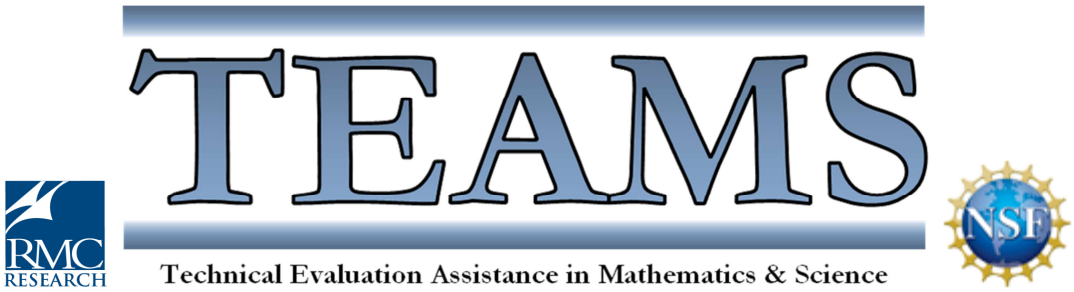

PROMOTING RESEARCH AND INNOVATION IN METHODOLOGIES FOR EVALUATION (PRIME) PROJECT SUMMARIES

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PROJECT DESCRIPTION

The Technical Evaluation Assistance in Mathematics and Science (TEAMS) project (DRL#1238120) is funded under the National Science Foundation (NSF) Mathematics and Science Partnership (MSP) Research Evaluation and Technical Assistance (RETA) program. TEAMS began operations in May 2013 with the specific goal to: *Strengthen the quality of MSP project evaluation and build the capacity of evaluators by strengthening their skills related to evaluation design, methodology, analysis, and reporting.* Any opinions, suggestions, and conclusions or recommendations expressed in this paper are those of the TEAMS project and do not necessarily reflect the views of the NSF; NSF has not approved or endorsed its content.

DOCUMENT PURPOSE

The purpose of this document is to outline and share resources from Promoting Research and Innovation in Methodologies for Evaluation (PRIME) funded projects that may be helpful to Mathematics Science Partnership (MSP) evaluators. PRIME projects are funded by NSF. PRIME funding supports research that promotes creative methodological and evaluation approaches that build on and create new opportunities to examine science, technology, engineering, and mathematics (STEM) education projects and programs. To learn more about PRIME funding please visit the PRIME website: http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503586.

PROMOTING RESEARCH AND INNOVATION IN METHODOLOGIES FOR EVALUATION (PRIME)

NSF is the premier Federal agency supporting research at the frontiers of knowledge, across all fields of STEM and all levels of STEM education. NSF enables innovation and discovery in STEM by educating and preparing a diverse, world-class STEM workforce of people who are motivated to participate at the frontiers of science. STEM education and workforce development programs are rooting their approaches in the learning sciences, neuroscience, and other research literatures; investigating cognitive development, motivation, social interaction, and the nature of learning in diverse contexts; and utilizing

cutting-edge, evidence-based approaches to engage the public and broaden the future scientific workforce at all levels of the STEM education enterprise (NRC, 1999; NRC, 2007; NRC, 2009).

The new developments in STEM education and workforce development, along with increasing pressures for accountability, challenge evaluators to develop innovative evaluation approaches, questions, theories, methodologies, measures, analytic tools and reporting formats. Evaluation theory and practice need to complement innovations in STEM education and human resource development in order for program evaluations to inform decision making, meet accountability requirements, and provide useful information for program improvement.

The PRIME program seeks to advance evaluation theory and practice across all levels of the STEM education enterprise in both formal and informal settings. PRIME calls for studies with special emphasis on developing innovative STEM evaluation methodologies and identifying ways to measure or demonstrate the impacts of STEM education programs. Approaches are encouraged that address new ways to conceptualize evaluation, such as a focus on themes of national importance (e.g., teacher education, cyberlearning, innovation) rather than on particular projects or programs. Other areas of interest include assessing the cumulative effects of engaging in STEM programs over time or determining impact in the context of complex and multivariate causation that is inherent to STEM learning in real-world settings.

The overarching goal of the PRIME program is to support the development, demonstration, and validation of innovative new methodologies and approaches in STEM evaluation. To address this goal, the program is interested in proposals that:

1. Explore innovative new approaches for determining the impact and usefulness of evaluations of STEM education projects or programs, with appropriate rigor.
2. Expand the theoretical foundations for evaluating STEM education and human resource initiatives, including translating approaches from other fields.
3. Increase the capacity of and infrastructure for researchers and evaluators by increasing the number of individuals who can produce conceptually sound and methodologically appropriate evaluations of STEM education and workforce projects, portfolios, and programs.

On the following pages are brief descriptions of projects funded beginning in 2010 under the PRIME program. The projects are developing methodologies, tools, measures, and techniques that can contribute to the evaluation rigor of STEM projects. The TEAMS project staff reviewed each of these projects to prepare information that can raise the awareness of project evaluators regarding emerging methodologies and approaches in STEM evaluation.

On the next page is a listing of the content of the document structured around the focus area for each project. If you click on the topic link, it will take you to the project focusing on that topic. Within each project summary, you will find the same format:

- What's it about? – provides a brief description of the focus of the project;
- What's new? – describes what the project is developing that has application and utility for MSP project evaluation;
- Resources – identifies any resources or materials that are accessible from this project; and
- For More Information – provides contact information for the project principal investigator(s) (PIs) and a website url, if available.

CONTENTS

DIVERSITY

WHAT'S IT ABOUT?

NSF values developing a more diverse STEM workforce. Many programs can contribute toward this aim, but they must think and act intentionally with respect to engaging a diverse base of participants and have evaluation methods targeted toward the needs, issues, and goals of various subgroups.

WHAT'S NEW?

The *What Works for Whom in What Context: A Practical Guide to Conducting Evaluations with Diverse Populations* project (DRL#1146249) is creating guidelines for the evaluation of projects that develop the diversity of the STEM workforce, along with materials about designing, implementing, and assessing the quality of projects and activities that broaden participation in STEM education.

