Video Cases for the Professional Development of Novice College Mathematics Instructors

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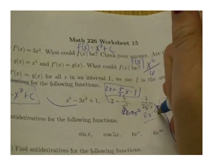
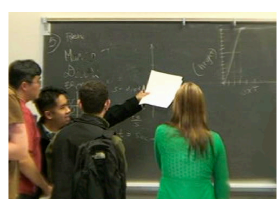
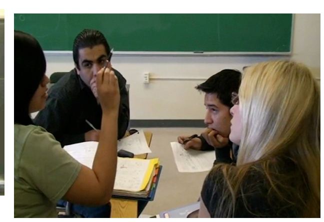
FINAL REPORT

1. Introductory Overview

The Project Director, senior personnel at partner institutions, and consultants are a group of specialists in mathematics education and mathematics who firmly believe the time has come for graduate mathematics programs to prepare TAs to teach well *and* that PD through video cases is an excellent, sustainable, method. The goal realized by the project was to create a research-informed collection of video and textual materials for college mathematics instructor[1] professional development. The materials provide video vignettes with associated activities (10 video cases), short reports on theory and on ways research can inform college mathematics instructional practice (10 essays), and resources for facilitating the use of materials (facilitator notes). Institutions (senior personnel) responsible for the project are: WestEd and University of Northern Colorado (Project Director: Shandy Hauk), University of Maine (Natasha Speer), St. Mary's College of Maryland (Dave Kung), and University of Texas, Pan American (J-J. Tsay). The development process has given us the opportunity for research on collegiate mathematics teaching and learning and, conversely, the research process has informed decisions on developing case materials – about student thinking and instructor learning – and continues to guide our planning for how to assess the impact of video case use on teaching and learning.







The Development Group, lead by the Project Director, met the goals of identifying video vignettes for ten cases, generating case materials, creating a list of other (outside the project) Resources, and developing Theory and Practice essays (see Table 1). The Research Group, made up of project senior personnel at the four collaborating institutions, met research goals of developing protocols, obtaining and maintaining IRB approval, gathering data (video, survey, and interview) and preliminary dissemination and publication, (see Table 2). The Evaluation Team, in collaboration with the Research Group, has met its goals, completed data gathering on communication processes, and given formative feedback to senior personnel (see attached External Evaluation report). Members of the Advisory Panel reviewed and provided feedback on draft case materials and on knowledge-awareness building activities (e.g., format for sessions about the project at national meetings). Also, as planned in the

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[1] "College mathematics instructor" refers to anyone who works to help college mathematics learners, from instructor-of-record to graduate teaching assistant to undergraduate tutors and lab assistants.

revised timeline, we piloted video cases in Spring and Fall 2009, expanded piloting to include focus group feedback in Spring 2010, gathering feedback and revising materials for a final round of pilot work among those not involved in development in Spring, Summer, and Fall 2011.

The project has been supported by the American Mathematical Society (AMS) and the Mathematical Association of America (MAA) – both organizations included special sessions on the materials at their national meetings (AMS in January 2010 and MAA through the SIG on Research in Undergraduate Mathematics Education in 2009, 2010, and 2011). As of this writing we continue negotiations with the AMS for publishing and distributing the project's final product of text and video through the Conference Board for the Mathematical Sciences.

2. Problem

A significant issue for many new college mathematics instructors is the disconnect between their own learning experiences, expectations, and cultural backgrounds and those of their students. Many are unaware that undergraduates may not share their own views and may never have experienced mathematics as interesting or clear [26,28,30,44]. Yet, the teaching practices of novice instructors shape learning for many students [40,54]. Of the 15 million undergraduates in the U.S., 85% take mathematics service courses like college algebra, liberal arts mathematics, and prospective K-8 teacher classes – the courses most often taught by new instructors [41]. Nationwide, the average pass-rate for these courses hovers around 60%, the other 40% either withdraw or fail. Moreover, half of mathematics and physical science majors *switch* to other majors, with 90% citing poor teaching as a reason [55]. Improving college mathematics instruction promises to have broad national impact, from courses for pre-service teachers to advanced mathematics. This leads to an obvious question: How do we improve college teaching? Part of the likely answer: Improve the preparation for teaching of graduate students.

