Community for Advancing
Discovery Research in Education

Summary of Discovery Research K-12 (DR-K12) Projects on Assessment: Working Document

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Prepared by

Hilary Rhodes
Alina Martinez

Abt Associates Inc.

CADRE

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This document provides a summary of the assessment-related projects that were funded in the first two cohorts under the National Science Foundation's (NSF) Discovery Research K-12 (DR-K12) program. It describes the assessment projects that have been funded as well as presents information on the research and development activities these DR-K12 grantees proposed.

Background

NSF's Division of Research on Learning in Formal and Informal Settings (DRL) maintains a portfolio of complementary programs aimed at improving science, technology, engineering, and mathematics (STEM) learning at all stages. DR-K12 is DRL's key program to support high-quality research and development on STEM learning and teaching at the elementary through high school levels.

NSF has funded the Community for Advancing Discovery Research in Education (CADRE) network to support the diverse DR-K12 community and further the goals of the DR-K12 program. One of CADRE's strands of work involves the syntheses of information, along specific topic areas, in the collective body of DR-K12 grantees' work. CADRE has identified assessment as a possible topic for synthesis.

This document summarizes some key characteristics of the DR-K12 projects that have a focus on assessment. It is intended to provide an overview of the projects' scope and the work being conducted. If assessment remains a topic area for synthesis, this overview will only serve as a starting point. Any synthesis would build on additional information about the projects and ideas that emerge from the upcoming PI meeting.

The data used to identify projects that focused on assessment and to code characteristics of these projects were found in publicly available documents and materials provided to CADRE by individual awardees. Using lists of DR-K12 projects, maintained by NSF and provided to CADRE, we identified 147 unique projects after multiple awards that funded the same project were combined; 87 projects were funded under the first DR-K12 solicitation (cohort 1), and 60 under the second solicitation (cohort 2).[1] CADRE contacted each project's PI and asked for a copy of their proposal, annual reports, project publications, and any other information that would give insight into the plans, activities, and achievements of the DR-K12 project. Where PIs did not provide materials (29 of the 147 projects), we examined the project abstracts and award information available on the NSF website.

CADRE staff systematically coded the available information about individual projects using a standard protocol developed through a review of the DR-K12 program solicitations, proposals, and annual reports. The protocol captured a wide variety of information including project attributes and characteristics, evaluations, dissemination plans, and the DR-K12 program goals being addressed.

During this process, we identified 36 projects (24 percent of the portfolio) that are conducting research on or developing an assessment (see Appendix for a list of projects).[2] In addition to using the data that

[1] NSF DR-K12 Solicitations, NSF06593 and NSF08502, respectively.

[2] For two of these projects, the only source of information was the publicly available information on NSF's website.

had been coded for each DR-K12 project, CADRE staff captured additional information about the assessment-related activities of these projects. These data have been analyzed and aggregated to present the summary of the assessment projects that follows.

What Assessment Projects Is DR-K12 Funding?

STEM Content

In terms of STEM focus, science is the discipline most commonly addressed (72 percent), followed by mathematics (53 percent, see Exhibit 1). The percentages of assessment projects that addressed each of these disciplines are slightly higher than for the entire DR-K12 portfolio, where 67 percent of the projects address science and 49 percent address mathematics. Science topics addressed in the assessment projects include biology, physics, physical science, chemistry, earth science, and scientific measurement. Math topics include geometry and measurement, number sense, elementary algebra, linear, matrix, and abstract algebra, proportional reasoning, and fourth year, non-calculus high school mathematics beyond linear programming. Just as in the entire portfolio, few projects address the STEM areas of engineering or technology.

Exhibit 1: STEM Content Areas of DR-K12 Assessment Projects

Discipline Content Area	% Assessment Projects (N=36)	% DR-K12 Portfolio (N=147)
Any science	72%	67%
Physics	8	6
Physical science	8	7
Biology	8	7
Chemistry	6	3
Earth science	6	5
Any math	53	49
Geometry and measurement	11	5
Elementary algebra	11	5
Number sense	8	3
Linear, matrix, and abstract algebra	8	3
Both math and science	25	20
Technology	8	14
Engineering	3	12

Participant Focus

The majority of projects target both students and teachers; however, several target students or teachers exclusively. Similar to the larger DR-K12 portfolio, more assessment projects target teachers than students (see Exhibit 2). The majority of projects target in-service teachers, although a few address teachers in the pre-service years. Few projects specifically target at-risk student groups (e.g., special education, English language learners) or the teachers who specialize in instruction for these groups.

Exhibit 2: Populations Targeted by Assessment Projects

Target Population	% Assessment Projects (N=36)	% DR-K12 Portfolio (N=147)
Teachers	83%	86%
Special education	3	4
ELL	0	3
Pre-service	14	12
Students	78	70
Special education	0	5
ELL	3	6
Doctoral	6	4
"at-risk" (economically disadvantaged or underrepresented)	11	16
School administrators	8	7

Most frequently, grant recipients focus on middle-school (19 target students, 20 target teachers) or the high-school level (10 target students, 13 target teachers; see Exhibit 3). Some projects focus on the elementary school level (7 target students, 7 target teachers), but few focus on the preschool years (1 targets students, 0 target teachers). When compared to the larger DR-K12 portfolio, assessment projects are more likely to target the middle school years and somewhat less likely to focus on the high school years.