RESOURCES

Beyond Rigor: Improving Evaluations with Diverse Populations. This website includes tips for evaluations with diverse populations, presented in a quick, slide-like format. Tips cover data, analysis, context, and funder considerations. The website also includes a list of other resources on this topic.

FOR MORE INFORMATION

PRIME Project	What Works for Whom in What Context: A Practical Guide to Conducting Evaluations with Diverse Populations
Principal Investigators	Eric Jolly Patricia Campbell
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Phone number	(651) 221-9444 (800) 221-9444
Website	http://www.beyondrigor.org

ANCHORING VIGNETTES

WHAT'S IT ABOUT?

Self-reports of teachers' instructional practices are not always reliable as teachers may have different standards against which they rate themselves. Anchoring vignettes are short stories or videos that can be used to provide a common reference standard for making judgments.

WHAT'S NEW?

The *Using Anchoring Vignettes to Improve Measures of Teaching Practice* project (DRL#1237543) is investigating the extent to which anchoring vignettes can improve the quality of teachers' self-report of six different instructional practices. The anchoring vignettes are based on videos collected for the Bill and Melinda Gates Foundation Measures of Effective Teaching project.

RESOURCES

Using Anchoring Vignettes to Calibrate Teachers' Self-Assessment of Teaching. This submission to the 2014 Society for Research on Educational Effectiveness (SREE) conference outlines the project's study design and findings. Available at: https://www.sree.org/conferences/2014s/program/downloads/abstracts/1094.pdf

Using Anchoring Vignettes to Improve Survey Measures of Teachers' Mathematics Instructional Practices. This webinar is scheduled for March 3, 2016. High-quality measures of instructional practice are essential for research and evaluation of innovative instructional policies and programs, as well as for providing feedback to teachers and administrators. However, existing measures have generally proven inadequate because of cost and validity issues. To address this problem, the webinar presenters developed vignette-based teacher survey self-report measures of ambitious mathematics instructional practices aligned with Common Core State Standards. Teachers read several contextualized "vignettes" describing hypothetical teachers engaged in a particular instructional practice, with vignettes varying in terms of the extent of that practice. Then, teachers rate the extent to which the hypothetical teachers in the vignettes were engaged in that practice. Lastly, teachers rate the extent to which they engaged in that practice themselves in a recently-taught lesson. Teachers' ratings of the vignettes are used to "calibrate" – or adjust – teachers' self-ratings to be more accurate. The webinar recording will be available for download at http://teams.mspnet.org/index.cfm/webinars

Vignettes. The project developed vignettes will be available to the public at the conclusion of the project.

FOR MORE INFORMATION

PRIME Project	Using Anchoring Vignettes to Improve Measures of Teaching Practice
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SYSTEMS ORIENTATION

WHAT'S IT ABOUT?

Many times interventions are embedded in a complex set of interconnected parts. Due to all the moving pieces of the system, interventions can have unexpected results if an evaluation focuses narrowly on only one part of the system. Considering the system as a whole provides a better understanding of the context of the intervention, as well as insight into why an intervention may lead to the intended or unintended effects observed.

WHAT'S NEW?

The *Evaluation Communities for Learning, Inquiry, and Practice about Systems* project (DRL#1118819) is developing a set of materials to introduce evaluators to integrating a systems orientation into their evaluations. The project is piloting these educational materials with six to eight STEM education evaluators and investigating how a systems approach can improve the effectiveness of evaluations.

RESOURCES

Building a Culture of Inquiry through Communities of Learning, Inquiry, and Practice. A series of online videos that introduce the design and operation of communities of learning, inquiry, and practice (CLIPs), through which members conduct collaborative inquiry to enhance their professional practice.

Using Complexity Science Concepts When Designing System Interventions and Evaluations. A brief summary of key concepts from complexity science for use in designing or evaluating interventions in large systems.

Questions that Matter: A Tool for Understanding Dynamics in Complex Situations. A checklist of key questions to guide thinking about the boundaries, relationships, and perspectives involved in a given system.

Designing Initiative Evaluation: A Systems-Oriented Framework for Evaluating Social Change Efforts. A guidebook for evaluating large-scale initiatives using a systems orientation.

Promoting and Assessing Value Creation in Communities and Networks: A Conceptual Framework. A detailed description of a framework for thinking about the value provided by communities of practice. The framework analyzes the value of such communities in terms of: immediate value, potential value, applied value, realized value, and reframing value.

Using the Visibility and Depth Iceberg Diagram to Understand Complex Systems. A description of the iceberg as metaphor for the visible and invisible elements of interventions in complex systems, including activities and results; patterns; norms, infrastructures, and policies; principles; and paradigms.

Theory of Change in Complex Systems: Strengthening Families Example. An empirical example of the development of a theory of change for an intervention designed to initiate change in the complex system surrounding child maltreatment.

Evaluative Inquiry for Complex Times. An article that describes how and why evaluative inquiry—a process for members of an organization to systematically investigate important questions—enhances the ability of an organization to respond to challenges. The article is intended to help readers adapt the approach to their own contexts.

Challenges and Successes Associated with Introducing Systems Concepts to an Existing Evaluation. A conference PowerPoint presentation about applying the concepts of boundaries, relationships, and perspectives to evaluations.

Leverage Points: Places to Intervene in a System. A conference PowerPoint presentation about finding places in systems where small changes can have big effects.

Blurring the Lines: The Process of Applying Systems Thinking to an Ongoing Evaluation. A conference PowerPoint presentation that looks at the role of the evaluator in a systems-based evaluation from a systems perspective.

FOR MORE INFORMATION

PRIME Project	Evaluation Communities for Learning, Inquiry, and Practice about Systems (ECLIPS)
Principal Investigators	Beverly Parsons Pat Jessup Marah Moore
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Phone number	(970) 226-1003
Website	http://www.insites.org/clip/index.html http://www.insites.org/CLIP_v1_site/index.html http://www.insites.org/evaluations-and-resources/building-evaluation-capacity-through-communities-of-practice/eclips

FIDELITY OF IMPLEMENTATION

WHAT'S IT ABOUT?

