Design-Based Implementation Research for Improving Undergraduate STEM Education

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Design-Based Implementation Research

An approach to research and development

focused on addressing persistent problems of practice

from multiple stakeholders points of view

that engages educators, subject matter specialists, and educational researchers in collaborative, iterative design

and that develops knowledge and theory while also building capacity for continuous improvement
Design-Based Implementation Research

An approach to research and development

Answers the question: How do we organize our effort to improve an educational system

Encompasses a range of more specific methodologies, such as improvement research, design-based research

Embraces multiple methods, including (when appropriate) experimental studies of impact

Relevance is an important criterion for rigor
Design-Based Implementation Research

An approach to research and development focused on addressing persistent problems of practice from multiple stakeholders points of view.

The focus of the research and development is squarely on the improvement of practice.

The focal problem is the “presenting problem of practice.”

The “problem” definition should be agreed upon by key stakeholders.

Negotiating the definition of the problem takes time and benefits from specific tools and routines.
Design-Based Implementation Research

A research and development approach focused on addressing persistent problems of practice from multiple stakeholders' points of view that engages educators, subject matter specialists, and educational researchers in collaborative, iterative design and that develops knowledge and theory while also building capacity for continuous improvement.

Iteration is key to improvement: Get it mostly right fast.

Collaboration is required, because implementation requires ownership and generates new dilemmas that practitioners can help solve.

Design embodies specific conjectures about how best to support learning across levels.

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Knowledge, theory, and practices can all be products of DBIR.

Theories that are useful span multiple levels of educational systems: classroom, faculty department, university, professional associations.

Capacity building is a goal and requires new skill development for both research and practice.

In DBIR, capacity building can entail a continuous but evolving partnership.

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Example:
Learning Assistant Model

LA Program Goals

- Discipline-Based Educational Research
- Teacher Recruitment & Preparation
- Undergraduate Course Transformation using LAs
- Transformation of Departmental Cultures
# Improving STEM Teaching: Negotiating the Problem

<table>
<thead>
<tr>
<th>Stakeholder Group</th>
<th>Aim</th>
<th>Challenge</th>
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<tbody>
<tr>
<td>Faculty</td>
<td>Provide “permission” and incentives to transform undergraduate courses</td>
<td>Lack of external reward or incentive for course transformation; resources; few opportunities to participate in faculty development</td>
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<td></td>
<td>Increase awareness and agency in educational change</td>
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<tr>
<td>Student Learning Assistants</td>
<td>Increase awareness about educational issues and agency in educational change</td>
<td>Faculty not as familiar with learning theories and pedagogical strategies; clickers are misused</td>
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<tr>
<td>Program leaders</td>
<td>Participate in collaboratives that result in the building and continued support of leaders in educational change on the local and national scale</td>
<td>Low value assigned to improving teaching (departmental norms). Institutional rewards and incentives are poorly aligned.</td>
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Collaborative Program Design

• Science, Math & Engineering research faculty and School of Education faculty, as well as grad/undergrad students are involved in design and redesign of key program elements.

• Strategic involvement of Provost, Deans, Department Chairs, and university-level administrators to provide strategic support
  – University and department policies and norms are integral targets of iterative design, when institutional challenges are uncovered.
Building Knowledge and Theory

- Evidence indicates that Learning Assistant Program can improve learning outcomes for students in classes with LAs....
Building Knowledge and Theory

- The fact that it is growing within CU and expanding to other institutions provides a diversity of contexts, so we can design research to learn from variation....
Building Knowledge and Theory

PROGRAM CONTEXT

Institutional and Organizational Supports
- Classroom spatial arrangements
- Tenure and promotion policies
- Departmental norms
- Status of Teaching Positions
- Continuous Improvement Process for LA program

Faculty Characteristics
- Disciplinary home
- Pedagogical approach
- Beliefs and knowledge about learning in disciplines

Individual Characteristics
- Content knowledge
- Empathy for student struggles

EMBODIMENTS OF DESIGN PRINCIPLES

Department Coordinators Group
- Building collective agency for change

Faculty Development Activities

LA Responsibilities
- Leading recitations
- Lesson Redesign
- Weekly meetings

LA Learning Opportunities
- Course teaches both theory and practical skills for leading discussions, assisting problem solving

OUTCOMES

Institution-Wide Transformation of STEM Teaching and Learning
- More interactive, student centered teaching in lectures and recitations
- Improved student learning
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**Space of Intervention and Research**
## Building Knowledge and Theory

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### Faculty Characteristics

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- Beliefs, knowledge, experience about learning in disciplines

### Individual Characteristics

- Content knowledge
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### Space of Intervention and Research

- **Explain variation in teaching in relation to variation in implementation and context**
- **Use analysis to inform iterative design**

**LA Learning Opportunities**
- Weekly meetings

Building Capacity

• Strengthening cycle of improvement through implementation research

• Supporting a network of LA programs at multiple institutions worldwide “Learning Assistant Alliance”

• Supporting a network of educational change leaders through LA model – Regional Workshop Leadership Team at universities throughout the nation

• Leadership built through mentoring at institution and regional scale.
Thanks

Laurie Langdon, Co-Director Learning Assistant Mode, School of Education University of Colorado Boulder
For More

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Colorado LA Model: [http://laprogram.colorado.edu](http://laprogram.colorado.edu)

International LA Alliance: [http://www.learningassistantalliance.org](http://www.learningassistantalliance.org)
LA Model - Mission

To develop, influence, and empower agents of change among different stakeholders in science, math, and engineering education by influencing norms, practices, and values among participants.

The change we seek is equitable science education especially for students from groups traditionally underrepresented in these disciplines, where the discipline is the mechanism, rather than the obstacle, for connecting to the lives and loves of the people.

Stakeholders: science teacher educators, policy makers, funding agencies, and science educators and their students at all levels, K-20