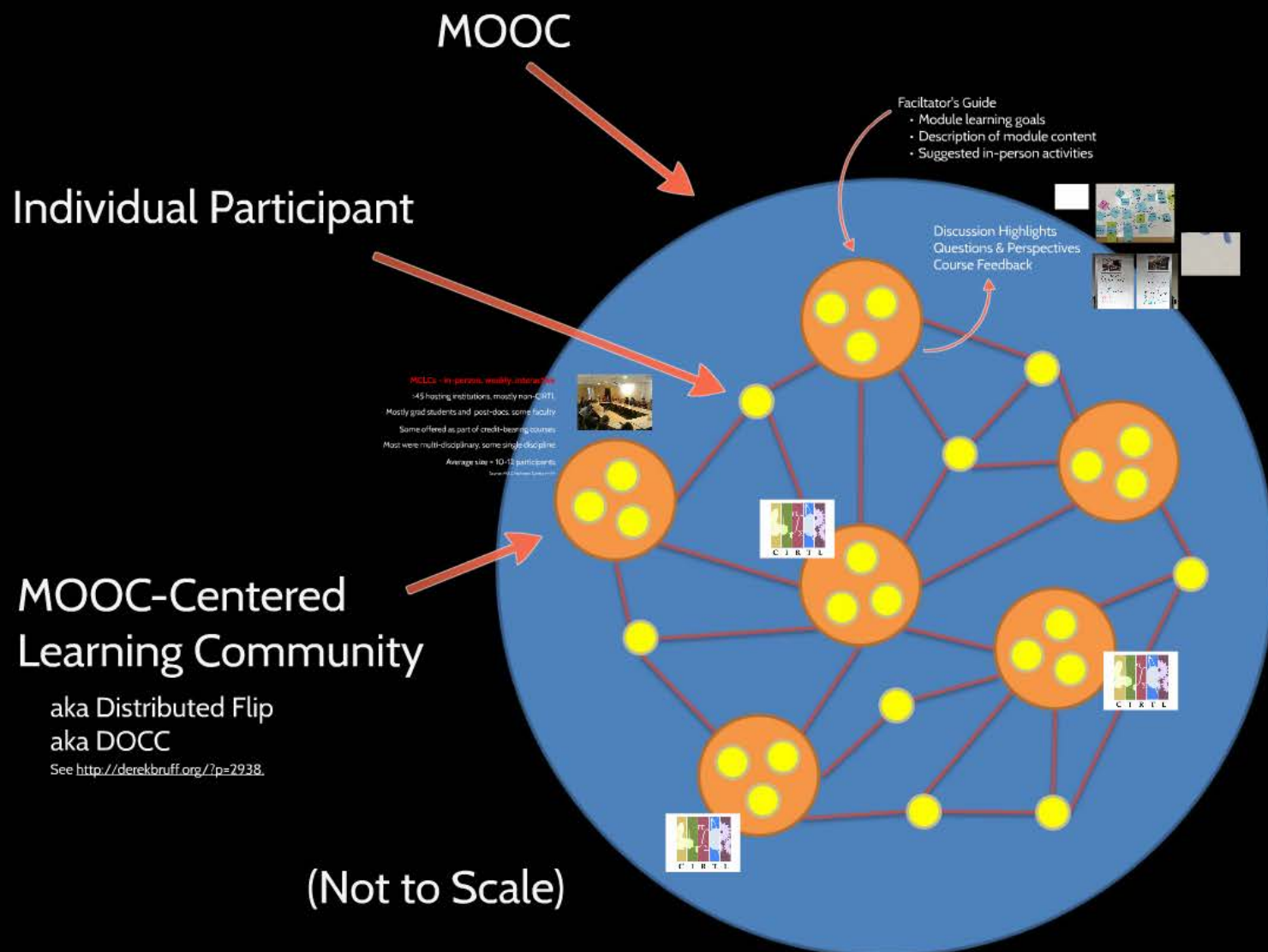
evidence-based teaching practices.



**Learning-through-Diversity:** capitalizes on the experiences, backgrounds, and skills among graduates-through-faculty to enhance the learning experience.