Investigating the extent to which a stated program design was implemented (fidelity of implementation) is important for interpreting and contextualizing evaluation results. Fidelity of implementation is particularly important for multi-site programs in which different sites may make different implementation decisions. Examining fidelity of implementation can help to illuminate differences in outcomes for participants at different sites.

WHAT'S NEW?

The *Rigorous Measures of Implementation: A Suite of Tools for Evaluating STEM Instructional Materials Use* project (DRL#1118866) is conducting field-test studies on a suite of fidelity of implementation instruments to determine and enhance their usability for STEM education evaluations on the ground, as well as to demonstrate and further develop the theory behind the instruments.

RESOURCES

Conceptual Framework for Fidelity of Implementation. This brief provides an overview of the project's conceptual framework for fidelity of implementation of instructional materials based on procedural and educative structural components and pedagogical and student engagement instructional components. Download at: http://cemse.uchicago.edu/research-and-evaluation/research/foi/project_brief_1.pdf

Defining and Identifying Critical Components of Reform-Based Mathematics and Science Materials. This brief describes the project's process for identifying the critical components in instructional materials from the fidelity of implementation conceptual framework. Download available at: http://cemse.uchicago.edu/research-and-evaluation/research/foi/project_brief_2.pdf

A framework for measuring fidelity of implementation: A foundation for shared language and accumulation of knowledge. This academic article describes the project's framework for fidelity of implementation, including its development and connection with existing literature. Century, J., Rudnick, M., & Freeman, C. (2010). *American Journal of Evaluation, 31,* 199–218. doi:10.1177/1098214010366173.

FOR MORE INFORMATION

PRIME Project	Rigorous Measures of Implementation: A Suite of Tools for Evaluating STEM Instructional Materials Use
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Phone number	(773) 834-2778
Website	http://cemse.uchicago.edu/research-and-evaluation/research/create-instruments

CLUSTER RANDOMIZED TRIALS

WHAT'S IT ABOUT?

In randomized experiments for some interventions, participants cannot be assigned individually to different treatments, but must be assigned as groups, such as classrooms or schools. Planning such studies should consider the statistical power that the experimental design may yield, but computing power for cluster randomized trials requires estimates of the variability within the groups and correlations with covariates.

WHAT'S NEW?

The *Advancing Methodological Knowledge in STEM Education Research: An Empirical Investigation of Design Parameters for Planning Cluster Randomized Trials in Science Education* project (DRL#1118555) is building on previous work related to a no-cost power analysis software package to assist in planning cluster randomized trials (*Optimal Design*). The project is taking a multifaceted approach to provide reasonable estimates of design parameters, including a meta-analysis of science education research to identify effect sizes, and analyses of state science data sets to identify intraclass correlations and correlations with covariates. The *Planning Cluster Randomized Trials: An Empirical Investigation of Design Parameters for Studies of Science Teacher Interventions* project (DRL#1544236) is developing a similar base of design parameter estimates for studies of teacher professional development.

The *Empirical Benchmarks of Design Parameters for Group Randomized Trials in Teacher Professional Development Intervention Studies* project (DRL#1405601) is developing estimates of the empirical benchmarks of design parameters to be used to structure evaluations of whole school professional development efforts in mathematics.

RESOURCES

An empirical investigation of variance design parameters for planning cluster-randomized trials of science achievement. This academic article provides estimates of cluster-randomized trial design parameters for science education programs and compares them with mathematics and reading programs. Westine, C. D., Spybrook, J., & Taylor, J. A. (2014). *Evaluation Review.* doi:10.1177/0193841X14531584

Considerations for designing group randomized trials of professional development with teacher knowledge outcomes. This academic article provides estimates of cluster-randomized trial design parameters for teacher professional development programs. Kelcey, B. & Phelps, G. (2013). *Educational Evaluation and Policy Analysis, 35,* 370-390. doi:10.3102/0162373713482766

Optimal Design with Empirical Information Software. This no-cost software package helps researchers plan cluster-randomized trials and includes empirical estimates of design parameters for interventions in elementary, middle, and high schools. Results from the *Advancing Methodological Knowledge* projects will be incorporated into a future version of this software. Available at the following site: http://wtgrantfoundation.org/FocusAreas#tools-for-group-randomized-trials

What's Missing in Reports and Articles? Results From Meta-analyses To Find Effect Sizes. This webinar presented information to MSP projects to increase the rigor of evaluation and research documentation. The presenters conducted synthesis studies in science education and documented the types of information that is frequently left out of reports and journal articles. The missing information is vital for determining effect sizes, comparing programs, supporting replication impact studies, and promoting the advancement of the field. Furtak, E., Kowalski, S., Martinez, A., Taylor, J., (2015, November 5). Webinar recording available at: http://teams.mspnet.org/index.cfm/webinars/webinar_info?id=462

FOR MORE INFORMATION

PRIME Project	**Advancing Methodological Knowledge in STEM Education Research: An Empirical Investigation of Design Parameters for Planning Cluster Randomized Trials in Science Education**
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E-mail address	skowalski@bscs.org
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Phone number	(719) 219-4148
Website	http://www.bscs.org/advancing-methodological-knowledge

PRIME Project	**Planning Cluster Randomized Trials: An Empirical Investigation of Design Parameters for Studies of Science Teacher Interventions**
Principal Investigators	Jessaca Spybrook Susan Kowalski Joseph Taylor Fatih Unlu
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PRIME Project	Empirical Benchmarks of Design Parameters for Group Randomized Trials in Teacher Professional Development Intervention Studies
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Phone number	(313) 577-5244

MEASURING SCIENTIFIC REASONING

WHAT'S IT ABOUT?

Science education programs are increasingly emphasizing acquisition of scientific reasoning skills over scientific content knowledge alone. Evaluations of science programs that focus on reasoning will need a high quality measure of scientific reasoning to determine how students' develop this skill over the course of the program.