Exhibit 3: Grade Levels Included in Assessment Projects

Grade Levels Addressed	% Assessment Projects (N=36)	% DR-K12 Portfolio (N=147)
Teachers, any level	86%	90%
Pre-K	0	1
Elementary school	19	33
Middle school	56	50
High school	23	39
Students, any level	81	77
Pre-K	3	2
Elementary school	19	22
Middle school	53	38
High school	28	33

Project Status

As of September 1, 2009, only 3 of the assessment projects have been completed; the majority of projects (25) are expected to finish in 2010, with an additional 4 in 2011 and 3 in 2012.[3] As such, the description below focuses on what these projects propose to accomplish rather than on the actual results of their work.

[3] End date not known for one project.

What's the Focus of DRK-12 Assessment Projects?

Instrument Development

Instrument development is a primary activity of many assessment-related projects: more than three-quarters (28 projects) of the assessment projects are developing assessment instruments. Of the projects preparing instruments, most (26 projects) are producing student assessments while few (3 projects) are developing assessment instruments to measure teacher knowledge and capacities. Nearly twice as many DR-K12 assessment projects will develop student assessments in science (20 projects) than in mathematics (11 projects). The opposite is true of teacher assessments, where two projects will produce teacher assessments in math and one project will prepare an assessment in science.

Among projects developing instruments, more than half (15 projects) describe their instruments as formative; these include instruments to measure misconceptions, diagnostic tests, and assessments-for-learning. Four projects explicitly describe their instruments as summative or developed with the intention of providing large-scale accountability results. Half of the instruments being developed are part of the research team's efforts to produce a new curriculum.

Knowledge to Improve Assessment Development

Nearly half of the projects (17 projects) focus on producing knowledge that will inform future efforts to develop instruments and continue to move the assessment field forward. Ten projects will create frameworks (e.g., learning trajectories, continua, and progressions) that provide conceptual structure to complex assessment issues, such as children's ways of understanding key math and science concepts. Eight of these projects will employ these new frameworks to design new assessments during the grant period. Three of these projects will consider the role technology might effectively serve in administering assessments.

Seven projects will improve the design of future assessments by addressing key issues confronting the field. For example, one project is investigating how assessment can be used as an integral part of learning rather than a "time wasting" activity while another is looking at how illustrations might provide effective testing modifications for English Language Learners. Two projects will use case studies to explore the implementation of assessments to uncover obstacles to their effective use.

Capacity Building Through Fellowships and Conferences

The primary activities in four assessment projects intend to develop capacity through fellowships or conferences. Two projects provide funding for graduate fellowships, to ensure doctoral students develop expertise in math or science assessment. Two other projects, both focusing on both math and science, are organizing conferences to enable the exchange of ideas; one seeks to stimulate discussions amongst researchers about assessments that both diagnose student learning and are useful for large-scale accountability purposes; the other will bring together researchers and educators to explore how to integrate research-based curricula and assessment strategies into teaching.

Technology Affinity

A third of the assessment projects (12 projects) include a technology component. Six projects are using technology to help customize instruments, curriculum materials, and assessments to their

audience; four projects are looking at how "games" and simulations can encourage student learning. Two additional projects are focused on learning how to enhance the role of technology in assessments overall.

What Research Is Being Conducted?

Research and Analysis Plans

In the research they have proposed, the majority of assessment projects (20 projects) plan on using mixed methods while nine will use primarily qualitative and one will only use quantitative techniques. This fact is not surprising as many of the projects developing instruments will use both and quantitative and qualitative analyses to validate the work: 9 of the 20 projects mention use of both psychometrics or statistical analyses as well as qualitative techniques like cognitive, "think aloud" interviews. Few of the projects are pursuing longitudinal studies (4 projects), as many are using an iterative process of "write- test- revise" (11 projects). Field testing is common (13 projects) in the development of instruments and materials. Many projects (11) are also using expert review panels to provide direction as they move forward. In addition, several projects (5) will perform content analysis of educational artifacts, such as textbooks, assignments, assessments, and conversations, and four projects are pursuing case studies that consider issues of implementation. Twenty projects have explicit plans for evaluation.

Data Collection

Key data will be collected by projects via interviews (18 projects), classroom observations (13 projects), and student assessments with instruments other than the one they are developing (12 projects). Less frequently, projects will collect survey data (6 projects), conduct focus groups (5 projects), code text from classroom artifacts such as textbooks, teacher references, lesson plans, and pupils' work (4 projects), administer teacher assessments (3 projects), or review logs or school records (3 projects).