⇒ Excellence and diversity

What effects on participation behaviors and the MOOC?



**MOOCs Local Learning Communities**  
**An Experiment**



# CIRTLMOOC Outcomes

Neda Derakhshani  
Chris Dellarocas

increased your completion by whether you intended to

- Postdocs completed at ~50%
- Grad students completed at ~40%
- Meeting large need of future faculty!

## Metrics and Research Questions:

- Measurements:**
- Completion rates

61% Female  
37% Male



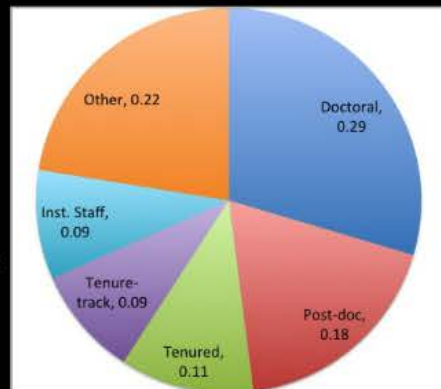
# CIRTL MOOC Participation

**5908** Enrolled Students

**4009** Active Students

**566** Statements of Accomplishment

**14%** Completion Rate



29% Doctoral student  
18% Post-doc  
20% Faculty member  
9% Instructional staff

75% United States  
3% Canada  
2% India  
20% Elsewhere

99% already had a college degree!

Source: Pre-Course Survey (response rate = 26%)

ons:

# CIRTL MOO

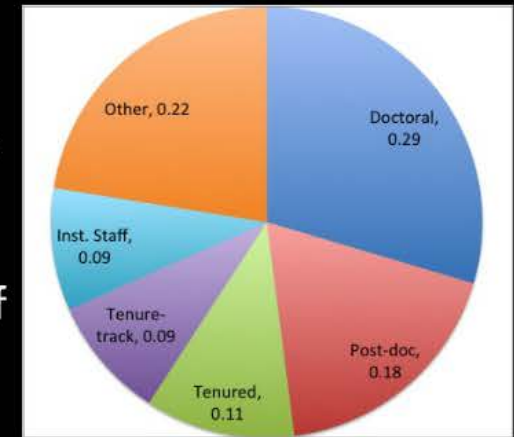
61% Female  
37% Male  
2% Prefer not to say

14% Spent 0-2 hrs/wk  
62% Spent 3-6 hrs/wk  
19% Spent 7-10 hrs/wk  
5% Spent >10 hrs/wk

Source: Post-Course Survey (response rate = 12%)

39% Biological sciences  
20% Physical sciences  
12% Engineering  
5% Earth sciences  
5% Mathematics  
4% Computer science  
4% Social sciences

29% Doctoral student  
18% Post-doc  
20% Faculty member  
9% Instructional staff



75% United States  
3% Canada  
2% India  
20% Elsewhere

99% already had a college degree!

Source: Pre-Course Survey (response rate = 36%)

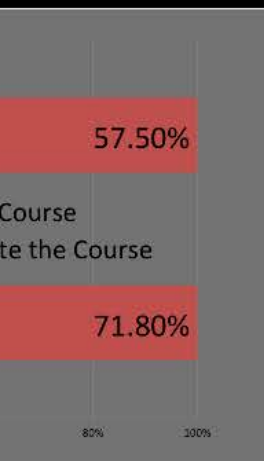


(Not to Scale)

# CIRTL MOOC Outcomes

Neda Derakhshani  
Chris Dellarocas

Course completion by intention to attend to



- Postdocs completed at ~50%
- Grad students completed at ~40%
- Meeting large need of future faculty!