WHAT'S NEW?

The *Linking Cognitive Science, Measurement Theory, and Evaluation Approaches to Assess Development of Scientific Reasoning* project (DRL#1118433) is developing and validating new measures of the scientific reasoning skills of control of variables and evaluating evidence based on rigorous modern instrument development techniques. The ultimate goal is to create an assessment system that will provide information to: (1) STEM researchers who want to understand how innovative technologies, instructional approaches, and/or teaching practices impact students' scientific reasoning abilities, and (2) teachers who need to understand how students are responding to particular aspects of inquiry instruction.

RESOURCES

Project Poster available (http://teams.mspnet.org/index.cfm/27180)

FOR MORE INFORMATION

PRIME Project	Linking Cognitive Science, Measurement Theory, and Evaluation Approaches to Assess Development of Scientific Reasoning
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Phone number	(612) 625-2046
Website	http://experts.umn.edu/grantDetail.asp?id=13651

MEASURING STUDENT MOTIVATION

WHAT'S IT ABOUT?

Motivation is a strong predictor of student engagement with learning and academic success.

WHAT'S NEW?

The *Validating a Rapid Measure of Student Motivation: Using the Expectancy-Value Theory of Motivation to Understand Student Achievement and Interest in STEM Classrooms* project (DRL#1228661) is developing a brief scale for measuring student motivation based on Expectancy-Value Theory.

RESOURCES

No resources are currently available from the project at this time.

FOR MORE INFORMATION

PRIME Project	Validating a Rapid Measure of Student Motivation: Using the Expectancy-Value Theory of Motivation to Understand Student Achievement and Interest in STEM Classrooms
Principal Investigators	Stephen Getty Joseph Taylor Christopher Hulleman Kenneth Barron
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E-mail address	chris.hulleman@virginia.edu
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Phone number	(434) 924-6998
Website	http://curry.virginia.edu/research/centers/castl/project/STEMmotivation

EVALUATING INNOVATION TRAINING

WHAT'S IT ABOUT?

Finding new solutions to persistent challenges requires innovative thinking. Some STEM programs, such as the NSF Integrated Graduate Education and Research Training (IGERT) program, aspire to increase the capacity of their participants for innovation. But, relatively little is known about the necessary skills for innovation and how best to train future innovators.

WHAT'S NEW?

The *Workshop: Educate to Innovate—What and How?* project (DRL#1241823) is drawing on the experience of leading innovators to discern experiences that best prepared them to innovate. The results will be used to develop a rubric for describing and assessing innovation training in NSF IGERT programs.

RESOURCES

The project website includes a number of resources (http://www.educatetoinnovate.org/resources) which include**:**

University Programs (sample) for innovation program

1. University of California, Berkeley. Program in Open Innovation. 2010. Available from: http://openinnovation.haas.berkeley.edu/
2. Darthmouth College. Ph.D. Innovation Program. 2010. Available from: http://engineering.dartmouth.edu/graduate/innovation/
3. University of Colorado at Colorado Springs. UCCS Bachelor of Innovation™ Family of degrees. 2010. Available from: http://innovation.uccs.edu/

Articles (sample)

1. Atkinson RD, Andes SM. The Atlantic century: Benchmarking EU and U.S. innovation and competitiveness. Washington, D.C.: European-American Business Council and The Information Technology and Innovation Foundation; 2009. Available from: http://www.itif.org/files/2009-atlantic-century.pdf
2. The Role of the National Science Foundation in the Innovation Ecosystem. Washington, D.C.: National Science Foundation Directorate of Engineering; 2010 Aug. Draft Report. Available from: http://www.nsf.gov/eng/iip/innovation.pdf
3. Measuring Innovation: A New Perspective. Organisation for Economic Co-operation and Development (OECD); 2010. Available from: http://www.oecd.org/sti/measuringinnovationanewperspective.htm

FOR MORE INFORMATION

PRIME Project	Workshop: Educate to Innovate—What and How?
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Phone number	(217) 333-6715
Website	http://www.educatetoinnovate.org

EVALUATING TEACHER EDUCATION

WHAT'S IT ABOUT?

Following calls for increased accountability for school and teacher performance, teacher education programs are beginning to be scrutinized for quality. Just as some teachers are being evaluated in part by the performance of their students, some have called for evaluation of teacher education programs on the basis of the quality of the teachers they graduate. Relatively little is known about how best to evaluate teacher education programs.

WHAT'S NEW?

The *Evaluation of Teacher Education Programs: Toward a Framework for Innovation* project (DRL#1153848) is conducting a synthesis of existing research on evaluation of teacher education programs in order to create a framework for recommending and investigating innovative approaches to evaluating these programs.

RESOURCES

2013 National Academy of Education (NAEd) Annual Meeting Plenary Sessions. Two 90-minute video recordings of the plenary session discussions of the project's work.

Evaluation of Teacher Preparation Programs: Purposes, Methods, and Policy Options. This report summarizes the current landscape of teacher preparation program evaluation, provides a framework for thinking about teacher education evaluation in the form of seven questions that guide the design of such an evaluation, and suggests four priorities for future research.

Variations in Teacher Preparation Evaluation Systems: International Perspectives. This paper surveys the range of teacher preparation evaluation systems used internationally, including a framework for categorizing systems by their various features and specific country case studies for the systems in Finland and Singapore.

Recent Developments in STEM Education Relevant to the Qualities of Teacher Preparation Programs. This paper examines teacher education evaluation from the perspective of STEM education programs, particularly in the evolving context of new science standards and initiatives to increase the corps of qualified STEM teachers.

FOR MORE INFORMATION

PRIME Project	Evaluation of Teacher Education Programs: Toward a Framework for Innovation
Principal Investigators	Michael Feuer Gregory White
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Phone number	(202) 994-6161
Website	http://naeducation.org/NAED_080456.htm

TRANSLATIONAL RESEARCH

WHAT'S IT ABOUT?