3. Background and Origins

University programs for preparing novice college mathematics instructors, particularly graduate student teaching assistants (TAs) in the U.S. are a mixed bag, often consisting of one to six hours of "training" in the week before classes begin [56]. Sometimes, a manual on teaching is given to TAs to read on their own. These resources generally focus on basic administrative duties with little attention to teaching strategy, much less to how students learn. Preparing Future Faculty and regional and national variations (e.g., Project NeXT, CIRTL [2]) go deeper. A few universities devote a semester or more to novice TAs, guided by materials like text-based cases [24,a,b] or teaching seminar guides [17]. Understandably, it is challenging for TAs to develop comfort and expertise in teaching. In particular, there is an acknowledged need for tools to help them understand and facilitate the richly diverse approaches to learning they will encounter in college classrooms [1,38,47]. The American Mathematical Society and Mathematical Association of America have called for better college teaching in mathematics and have supported efforts to create materials for instructional "professional development (PD)" [19,25]. The emerging consensus at all levels of teacher preparation is that it is clinical work: instructors must evaluate, diagnose, and prescribe, while also developing their practice [37]. Great success in preparing clinicians in medicine, psychology, education, and law has come through case-based study. Our plan for video case development was based on the following assumptions:

- Case-based learning offers a proven model for professional development.

- Attention and responsiveness to the experiences and ways of thinking about mathematics that college students bring to the classroom is central in effective teaching.
- The large body of research and practical literature on K-12 teaching, learning, and professional development offers collegiate teaching many valuable lessons.
- Novice college teachers, especially graduate student teaching assistants, offer the most productive avenue for professional development using video cases.
- Measures of student learning include and go beyond traditional forms of assessment.

A *case* is not just a short story, it is a context-rich description in words, images, or both, of a dilemma, challenge, or epitome (e.g., good or not-so-good practice). An effective case generates dissonance between what case users thought they knew to be true and what they are witnessing. Such cognitive dissonance is the basis on which new understanding is built.

4. Project Description

Creating a pool of video from which to choose case vignettes required strategically narrow as well as holistically broad capturing on video of college mathematics interactions in classrooms, labs, and offices across the United States. As with attempting to capture details in any natural setting, it is rare to find the "typical" or "usual" is densely epitomized in a rich and useful way. Video collection and associated research investigations were based on four basic approaches: (1) task based interviews with individuals and with groups of TAs, professors, and students, (2) video-clip interviews where instructors watched and reflected on a video vignette (from their own class, someone else's class, or from interviews with undergraduates), (3) video recording every class meeting for an extended period (from 2 weeks to the entire semester), and (4) close shadowing of an instructor throughout the instructional day for a few days in a row. From these approaches we gathered over 2000 hours of video of and about college mathematics instruction. The set of ten cases (video, activity, and facilitator notes) is based on a set of vignettes culled from this pool.

Note on permissions for video use: The vast majority of people in the thousands of hours of video provided both "research release" – a restricted set of permissions for researchers to view video as well as "talent release" – a form of release from liability for the use of the video of the type that actors complete. In the video case materials the only people identifiable in the video are those who gave the comprehensive talent release.

Several of the essays (practical and theoretical) are based on research conducted around the classrooms and activities captured in the video collection (e.g., the Questions essay compared questioning strategies, question types, and nature of mathematical discourse elicited across four calculus instructors at two different universities; the Responsiveness essay emerged from instructional activities at two other video collection sites; the Mid-term Evaluations essay pulled together qualitative information generated by creating the Evaluations case with results from a project-sponsored survey of Research I faculty and TAs; the WebWorK essay came about, in part, because of the difficulties we encountered in attempting to gather video and create a worthwhile case about technology use). Cases include students working on and talking about mathematics, strategies for effective communication, and exploration of the challenges of teaching. Case video contexts are lower-division mathematics (e.g., first-year calculus, college algebra, classes for pre-service elementary school teachers). The tools in the video case materials and essays may be used as a core for professional development programs or as a part of an already established program. To date, the piloting, testing, and implementation of materials has been of this second type – folded into existing programs. Launch of the dissemination web site is expected in June 2012 at www.collegemathvideocases.org.

Materials Summary

Part 1 – Introduction

Part 2 – Case Selection and Combination Guide – including suggested pacing as well as connections to the Boston College Case Studies text (Friedburg et al., 2003).