Current Position	All Participants		MCLC participants		Non-MCLC participants	
	Overall Number	Completion Rate	Overall Number	Completion Rate	Overall Number	Completion Rate
Doctoral student	404	38.40%	145	46.9%	259	33.6%
Post-doctoral researcher	262	49.60%	92	55.4%	170	46.5%
Instructional Staff	134	26.90%	38	34.2%	96	24.0%
Faculty member (tenured)	156	18.60%	32	25.0%	124	16.9%
Early career faculty member (pre-tenure)	129	17.80%	28	25.0%	101	15.8%
Master Student	63	33.30%	16	31.3%	47	34.0%
Faculty professional development staff	44	20.50%	16	31.3%	28	14.3%
Other	57	24.60%	15	46.7%	42	16.7%
Researcher	33	33.30%	14	57.1%	19	15.8%
Not affiliated with a higher education institution	96	27.10%	13	38.5%	83	25.3%
Administrator	35	17.10%	8	12.5%	27	18.5%
Information technology staff	3	33.30%	2	50.0%	1	0.0%

**Table 1:** Completion rate by current position overall and as a function of their intention to participate in a MOOC-centered learning community as reported on the pre-course survey. Note that graduate students and post-docs had by far the largest completion numbers and rates, with MCLC participant rates higher than individuals.

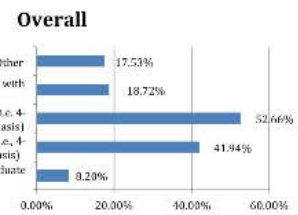
## Metrics and Research Questions

- Completion rates
- Individual or Group participant
- Intention to complete
- Learning activities during course

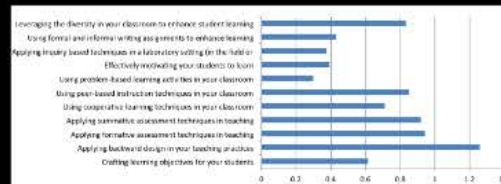
### Questions:

- Who were high completers and why?
- Does being in a learning community impact completion?
- Does intention impact actual completion?
- Correlations among learning activities

Intention to pursue



Learning Gains



Completion Rate



- The number of participants who watched at least one video was 3100. If they watched one video, they watched on average 35% of the videos, based on regression.
- The number of participants who completed one quiz was 1119. If they completed one quiz, they completed on average 50% of the quizzes.

## Metrics and Research Questions:

### Measurements:

- Completion rates
- Individual or Group participant
- Intention to complete
- Learning activities during course

14% Spent 0-2 hrs/wk  
62% Spent 3-6 hrs/wk  
19% Spent 7-10 hrs/wk  
5% Spent >10 hrs/wk

Source: Post-Course Survey (response rate = 12%)

### Questions:

- Who were high completers and why?
- Does being in a learning community affect completion?
- Does intention impact actual completion?
- Correlations among learning activities

- Postdocs completed at ~50%
- Grad students completed at ~40%
- Meeting large need of future faculty!

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# Grad students completed at ~40%

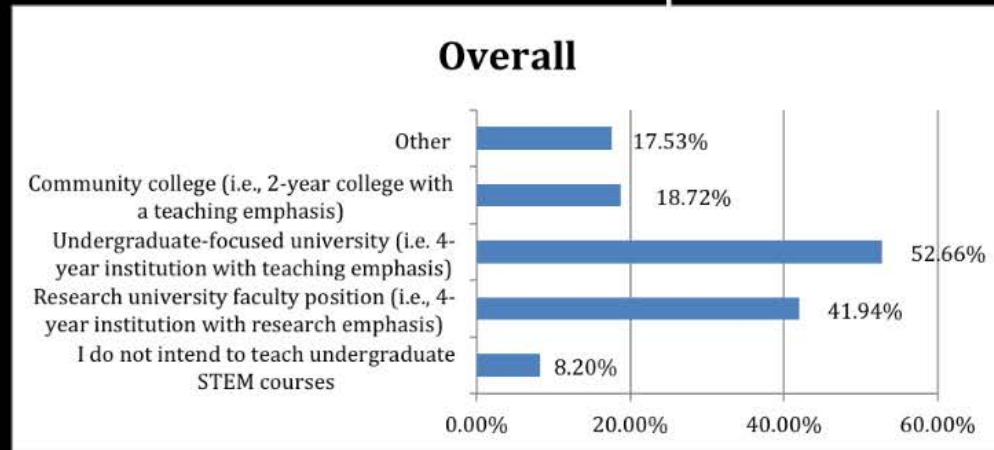
## Meeting large need of future faculty!

