

Design-Based Implementation Research for Improving Undergraduate STEM Education

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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



An approach to research and development

foc 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

and that develops knowledge and theory while also building capacity for continuous improvement



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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.



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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An approach to research and development

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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Improving STEM Teaching: Negotiating the Problem

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



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 of iterative design, when institutional challenges are uncovered.



• Evidence indicates that Learning Assistant Program can improve learning outcomes for students in classes with LAs....





• 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....



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



OUTCOMES PROGRAM CONTEXT EMBODIMENTS OF DESIGN PRINCIPLES Institutional and Organizational **Supports** Department Classroom spatial arrangements **Coordinators Group** Tenure and promotion policies Building collective agency for Institution-Wide **Space of Intervention and Research** St Transformation of Faculty Development **STEM Teaching** program **Activities** and Learning More interactive, student LA Responsibilities centered teaching in **Faculty Characteristics** Leading recitations lectures and recitations **Disciplinary home** Lesson Redesign Improved student Pedagogical approach Weekly meetings learning Beliefs and knowledge about learning in disciplines LA Learning **Opportunities** Individual Characteristics Course teaches both theory Content knowledge and practical skills for leading Empathy for student struggles

solving

discussions, assisting problem



OUTCOMES PROGRAM CONTEXT EMBODIMENTS OF DESIGN PRINCIPLES Institutional and Organizational **Supports** Department Classroom spatial arrangements **Coordinators Group** Tenure and promotion policies Building collective agency for Institution-Wide **Space of Intervention and Research** St **Transformation of** Explain variation in teaching in **STEM Teaching** program relation to variation in and Learning More interactive, student implementation and context centered teaching in Faculty Characteristi Use analysis to inform iterative lectures and recitations **Disciplinary home** Improved student design Pedagogical approach learning Beliefs, knowledge, experience about learning in disciplines LA Learning **Opportunities** Individual Characteristics Course teaches both theory Content knowledge and practical skills for leading Empathy for student struggles discussions, assisting problem

solving

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

University of Colorado Boulder





For More

| R+P Collaboratory | DBIR |
|--------------------------|-----------------------------|
| Website | Website |
| <u>http://</u> | <u>http://learndbir.org</u> |
| researchandpractice.org | |

TwitterTwitter@RPCollaboratory@LearnDBIR

Colorado LA Model: <u>http://laprogram.colorado.edu</u>

International LA Alliance: <u>http://www.learningassistantalliance.org</u>





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