Ideally, new insights about education generated through the research process should make their way into educational practice to improve educational outcomes. For various reasons, research many times has little effect on actual practice. "Translational research" addresses the gap between research and practice by focusing on the adaptation of research into practice through a bi-directional cultural exchange in which both researchers and practitioners come to understand how the knowledge produced in each field can strengthen the other.

WHAT'S NEW?

The *Research+Practice Collaboratory* project (DRL#1238253) is working with leading professional associations and STEM improvement efforts to build sustainable strategies for closing the gap between research and practice through collecting translational research resources about STEM education, supporting cross-sector meetings to foster engagement and exchange, and developing new resources at adaptation sites.

RESOURCES

Organizing Research and Development at the Intersection of Learning, Implementation, and Design. This article describes design-based implementation research, an approach to the development and testing of innovations that focuses on: attending to persistent problems in practice from multiple stakeholders' perspectives; iterative, collaborative design; developing theory through systematic inquiry; and building capacity for sustainable systems change.

Research-Practice Partnerships: A Strategy for Leveraging Research for Educational Improvement in School Districts. This white paper provides an overview of school district partnerships, their challenges, and strategies for success.

CCSSM: Keeping Teaching and Learning Strong. This article suggests that the Common Core State Standards (CCSS) for Mathematics provide a framework for teaching that must be woven into grade-level content by developing constellations of Content and Practice Standards, putting mathematical thinking at the heart of each lesson.

Common Core Implementation Handbook. This workbook guides states and districts through a systematic and comprehensive way of thinking about implementation of Common Core State Standards-based policies.

CCSS Implementation Rubric and Self-Assessment Tool. This rubric complements the Common Core Implementation Handbook, providing a framework for thinking about and evaluating the quality of CCSS policy implementations.

Large-Scale Science Education Intervention Research We Can Use. This article describes design-based implementation research (DBIR), which focuses on implementation in both the initial testing of

interventions and in their scale-up, and outlines four aspects of DBIR that may improve the link between new standards for science education and an effective, equitable, and coherent system of opportunities for science learning.

Videos from the Critical Issues in Mathematics Education Workshop. These two videos discuss mathematical practices, a prominent feature of the Common Core State Standards for Mathematics.

FOR MORE INFORMATION

PRIME Project	**A Research+Practice Collaboratory**
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INTERACTIVE ASSESSMENTS

WHAT'S IT ABOUT?

New technologies are transforming student learning. Integrating technology into instruction also affords opportunities for new forms of interactive assessment of learning, but relatively few tools are in place to facilitate the development of these new assessments.

WHAT'S NEW?

The *Nimble Assessments: Tools for the Design and Analysis of Interactive Assessments* project (DRL#1228831) is developing and adapting tools to facilitate the design of interactive assessments of technology-enhanced learning. The project is enhancing an existing platform with authoring tools, a crowd sourcing dashboard to facilitate measure validation, and a data abstraction platform to assist in the collection and analysis of the rich corpus of data generated by interactive assessments.

RESOURCES

Measuring What Matters Most: Choice-Based Assessments for the Digital Age. This book argues that making good choices is the most important outcome of education that prepares students to act independently in the world. The book describes choice-based interactive assessments as a more-appropriate alternative to current knowledge-based assessments. Schwartz, D. L. & Arena, D. (2013). MIT Press. http://mitpress.mit.edu/books/measuring-what-matters-most

FOR MORE INFORMATION

PRIME Project	Nimble Assessments: Tools for the Design and Analysis of Interactive Assessments
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MEASURING STUDENT UNDERSTANDING OF DESIGN AND STUDENT REFLECTIVITY

WHAT'S IT ABOUT?

Practicing science is one of the most important goals of K-12 engineering education, which is now part of the Next Generation Science Standards. Although previous research suggests that engineering design is an effective pedagogical approach to promoting science learning, there are concerns about the "design-science gap" that fails science learning in design projects.

WHAT'S NEW?

The *Collaborative Research: Large-Scale Research on Engineering Design Based on Big Learner Data Logged by a CAD Tool* project (DRL#1348547, 1348530) used computer aided design (CAD) software, Energy3D, developed by the Concord Consortium to provide two innovative data sources for researchers/evaluators: (1) Energy3D allows students to record electronic reflective notes during the design process and (2) Energy3D records snap shots of the students' design processes that are later run as a slide show concurrently with the students' reflective notes to allow teachers, researchers, or evaluators to see what the students did and what they thought. Additionally the project adapted instruments to assess student understanding of design and student reflectivity.

RESOURCES

Exploring the Relationship Between Student Reflectivity and their Understanding of Informed Design. This paper describes how reflection is one of the key behaviors expert designers engage in. However, research on the reflectivity of student designers is limited. In the study, they investigated high school students' (*n* = 109) understanding of informed design in association with their reflectivity. Goldstein, M. H., Purzer, S., Adams, R. S., Xie, C. (2015). *Research in Engineering Education Symposium*, July 13-15, Dublin Ireland.

An exploratory study of informed engineering design behaviors associated with scientific explanations. This academic article describes how the study team examined the relationship between design behaviors and scientific explanations. Purzer, S., Goldstein, M. H., Adams, R. S., Xie, C., and Nourian, S. (2015). *International Journal of STEM Education. 2*(9). doi:10.1186/s4059401500197. Download at available at: http://www.stemeducationjournal.com/content/2/1/9

Informed Design Test. This test was developed by researchers[1] to assess student understanding of design. Students complete the test as a pre- and post-assessment. This project modified the test for

[1]Mosberg, S., Adams, R. S., Kim, R., Atman, C. J., Turns, J. & Cardella, M. (2005). Conceptions of the engineering design process: An expert study of advanced practicing professionals. *In Proceedings of the 2005 American Society for Engineering Education Annual Conference & Exposition.* Atman, C. J., Adams, R. S., Cardella, M., Turns, J., Mosborg, S., & Saleem, J. (2007). Engineering design processes: A comparison of students and expert practitioners. *Journal of Engineering Education, 96*(4), 359–379. Atman, C. J., Kilgore, D., and McKenna, A., (2008). Characterizing design learning: A mixed methods study of engineering designers' use of language. *Journal of Engineering Education, 97*(3), 309–326.

use in the Energy 3D environment and included design language applicable to secondary school students.