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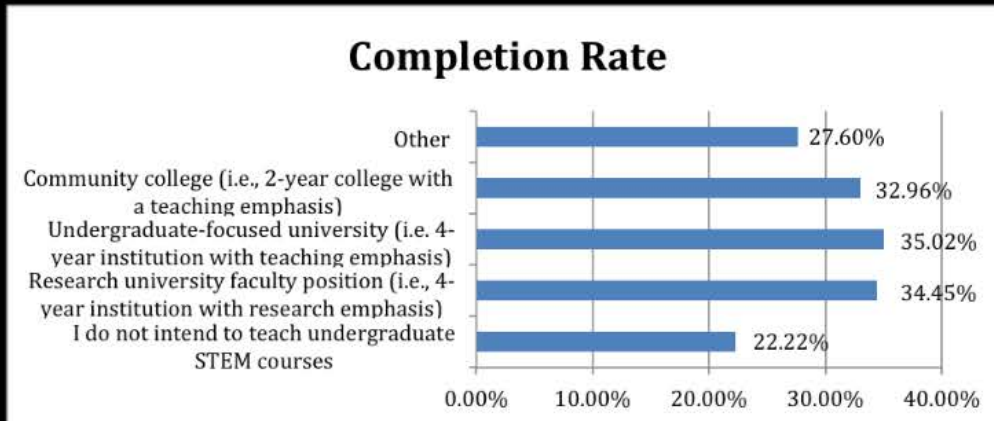
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# Overall intention to pursue

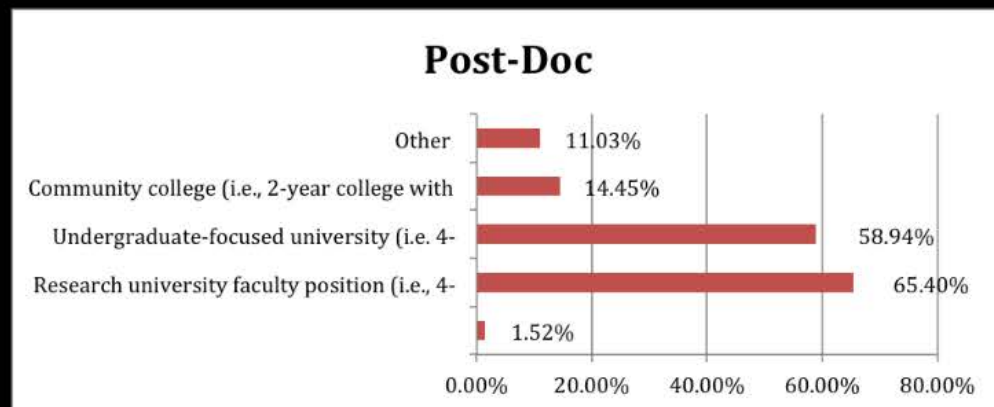
Participants' career goals are to be STEM faculty



Participants complete with small preference those who want to be STEM faculty



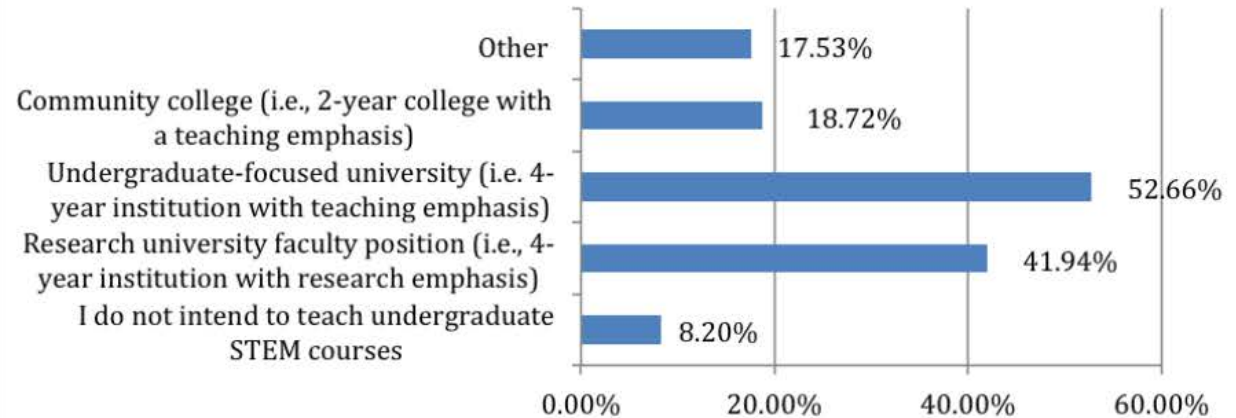
Postdocs are focused on careers as STEM faculty