Part 3 – Short reports on theory and essays on research informing practice

- 3.1. Using Cases
- 3.2. Undergraduates' Mathematical Autobiographies
- 3.3. Mid-term Evaluation
- 3.4. Questions Strategies
- 3.5. WebWorK as an Example of Technology Use
- 3.6. Constructivism
- 3.7. Group Work
- 3.8. Pedagogical Content Knowledge
- 3.9. Responsive Instruction
- 3.10. Mathematics Teaching Assistant Reflections

Part 4 – Video Cases – ordered according to the complexity of the activities and skill of facilitation that piloting suggested was needed to enact the case effectively

- 4.1. First Day – various first-class-meetings of different instructors from calculus, college algebra, liberal arts math
- 4.2. Facilitating Group Work – unpacking the communication as instructors work with student groups in calculus
- 4.3. Viewing Tubes – a look at experienced and novice instructor implementations of the same activity in geometry
- 4.4. Fundamentals of Mathematics – whole class discussion in an introduction to proofs course
- 4.5. Evaluation Feedback – interviews with instructors about student evaluations of teaching in college algebra and statistics
- 4.6. Office Hour – exploring student thinking in glimpses of a variety of office hour interactions
- 4.7. Grades – teaching seminar conversation among instructors of college algebra, liberal arts mathematics, and calculus about grades and grading
- 4.8. Angelica's Group – exploring student thinking through a look at one student group working on a newly introduced calculus concept: integration
- 4.9. Proof by Mathematical Induction – responses by two experienced instructors and six of their students to the question "What is proof by math induction?"
- 4.10. Power Series – exploring student thinking from interviews and written work as students determine whether a particular infinite series converges.

Part 5 – Additional Resources, References, and Index.

5. Summary of Evaluation and Project Results

Development: *Create, hone, and disseminate a book and digital video disk (DVD) package of materials for college mathematics teaching professional development.*

Cases – Obstacle(s) and how handled: Focus group testing of early cases in Year 2 indicated a need for extensive revision and redevelopment. Though the final product contains only 10 cases, we developed 20 case outlines, identified 16 for which we had potential video and focus group tested these (before field testing final choices) in order to be responsive to the needs of the programs/institutions that prepare future college mathematics teachers. For example, the master's granting institution focus groups indicated that the lower math level (college algebra, pre service elementary teacher courses, liberal arts math) would be most accessible to their graduate students while the Ph.D. granting university focus groups indicated that a focus on calculus, preservice secondary teacher courses, and transition to proof courses was more accessible. We modified our case development goals to reflect this feedback from the field.

Field Testing. Materials were used at multiple institutions, at least twice in the piloting, revising, re-test process. Based on our reading of Rogers' (2000) *Diffusion of Innovations* during the first year of the project we **modified** our field-testing protocol: we expanded development to include college mathematics instructor and course coordination focus-group analysis of draft case materials prior to revising and seeking another round of feedback. Comprised of Research Intensive, Extensive, and Comprehensive universities (i.e., Research I, II, and III) along with Liberal Arts and Community colleges, the focus-group and field-testing sites include a cross-section of minority-serving institutions. These sites have socio-economically and culturally diverse faculties and student bodies to ensure the broadest possible usefulness of materials, such as use in preparing master's students to be community college faculty members.

Obstacle(s) and how handled: One challenge the Development Group met early on was a need to know more about diffusion processes for products like the materials we were developing. As a result, the Project Director convened a weekly seminar where members of the Research Group, Development Group, and Evaluation Team meet to discuss Everett Roger's (2000) *Diffusion of Innovation (DoI)* book and other readings on diffusing ideas. The seminar was a wonderful opportunity to discuss ideas about developing, testing, and disseminating case materials and led to revisions in our processes. The result was higher quality cases and essays through greater numbers of feedback cycles from novice instructors (mostly graduate students actively pursuing either a master's or doctorate in a university mathematics department), experienced faculty who were novices at facilitating TA development, and faculty experienced in both the teaching of mathematics and the preparation of new college mathematics faculty.