Scoring Protocol for Student Reflectivity. This protocol provides a means for scoring student reflectivity. The protocol was based on an existing framework for reflecting on practice[2].

FOR MORE INFORMATION

PRIME Project	Collaborative Research: Large-Scale Research on Engineering Design Based on Big Learner Data Logged by a CAD Tool
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[2] Bain, J.D., Ballantyne, R., Mills, C. & Lester, N.C. (2002) Reflecting on practice: Student teachers' perspectives, Post Pressed: Flaxton, Qld

MATHEMATICAL KNOWLEDGE FOR TEACHING

WHAT'S IT ABOUT?

Harvard University, the University of Michigan, and Brigham Young University are conducting research on the relationship between mathematical knowledge for teaching (MKT), teaching practice, and student outcomes. This work has taken place in the context of a cluster randomized trial of a popular professional development program.

WHAT'S NEW?

The *Investigating the Effect of Professional Development, Mathematical Knowledge for Teaching, and Instruction on Student Outcomes* project (DRL#0918383) has supported the development of several measures and other resources for the research community. These include a student assessment for fourth and fifth grade, new measures of teachers' knowledge of students and content, a framework for analyzing null results, and a video library.

RESOURCES

It's Analysis Time for Your Experimental Study and There is No Significant Effect, Now What? This TEAMS webinar addresses steps that researchers can take to investigate and understand a null result when evaluating a professional development program. Hill, H., (2015, December 5). Webinar recording available at http://teams.mspnet.org/index.cfm/webinars/webinar_info?id=491

Teachers' Knowledge of Students: Defining a Domain. In this paper the study team describes and evaluates two metrics that tap teachers' knowledge of their students' mathematical thinking. These measures capture teacher accuracy in predicting student performance and, following Sadler et al. (2013)[3], teacher knowledge of student misconceptions. Specifically, the research team asks: (1) How well do these metrics differentiate among teachers? (2) Do teachers' scores on these measures show evidence of convergent and discriminant validity? (3) How well, if at all, do scores on these constructs predict student outcomes? Hill, H., Chin, M., & Blazar, D. (2015). Presented at the American Educational Research Association Conference. Download available at: http://cepr.harvard.edu/files/cepr/files/hill_chin_blazar_knowledge_of_students_aera2015.pdf

National Center for Teacher Effectiveness (NCTE) Student Assessment. This assessment was developed jointly by Harvard and Educational Testing Services (ETS), and is an open resource for use by researchers and practitioners. Few instruments are available to measure student knowledge and growth in upper elementary grades. Researchers are often constrained to use scores from standardized state tests; the NCTE student assessment provides an alternative. The assessment is designed to be sensitive to variation in teachers' mathematical knowledge for teaching and

[3]Sadler, P. M., Sonnert, G., Coyle, H. P., Cook-Smith, N., & Miller, J. L. (2013). The influence of teachers' knowledge on student learning in middle school physical science classrooms. *American Educational Research Journal*, *50*(5), 1020–1049.

instruction, to measure improvements in student learning that might result from teacher professional development, and to reveal patterns in student achievement with respect to the Common Core State Standards in Mathematics. Materials available for download at: http://cepr.harvard.edu/ncte-student-assessments

National Center for Teacher Effectiveness (NCTE) Video Library. The Mathematical Quality of Instruction (MQI) Video Library contains over one hundred short video clips of mathematics lessons from grades three through nine. The library is designed for use by teachers, administrators, professional developers, and researchers interested in improving the quality of mathematics instruction. Videos are tagged by topic and by features of the instruction, including student cognitive demand and teacher use of student ideas. The library contains a range of practices on each of these codes. Use of the video library is limited to research and educational purposes. If you would like more information on how to access the MQI Video Library, please contact Fallon Blossom (fallon_blossom@gse.harvard.edu). To learn more about the MQI instrument, visit the MQI training website: http://isites.harvard.edu/icb/icb.do?keyword=mqi_training

FOR MORE INFORMATION

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MEASURING STUDENT SCIENCE LEARNING EXPERIENCES

WHAT'S IT ABOUT?

The project develops evaluation tools around the concept of "science learning activation" a construct that includes: fascination with science, valuing science, competency belief, and engagement in scientific sense-making. This enables evaluation of a broader range of outcomes beyond achievement test scores.

WHAT'S NEW?

The *Activation Approach: A Comprehensive Method and Toolkit for Evaluating the Impact of Science Learning Experiences Across Environments* project (DRL#1337186) has established the goal of transforming the measures of science learning activation and related surveys and protocols that were previously developed for research purposes into evaluation instruments that can be used online or offline. This goal aligns with the goal of the PRIME program by developing methods for evaluating the impact of science learning experiences on youth affect, behavior, and cognition in science. While the field recognizes the importance of studying these elements, whether they are called engagement, interest, enjoyment, and include efficacy beliefs or even statements about learning and behavior, they are difficult to measure, and the resulting data are often difficult to interpret. As a way of focusing much of the previous research emerging from learning sciences, psychometrics, and studies of engagement, the project posits a new construct, science learning activation. This construct is meaningful for several reasons. First, science learning activation is hypothesized to have short-term and long-term utility for predicting consequential outcomes. Second, it offers a framework that is meaningful across learning environments and settings and thus affords the potential for comparative studies that are impossible with current measurement systems and technologies.

RESOURCES

Science Learning Activation Survey. This survey is designed to be used with 10-14 year olds. These survey scales are used to assess an individual across each of the four dimensions of science learning activation**.** These scales can be used concurrently to measure the multi-dimensional construct of *science learning activation* or separately to measure individual dimensions, (e.g., fascination, values, competency belief, and scientific sense-making).