# Overall intention to pursue

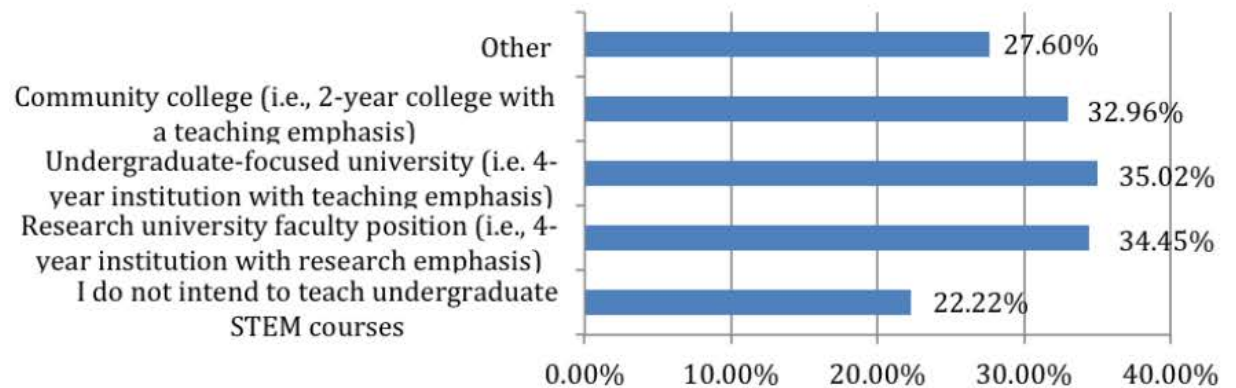
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## Overall