Research: *Investigate the nature of student thinking in a variety of college mathematics settings while exploring and documenting the development of pedagogical content knowledge among college mathematics instructors.*

Video for the cases was captured and developed along with our own ongoing scholarly activity in collegiate mathematics education. Relying primarily on video gathered through planned research served two key purposes: (1) case activities for novice instructors were grounded in the latest research in collegiate mathematics education and (2) the cyclic nature of materials development ensured that research was informed by practice. Both are critical components in building bridges between research and practice. Project materials and research were presented at the Joint Meetings of the American Mathematical Society and the Mathematical Association of America (2008, 2009, 2010), conference for the International Group for the Psychology of Mathematics Education-North America (PME-NA, 2007), the Institute for Mathematics and Education (2008), and the Conference on Research in Undergraduate Mathematics Education (RUME, 2008, 2009, 2010, 2011). Peer-reviewed publications have appeared in *Educational Studies in Mathematics* (2011), *Studies in Graduate and Professional Student Development* (2010), *Culturally Responsive Mathematics Education* (2009), and PME-NA and RUME proceedings. More on research is given below under Dissemination and detailed in Sections 6.2 and 6.3.

Evaluation: *Monitor progress toward project goals and examine how undergraduate teaching and learning is affected by instructor professional development through video cases.*

The Evaluation Team and Research Group worked closely together to implement the Evaluation Plan. The progress monitoring areas of focus were (1) formative evaluation of communication within the project and (2) formative evaluation of the approaches to documenting collegiate mathematics instruction. The first led to regular meetings of project working groups (monthly or twice-monthly) and, ultimately, to the adoption of box.net as the central storage and sharing site for materials development. Feedback in the second area (a) fostered the redesign of focus groups and (b) led to the adoption of the shadowing approach for capturing video – material from shadowing novice and experienced instructors contributed to four of the video cases (2 centrally and 2 as a component).

Obstacles and how handled. The project's initial evaluator, involved in the preparation of the proposal and the first year of funded work, had to leave the project in Year 2. Thankfully, the design of the project included a graduate student evaluation intern who continued and provided continuity for the new evaluator in Years 2 and 3. For a variety of reasons, the second external evaluator ended up delegating a great deal of work to the intern after Year 3 and the Research Team worked with the intern to ensure the completion of evaluation work through the end of the project.

Dissemination: *Build knowledge-awareness of the project among college mathematics professional development specialists and researchers in collegiate mathematics education.*
In meeting this goal we:

- Created and disseminated flyers about the project at January national meetings of mathematicians (2009, 2010, 2011) and February national meetings of collegiate math educators (2008, 2009, 2010, 2011).
- Co-organized and presented in the Working Group on Novice College Mathematics Instructors at the *Conference on Research in Undergraduate Mathematics Education*, in 2009, 2010, 2011, and accepted for 2012.
- Presentations and Publications by project graduate student and faculty researchers (see Evaluation Report).

6. Conclusions and Lessons Learned

6.1. Project Management

Logistically, as was noted in conversations with our first Program Officer, the project was funded just as two of the senior personnel (Hauk and Kung) had achieved tenure and submitted sabbatical leave proposals. Hauk's sabbatical occurred in Year 2 and Kung's in Year 3. We adjusted the original timeline and organization for some project activities to capitalize on the sabbatical leave opportunities of both. To address concerns about continuity of communication that arose in our Year 1 formative evaluation, the senior leadership team had Skype (web-based teleconference) calls 1 to 3 times per month. Actually, Skype was quite useful in year 3 when Kung spent most of the year in China! We also used Skype for annual project "sequestering" – senior personnel set aside two days as if traveling to a distant conference and sequestered themselves in a room at their local site with a computer for a two-day intensive working session that included whole group work, paired work, and working breaks (while Skype still ran and text chatting was still active). Additionally, the development team met annually at the RUME research conference to present results and hold additional project working sessions. We exercised flexibility and some creativity in moving forward in our work in the face of several delays (some from institutional inertia, others from support personnel changes, and some from job changes – Hauk and Speer both changed jobs during the project). From chats at the FIPSE Project Directors meetings, we learned to not fret about the existence of these challenges – we learned they are faced by all projects!