***Emerging STEM Learning Activation Survey*.** This survey is designed to be used with 7-9 year olds. This survey is used to assess the degree to which a child demonstrates emerging STEM learning activation.

Engagement Survey. This survey measures a respondent's self-reported cognitive, behavioral, and affective engagement during a science learning opportunity.

Choice Preference Survey. This survey is used to measure student's preference for selecting science and science related options when presented with an array of potential choices.

***Engagement Observation Protocol*.** This observation protocol is used by a trained observer to score an individual's engagement in a science learning experience.

Demographic Survey. This survey is used to collect general demographic information (e.g., age, gender, ethnicity, languages spoken at home, parental education level) and to measure two particular factors related to demographics: (1) resource availability (e.g., a quiet place to study, a calculator, an internet connection) and (2) the emphasis the family places on learning (e.g., adult helps with homework or is familiar with what is going on at school).

Collaborative Scientific Sense-Making (CSSM) Survey. This survey measures the extent to which a respondent feels that they made sense of the scientific content in an activity on their own or in collaboration with others.

Perceived Autonomy in a Science Investigation (PASI). This 10-question survey measures a respondent's perception of the autonomy they had in designing and conducting their science investigation, an important component of "authentic" science learning.

All instruments and the online system for evaluation instrument construction are available at: http://www.activationlab.org/

FOR MORE INFORMATION

PRIME Project	The Activation Approach: A Comprehensive Method and Toolkit for Evaluating the Impact of Science Learning Experiences Across Environments
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PLATFORM TO CONDUCT CONTROLLED EXPERIMENTS

WHAT'S IT ABOUT?

ASSISTments is a free, university-based platform created to perform controlled experiments with the potential to help increase the quality, speed, and reliability of results related to K12 education.

WHAT'S NEW?

The *Adding Research Accounts to the ASSISTments' Platform: Helping Researchers Do Randomized Controlled Studies with Thousands of Students* project (DRL#1440753) adds researcher accounts to ASSISTments to better facilitate the research process. Researchers will create their own experiments, get approval from WPI for release to teachers, and get anonymized data. ASSISTments will reach out to its community of teachers who trust ASSISTments, to invite them to run the study in their classrooms. The project's ten-year goal is to have a community of hundreds of scientists that use this tool to do their studies. Psychologists tend to study human learning in lab studies; researchers in education and learning sciences point out that it's not clear if those studies generalize to K12. These communities need to work together, but are lacking common ground. Thousands of researchers in psychology, mathematics education, and learning sciences care about using science to better understand human learning. Some researchers study how to help students with motivational messages, spaced retesting, or comparing feedback. Many researchers have used thousands of psychology undergraduates as subjects, but want their ideas tested and validated in authentic K12 settings. Everyone understands physicists need a shared scientific instrument to do their work, but so do educational psychologists and ASSISTments help meet this need.

RESOURCES

ASSISTments. Researchers and evaluators may access this system at:
https://www.assistments.org/staticpages/Home.htm

Assessment of Learning Infrastructure (ALI): The Theory, Practice, and Scalability of Automated Assessment. To be included in the Proceedings of the 6th International Conference on Learning Analytics and Knowledge, 2016.Ostrow, K., Selent, D., Wang, Y., Van Inwegen, E., Heffernan, N., & Williams, J.J. (accepted but not final version).

FOR MORE INFORMATION

PRIME Project	**Adding Research Accounts to the ASSISTments' Platform: Helping Researchers Do Randomized Controlled Studies with Thousands of Students**
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EVALUATING SCIENCE TEACHING PROFESSIONAL DEVELOPMENT EVALUATIONS

WHAT'S IT ABOUT?

This exploratory project is designed to identify and describe evaluations of Professional Development in Science Teaching (PDST) interventions with the ultimate goal of improving the quality of science instruction in elementary school classrooms.

WHAT'S NEW?

The *PEEPs for PD: Identifying Project Evaluation Effectiveness Principles for Professional Development in Elementary Science Teaching* project (DRL#1228809) identified and described evaluations of PDST interventions and developed mechanisms and examples for systematically reviewing, meta-evaluating, and aggregating results of these evaluations. The focus was on establishing a credible base of appropriate professional development STEM evaluation reviews, developing meta-evaluation techniques, and identifying the most appropriate strategies for determining the cumulative effectiveness of PDST programs.

RESOURCES

PEEPs for PD: Project Evaluation Effectiveness Principles for Professional Development in Elementary Science Teaching. This paper was presented at the annual meeting of the American Educational Research Association, Research on Evaluation Special Interest Groups, Chicago, IL. Schroeter, D. C., Snow, J. Z., Greenman II, G. D., Ozeki, S., Means, S. N., Fiekowski, E., & McCowen, R. (2015, April).

A Metaevaluation of Professional Development Evaluations in Science Education and Implications for Evaluation Reporting. Presented at the annual meeting of the American Evaluation Association, Chicago, IL. Schroeter, D. C., Fiekowsky, E., Coryn, C. L. S., Means, S. N., Greenman II, G. D., Snow, J. Z., & Ozeki, S. (2015, November).

The Logic of Evaluation in Professional Development Evaluation Practice. Paper presented at the annual meeting of the American Evaluation Association, Chicago, IL. Ozeki, S., Schroeter, D. C., Coryn, C. L. S., & Haitova, N. (2015, November).

A Systematic Review of Evaluation Approaches and Reports: The Status of Evaluation Reporting in Professional Development in Elementary Science Teaching. Paper presented at the annual meeting of the American Evaluation Association, Chicago, IL. Means, S. N., Greenman II, G. D., Schroeter, D. C., Snow, J. Z., Ozeki, S., Fiekowsky, E., Coryn, C. L. S., & McCowen, R. (2015, November).

Exploratory Identification of Project Evaluation Effectiveness Principles for Professional Development in Elementary Science Teaching: PEEPs for PD. Paper presented at the annual meeting of the American Educational Research Association, Research on Evaluation Special Interest Groups, Philadelphia, PA. Snow, J. Z., McCowen, R., Schroeter, D. C. & Greenman II, G. D. (2015, November).