Participants complete with small preference those who want to be STEM faculty

## Completion Rate

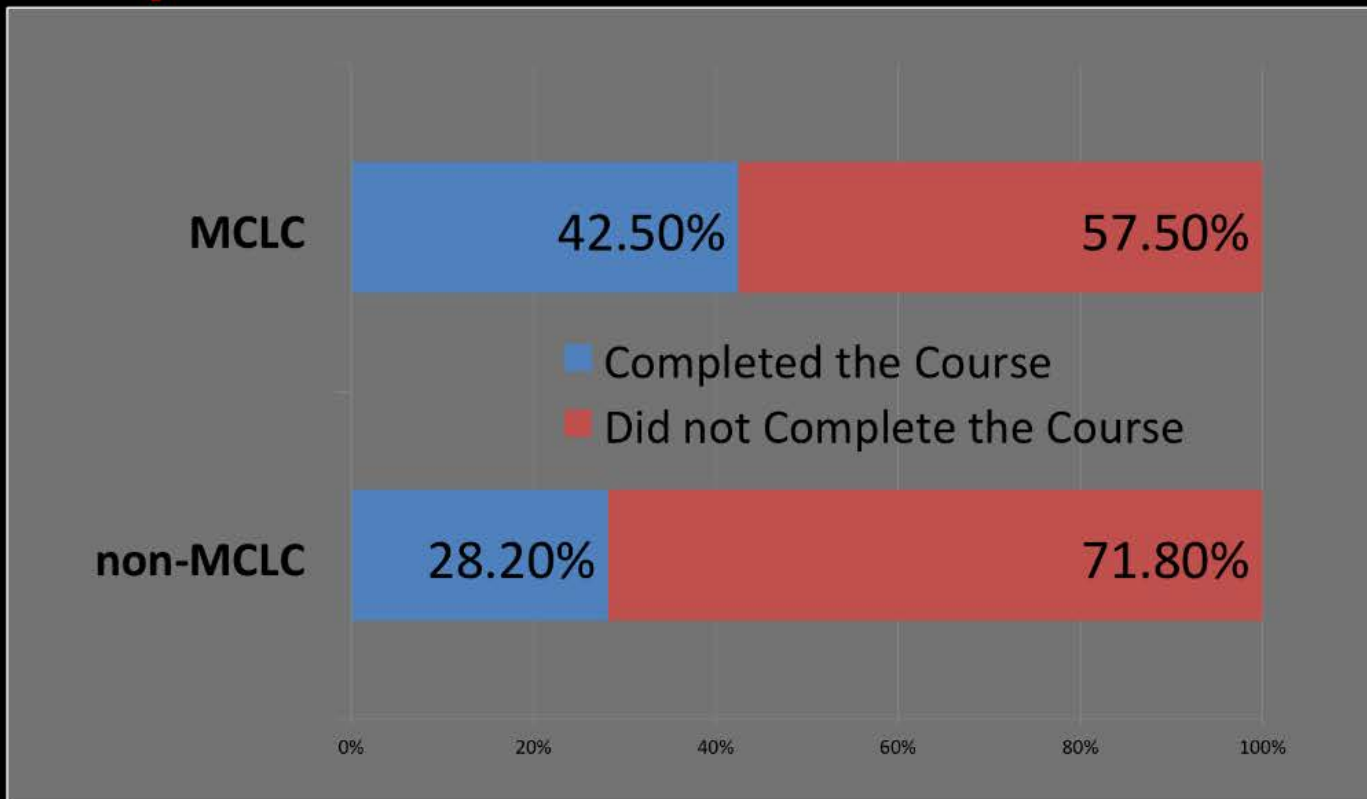


## Post-Doc



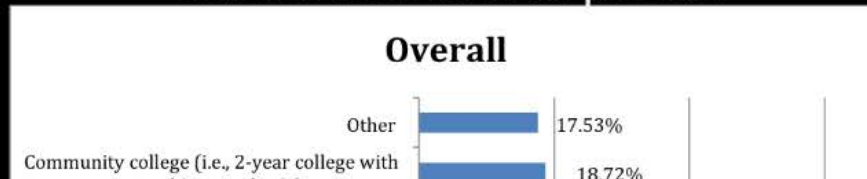
Being in an MCLC increased your completion by 1.5-2.0 times, whether you intended to complete or not

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**Table 1:** Co  
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Overall intention to pursue



Leveraging  
 Using t  
 Applying in

# Best aspects of the MCLC experience for participants?

92% Interacting with peers

86% Meeting others interested in teaching

75% Discussing course material & assignments

72% Discussing teaching topics beyond the MOOC

Source: Post-Course Survey (response rate = 12%)

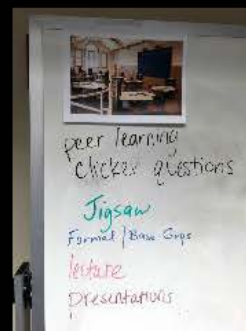
Given what you've heard about  
MOOC and its MCLCs, v

# MCLC Facilitator Survey (n=24)



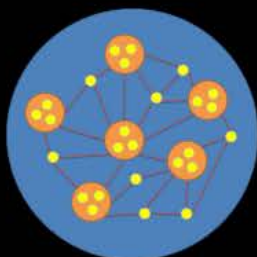
**Most facilitator prep time was spent deciding what topics, videos, and discussions to prioritize.**

"There was much more material than we could cover in an hour meeting so it was important for the participants to focus on what we would discuss during the meeting."



**Most (68%) selected activities from the facilitator's guide. Some (29%) just used the guide for inspiration.**

A common request: "Early communication, even earlier access to the videos than the students, and more complete facilitator notes would be immensely beneficial."



**Facilitators were of mixed opinions on the value of the global learning community to their local ones.**

"Yes. It is valuable to hear from other students and educators for a varied, diverse perspective."

"Some students engaged in the online forum earlier on in the MOOC; however, as time went on, it seemed apparent that the online discussion board was not used by our participants."

"We were all very pressed for time, and I think most of us prioritized the in-person MOOC over the online forum since it was nice to be able to discuss things in person."