Next Steps

This summary represents our first step in describing the work of the DR-K12 assessment projects. We are collecting and reviewing projects' status reports to augment this preliminary work and will begin adding the assessment projects from the third cohort of DR-K12 projects. As we move forward, we will consider the projects' progress towards their goals, identifying their successes and challenges. Ideas for a most substantive synthesis of these projects may emerge from conversations that are scheduled to be held at the upcoming PI meeting.

Appendix: DRK-12 Assessment Projects, Cohorts 1 and 2

Project Name	Primary Investigator (PI)	PI Institution
A Comprehensive Modeling Approach to Cognitively Diagnostic Assessment: Methodological Developments and Practical Implementations	Jimmy de la Torre	Rutgers University, New Brunswick
A Longitudinal Examination of Children's Developing Knowledge of Measurement: Mathematical and Scientific Concept and Strategy Growth from Pre-K through Grade 5	Jeffrey Barrett	Illinois State University
Application of Evidence-Centered Design to State Large-Scale Science Assessment	Geneva Haertel	SRI International
Assessment for Learning Research Scholars: Capacity Building in Mathematics and Science Education	Arlen Gullickson	Western Michigan University
ASSISTments Meets Inquiry	Janice Gobert	Worcester Polytechnic Institute
CAESL2008: International Conference on Assessment for Learning in Mathematics and Science	Michael Timms	WestEd
Calipers II: Using Simulations to Assess Complex Science Learning	Edys Quellmalz	WestEd
Chemistry Education Research Doctoral Scholars Program	Stacey Lowery Bretz	Miami University
Chemistry Facets: Formative Assessment to Improve Student Understanding in Chemistry	Angela DeBarger	SRI International
Conference 2008 - Integrating Science and Mathematics Education Research into Teaching IV: Resources and Tool for Improved Learning	Susan McKay	University of Maine
Creation and Dissemination of Upper-Elementary Mathematics Assessment Modules	Heather Hill	Harvard University
Cumulative Learning Using Embedded Assessment Results (CLEAR)	Marcia Linn	University of California, Berkeley
Design and Use of Illustrations in Test Items as a Form of Accommodation for English Language Learners in Science and Mathematics Assessment	Guillermo Solano-Flores	University of Colorado, Boulder
Developing an Empirically-Tested Learning Progression for the Transformation of Matter to Inform Curriculum, Instruction, and Assessment Design	Namsoo Shin	University of Michigan, Ann Arbor
Developing Contingent Pedagogies: Integrating Technology-Enhanced Feedback into a Middle School Science Curriculum to Improve Conceptual Teaching and Learning	William Penuel	SRI International
Diagnosing Teachers' Multiplicative Reasoning	Andrew Izsak	University of Georgia
Diagnostic E-Learning Trajectories Approach (DELTA) Applied to Rational Number Reasoning for Grades 3-8	Jere Confrey	North Carolina State University
DR - K12 R&D Geometry Assessments for Secondary Teachers (GAST)	William Bush	University of Louisville Research Foundation Inc

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Elicitory Test Design: A New Model for Understanding the Relationship Between Test Item Features and Student Performance on Large-Scale Assessments	Sharon Nelson-Barber	WestEd
Evaluation of HS Science Courses	Philip Sadler	Harvard University
Evaluation of the Cognitive, Psychometric, and Instructional Affordances of Curriculum-Embedded Assessments: A Comprehensive Validity-Based Approach	James Pellegrino	University of Illinois at Chicago
Evolution Readiness: A Modeling Approach	Paul Horwitz	Concord Consortium
Examining Different Curricular Approaches and Their Impact on High-School Students' Understanding of Algebra: Phase 1 - Studying the Intended Curriculum	Mary Ann Huntley	Cornell University
Formative Assessment Delivery System (FADS)	Mark Wilson	University of California, Berkeley
Helping Teachers to Use and Students To Learn From Contrasting Examples: A Scale-up Study in Algebra I	Jon Star	Harvard University
Honing Diagnostic Practice: Toward a New Model of Teacher Professional Preparation and Development	Stamatis Vokos	Seattle Pacific University
Iterative Model Building (IMB): A Program for Training Quality Teachers and Measuring Teacher Quality	Enrique Galindo	Indiana University
Linear Algebra and Geometry: Advanced Mathematics For More Students	Albert Cuoco	Education Development Center
Making Sciences: Data Modeling and Argumentation in Elementary Science	William Sandoval	University of California, Los Angeles
Mathematics Instruction Using Decision Science and Engineering Tools	Robert Young	North Carolina State University
Planting Science Research in Education	Claire Hemingway	Botanical Society of America
PUM (PhysicsUnionMathematics) Exploration	Eugenia Etkina	Rutgers University, New Brunswick
SAVE Science: Situated Assessment using Virtual Environments for Science Content and Inquiry	Diane Ketelhut	Temple University
Scale Up of Math and Science K-12 Education Reform in a Large Urban District	Stacy Wenzel	Loyola University, Chicago
Scientific Role-Playing Games for 21st-Century Citizenship	Kurt Squire	University of Wisconsin, Madison
Tool Systems to Support Progress Toward Expert-Like Teaching by Early Career Science Educators	Mark Windschitl	University of Washington