6.2. Attainment of Student Learning Outcomes

The primary focus of project research was the learning done by TAs (addressed in the next section, on faculty and staff development). Our exploratory research on student learning included (a) the comparison of college algebra final exam responses across two universities and (b) qualitative analysis of student engagement and response to instructor questions in first semester calculus classes across four instructors at two sites. In the larger study, (a), of undergraduate learning, instructors in college algebra at two universities agreed to include four common final exam items across the universities. The existing practices at both institutions included final exams that had a common part (the whole exam was not common). Course coordination groups at the two institutions identified four key ideas in algebra and agreed on the four items that each final would include (each exam also included other items – some were common across many tests, some were unique to an instructor). Twelve of the 22 instructors whose classes completed the exams had participated in video case enriched professional learning opportunities at least twice and as often as four times in the year of the final exam (experimental condition, at least 5 instructors at each institution), the other ten instructors had not (control condition, at least 4 at each institution). While no statistically significant difference in student scores was found between the experimental and control conditions, two interesting trends were noted: students in the experimental condition made more solution attempts than in control (that is, control group students were more likely to leave blanks on their tests) and the length of tests used by experimental condition instructors was less variable (i.e., researchers estimated the length of time to complete each version of the final exam by having research assistants complete the exams; the average length of time for both condition was about the same but the frequency of complex or ill-posed items was higher on control condition exams which would, arguably, make for either longer or shorter exam engagement times depending on how students persisted, or not, in attempting to solve such problems). A second study explored the calculus teaching practices of four novice TAs and one experienced instructor with a focus on question strategies (types of question asked, nature of timing of questions, types of student engagement elicited). More closely related to TA learning outcomes, this study led to a research proceedings paper and eventually became the basis for an essay in the project materials. This qualitative study focused on refining our framework to create a tool for identifying and discussing the questions TAs ask – and the kinds of responses elicited from learners – in teaching an undergraduate calculus course.

6.3. Faculty and Staff Development

Using questions to teach. Hufferd-Ackles et al. (2004) have said that in order to get students to become more capable at math-talk, teachers need to ask probing questions to try to understand the students' thinking and to get students to articulate their thinking. In their study, as students became more comfortable with escalating cognitive demands in lines of questioning, they became more supportive and encouraging of each other. In our study of question strategies used by calculus instructors, this was also evident in the expert instructor's interactions with students. By mid-semester – at the time of the videos we watched – when students had interactions with this professor (particularly in small groups or whole class discussion), the classroom context had been established that sense-making with clear explanation and justification were the responsibility of the students. The students were the primary "teachers" and it was their job to question each other. While the TA instructors we observed made statements in class that they expected such behavior from their students, the TAs' interactions with students (particularly in group work) were more often focused on helping students to identify and write down a correct answer than in scaffolding students to ask their own questions.

Effects of video case activities on instruction. The focus group and piloting work included interviews with novice TAs who were instructor of record for math classes and who had participated in course coordination that included video case use. The research and evaluation teams collaborated on several small projects to analyze the interview data and follow up with TAs after a semester or year had passed since the video case activities. The results of this work fell into two categories: (1) the case learning had given novice instructors *ideas for curriculum* that they used (e.g., TAs at multiple universities appropriated the calculus learning activities showcased in the Angelica's Group and Facilitating Group Work cases and TAs and faculty at two sites appropriated the Viewing Tubes activity) or (2) the case learning had given them *ideas for practice* – ways of thinking about teaching (and about learning) that lead to changes in how they spent their attention when in-the-moment of teaching in class, in a tutoring lab, or during an office hour interaction. A small study following three TAs across a semester suggested that at least as important as the content in the video case and opportunity to reflect on it, was the *discussion with others about teaching*. Over the second half of the project, in focus group work, this result was reiterated by dozens of others (mostly TAs with fewer than four semester-long experiences working with classrooms full of students). That is, the content of the video case was important, but the opportunity to try out talking about teaching and build a lexicon for describing experiences as a teacher was identified as being the most powerful aspect of video case work for novice instructors. This highlights the importance of good supports for those who would facilitate these discussions and led to the addition of Facilitator Notes and the *Using Cases* essay in the materials.