**Several facilitators pointed to the value of local learning communities.**

"Being at a research intensive institution, it's been difficult to find and connect with other graduate students who are interested in education and teaching as a future career. This learning community allowed us to meet and connect and, hopefully, will serve as the start of an education interest group."

"Our participants reported that the primary benefit of the MCLC was accountability to actually watch the videos and stay current with the course, and secondarily growing our local STEM teaching community."



**Almost all facilitators said they would use MOOC content in other contexts.**

"The videos are much more accessible than, say, assigning a reading on the same content. So I would appreciate being able to use the videos to help participants prepare for a workshop or class discussion."

"Actually I [already] have. I was giving a talk about diversity a few weeks ago... I used Mark Connolly's two videos about 'talking about leaving' - they were perfect."



1 - Principles of Learning  
Derek Bruff  
Vanderbilt U.



2 - Learning Objectives  
Stephanie Chasteen  
U. Colorado - Boulder



3 - Assessment  
Angela Little  
U. California - Berkeley



4 - Cooperative Learning  
Rogue Campa  
Michigan State U.



5 - Peer Instruction  
Bennett Goldberg  
Boston University



6 - Lecturing  
Derek Bruff  
Vanderbilt U.



7 - Inquiry-Based Labs  
Cynthia Braine  
Vanderbilt U.



8 - Writing to Learn  
Janet Littlell  
U. Pittsburgh



9 - Problem-Based Learning  
Rogue Campa  
Michigan State U.



10 - Inclusive Teaching  
Itey Mack  
Vanderbilt U.



11 - Student Motivation  
Derek Bruff  
Vanderbilt U.



Intros & Outros  
Trina McMahon, UW-Madison  
Derek Bruff, Vanderbilt U.

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peer learning  
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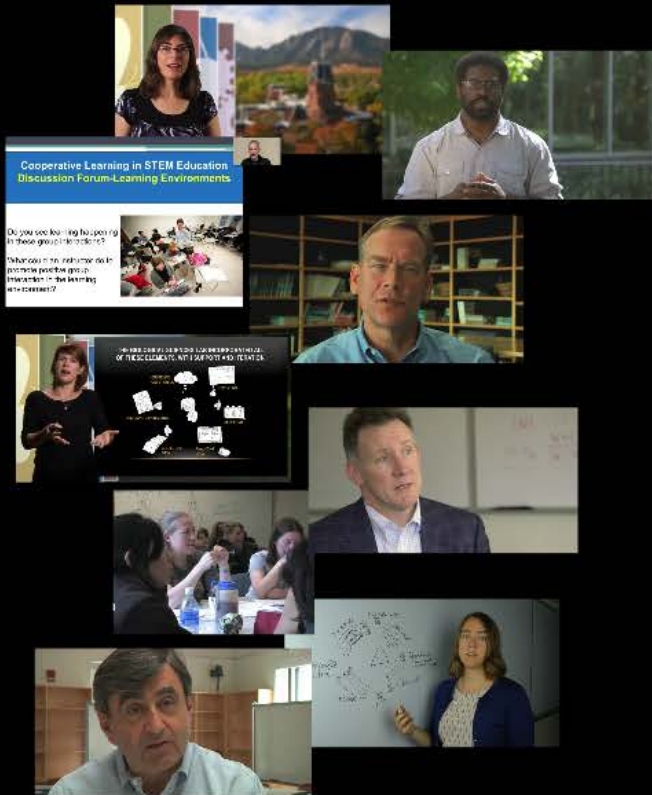
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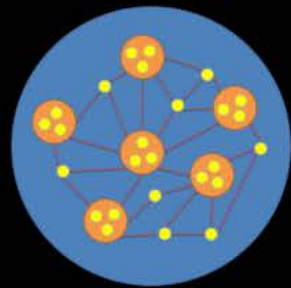
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# The future of STEM education: Preparing the next generation of faculty

## Challenge:

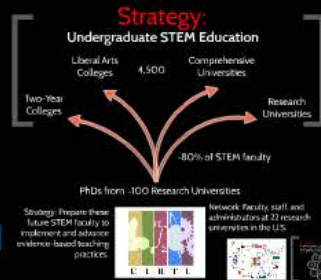
The challenge in undergraduate STEM education now lies less in knowing what works and more in getting people to use proven techniques.