What Counts as Evidence? The Misalignment of Evaluation in the Policy Cycle. Paper presented at the annual meeting of the Fall Research Conference of the Association for Public Policy Analysis & Management (APPAM), Miami, FL. Schroeter, D. C., II Greenman, G. D., & Means, S. N. (2014, April).

Insights, Barriers, and Strategies for Research on Evaluation Practice. Multipaper presentation at the annual meeting of the American Evaluation Association, Research on Evaluation TIG Washington, DC. Papers presented included the following (2013, October):

- ***Accessibility, Transparency, and Other Barriers to Metaevaluation.*** McCowen, R., Schroeter, D. C., Means, S. N., & Greenman II, G. D.
- ***Language Use, Coding Mechanisms, and Initial Findings.*** Means, S. N., Schroeter, D. C., McCowen, R., & Greenman II, G. D.
- ***Using Key Informants to Collect Grey Literature for Systematic Review.*** Snow, J. Z.

Identifying Project Evaluation Effectiveness Principles in Professional Development Evaluation. Think Tank presentation at the annual meeting of the American Evaluation Association, Minneapolis, MN. Schroeter, D. C., Snow, J. Z., & Hartry, A. (2012, October).

FOR MORE INFORMATION

PRIME Project	PEEPs for PD: Identifying Project Evaluation Effectiveness Principles for Professional Development in Elementary Science Teaching
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ENGINEERING DESIGN PROCESS PORTFOLIO SCORING RUBRIC

WHAT'S IT ABOUT?

Currently there are numerous opportunities for students to participate in design-based experiences organized by local schools and clubs, government laboratories and national organizations. While these programs can inspire students' interest in STEM, there are no commonly accepted frameworks to benchmark learning and instruction in order to study students' growth in STEM knowledge and skills or their self-efficacy and persistence to pursue STEM or to recognize their achievements based on common measures

WHAT'S NEW?

The purpose of the *Engineering Design Process Portfolio Scoring Rubric (EDPPSR)* project (DRL # 1118755) is to test the efficacy of the EDPPSR scoring system that can be applied to differentiate levels of performance in the domain of the engineering design-based projects. The intent of the study is to determine the reliability and validity of the EDPPSR across student work produced in diverse contexts (formal versus informal, low versus high stakes, high school versus college) and under different conditions (individual versus group work, self-initiated versus assigned, etc.). The study is a critical step in the scale-up of a validated and reliable scoring tool that could be used to evaluate design-based projects and to inform instructional practice. Specifically, the EDPPSR is ultimately proposed as the format for a future engineering advanced placement exam. The research is also exploring how to simplify the EDPPSR Rubric to make it more "understandable" and more readily adaptable to mobile technologies so that students can apply the EDPPSR as they develop, and document their design projects, anywhere and anytime utilizing mobile and / or web based technologies. The project is currently conducting focus groups to begin the process of translating EDPPSR into symbols, icons and templates. The project is investigating how this approach might enable the project to "codify" the data collected through the simplified EDPPSR to enable automated scoring. The work of the PRIME feeds into several other active NSF awards that now explore coding, alignment of the EDPPSR to 21st Century skills, teacher training on the EDPPSR, and use of a mobile platform to collect and analyze a design process thinking based on the use of icons, symbols and templates (e.g. creating a new simplified language for design).

RESOURCES

Engineering Design Process Portfolio Scoring Rubric (EDPPSR). This scoring rubric can be downloaded at: https://www.innovationportal.org

Measuring Student Learning with the Engineering Design Process Portfolio Scoring Rubric (EDPPSR). A recording of this webinar is available at: http://teams.mspnet.org/index.cfm/webinars

Design, Diversity and Digital Learning: Reframing 21st Century Education. This presentation describes a ten year effort to (a) develop the Engineering Design Process Portfolio Scoring Rubric (EDDPSR), (b) partner with Project Lead the Way to create an *e*-portfolio (www.innovationportal.org) framed by the EDPPSR, (c) launch an effort with the College Board to study the creation of an Advanced Placement in Engineering, and (d) pilot online tools for mobile devices. Abts. L., Massachusetts

Institute of Technology (MIT) Presentation, May 14, 2015. Available for download at: https://odl.mit.edu/news-and-events/events/design-diversity-and-digital-learning-reframing-21st-century-education

Revising an engineering design rubric: A case study illustrating principles and practices to ensure technical quality of rubrics. This research article provides a detailed account of a rubric revision process to address seven common problems to which rubrics are prone: (1) lack of consistency and parallelism; (2) the presence of "orphan" and "widow" words and phrases; (3) redundancy in descriptors; (4) inconsistency in the focus of qualifiers; (5) limited routes to partial credit; (6) unevenness in incremental levels of performance; and (7) inconsistencies across suites or sets of related rubrics. The author uses examples from both the draft stage precursor and the first revised (pilot) version of the Engineering Design Process Portfolio Scoring Rubric (EDPPSR), to illustrate the application of broadly relevant guidelines that can inform the creation of a new—or revision of an existing—rubric to achieve technical quality while preserving content integrity. Goldberg, G. (2014, August). *Practical Assessment, Research and Evaluation Journal*, *19*(8).

A Hybrid Model for Blended, Online Mathematics, Science, and Engineering Instruction and Assessment Based on Design. This conference presentation at the American Education Research Association was a presidential session on new ways to evaluate mathematics and science education. Abts, L., (2014, April).

Using an Engineering Design Process Portfolio Scoring Rubric to Structure Online High School Engineering Education. This conference paper presented at the American Society for Engineering Education (ASEE) Annual Conference and Exposition describes using the EDPPSR with online high school courses. Groves, J. F., Abts, L. R., & Goldberg, G. L., (2014, June). Available for download at: https://www.asee.org/public/conferences/32/papers/10738/view.

FOR MORE INFORMATION

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