-Forsheimer 2008  
-PCAST 2012

Center for the Integration of Research, Teaching and Learning

### Mission Statement:

To develop a STEM faculty committed to implementing and advancing effective teaching practices for diverse student audiences as part of their professional careers.



### Best aspects of the MCLC experience for participants?

- 95% Interacting with peers
- 84% Meeting others interested in teaching
- 72% Discussing course materials & assignments
- 71% Discussing teaching, research beyond the MOOC

To analyze: What effects did MCLC participation have on behaviors and outcomes in the MOOC?

Given what you've heard about the MOOC and its MCLCs, what predictions would you make for this experiment?

### MCLC Facilitator Survey (n=24)

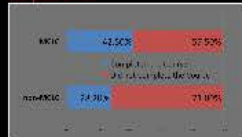
MOOC  
Individual Participant

MOOC-Centered Learning Community  
aka Distributed Flip  
aka DOCC  
See <http://coursera.org/7a-2111>

(Not to Scale)

## CIRTL MOOC Outcomes

Being in an MCLC increased your completion by 1.5-2.0 times, whether you intended to complete or not



- Postdocs completed at ~50%
- Grad students completed at ~40%
- Meeting large need of future faculty!

Category	Completed	Did not complete
Postdoc	50%	50%
Grad student	40%	60%

### Metrics and Research Questions:

#### Measurements:

- Completion rates
- Individual or Group participant
- Intention to complete
- Learning activities during course

#### Questions:

- Who were high completers and why?
- Does being in a learning community affect completion?
- Does intention impact actual completion?
- Correlations among learning activities

• The number of participants who watched at least one video was 2100. If they watched one video, they completed on average 5% of the videos, based on regression.

• The number of participants who completed one quiz was 1111. If they completed one quiz, they completed 65% of the quizzes and watched 51% of lectures on average.

## Bennett Goldberg

### CIRTL Core Ideas:

**Teaching-as-Research** is the deliberate, systematic, and reflective use of research methods to develop and implement teaching practices that advance the learning experiences and outcomes of both students and teachers.  
⇒ STEM professor as change agent

**Learning Communities**: bring together groups of people for shared learning, discovery, and generation of knowledge.  
⇒ Supports growth in teaching and learning

**Learning-through-Diversity** capitalizes on the rich array of experiences, backgrounds, and skills among STEM undergraduates and graduates-through-faculty to enhance the learning of all.  
⇒ Excellence and diversity are necessarily intertwined



### CIRTL Outcomes:

#### CIRTL Outcomes - Early Career Faculty

Participants use skills to foster student success in writing, classroom management, and other classroom teaching activities.  
Participants have been able to teach better. They are able to give better feedback. They are able to give better feedback. They are able to give better feedback.

#### Growth in participation



#### Longitudinal study of outcomes

Participants have been able to teach better. They are able to give better feedback. They are able to give better feedback. They are able to give better feedback.

#### CIRTL local (2016-18)

2700 CIRTL Associates  
600 CIRTL Practitioners  
150 CIRTL Scholars

#### 2013 - NSF WIDER CFP

WIDER seeks to substantially increase the scale of application of highly effective methods of STEM teaching and learning on millions of future educators, by employing instructional materials and methods that have a convincing evidence-based effectiveness.

## MOOCs as Networks of Local Learning Communities

An Experiment in Preparing Future Faculty



"An Introduction to Evidence-Based Undergraduate STEM Teaching" @CIRTLMOOC



### CIRTL MOOC Participation

5908 Enrolled Students  
4009 Active Students  
566 Statements of Accomplishment  
14% Completion Rate



45% Female  
55% Male  
7% Prefer not to say  
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9% Instructional staff  
33% Biological sciences  
25% Physical sciences  
12% Engineering  
20% Earth sciences  
4% Mathematics  
4% Computer science  
4% Social sciences  
70% United States  
21% Canada  
7% Other  
9% Accredited college degree  
20% Otherwise

What comes to mind when you hear the word "MOOC"?