Evaluation of Video Cases for Novice College Mathematics Instructor Professional Development Project

Evaluation Report

P116B060180

Project Description

Improving the quality of college mathematics instruction is a long-standing concern in post-secondary education. The project is producing video case materials to increase novice college mathematics instructors' knowledge of student thinking and self-awareness as teachers. A video case combines video clips of actual college mathematics teaching and learning with associated activities and readings. These materials will help new college mathematics instructors learn to teach well. The *Video Cases for Novice College Mathematics Instructor Professional Development Project* will result in a package containing at least 10 video cases and 10 readings along with supporting textual, video, and audio materials. By the end of the project, the project materials had been field tested at 12 higher education institutions across the United States:

Arizona State University (2008)
California State University, Dominguez Hills (2008)
California State University, San Francisco (2009, 2010)
California State University, San Diego (2008, 2011)
Michigan State University (2008)
Oklahoma State University (2008)
Portland State University (2008, 2009)
University of California, San Diego (2008, 2009, 2010)
University of Maine (2009, 2010, 2011)
University of Michigan (2011)
University of Northern Colorado (2007, 2008, 2009, 2010)
West Virginia University (2011).

Introduction

The evaluation objectives were to: (a) assess the project's progress toward meeting its goals and objectives, (b) document project research and development processes, and (c) provide feedback about communication and ownership of the project among project developers.

Project Goals

- Proximal: To create professional development materials to support the preparation of graduate students for teaching college mathematics.
- Distal: To improve undergraduate college mathematics instruction.

Methodology

Evaluation methods included data collection through interviews with project developers, paper and pencil questionnaires consisting of open and closed response items, and document review. Evaluators used quantitative analysis software, Statistical Package for the Social Sciences (SPSS) Version 12, to explore questionnaire data for patterns, correlations, and to extend earlier examinations of reliability. Additionally, evaluators conducted two focus group interviews with senior personnel and associate researchers (n=7). These interviews were digitally recorded, transcribed and analyzed for formative project feedback using constant comparative methods. Interviews were conducted with project developers (n=4) and field-testers (n=4) to gage their sense of progress on what is working well on the project and to learn where they felt work still needed to be done. The Evaluation Team (Lead: Karen Koski, grad student intern: Bernadette Mendoza-Spencer) reviewed documents generated and used by the development and research teams each quarter to provide timely feedback to the Project Director on project processes (communication through technology like Skype, the project web site, electronic document storing and sharing, and emails). The Evaluation Team met occasionally with the Project Director; this meeting included at least one evaluation representative (external evaluator or graduate student evaluation intern) and one or more project researchers or managers. Preliminary evaluative information obtained was shared with the Project Director through these meetings and quarterly evaluation summaries.

Executive Summary

In consultation with the program officer and senior personnel, the project timeline was revised each year to accommodate a variety of pressures (e.g., the sabbatical leaves of two senior personnel, job changes by two senior personnel). The only substantive change, approved by FIPSE program officer, was in response to feedback from early focus group testing: the design of case development was revised in 2008 to shift from full field-testing of proposed cases to shorter cycles of ongoing focus group feedback and materials revision.

Project Goals and Objectives

Objective 1. Development and testing of materials. After identifying 26 candidate video vignettes, 16 draft cases were developed. Each draft started with a target learning topic for participants and rough-edit video. Of the 16 draft cases, 10 were fully developed into case activities with associated notes for facilitators of case discussions.

Objective 2. Research on outcomes for novice college mathematics instructors and their students. Several short research projects were completed that investigated instructor knowledge changes and student learning. A listing of disseminated results is included in the Project Director's final report.

Objective 3. Assess impacts of project on stakeholders. Stakeholder questions and answers:

(1) Stakeholders: Diverse college students, parents, faculty, administrators, granting agency.
  Q: *Is mathematics more accessible in classes taught by instructors trained with the video case materials?*
  A: Evidence from the qualitative analysis of student conversations about and during mathematics lessons in the question strategies study suggests that case use supports increased accessibility of mathematical concepts, particularly cases that offer instructors the chance to reflect on understanding student thinking and build anticipations about the same. Research on college algebra learners suggests undergraduate students of teachers who learn about teaching with video cases may be more likely to attempt and/or persist in problem solving on exams.

(2) Stakeholders: Parents, students, administrators.
  Q: *Is learning in undergraduate mathematics improved?*
  A: Results of the small study of college algebra students in 22 classes, where students engaged with more final exam items, attempting more solutions, than comparison students are some evidence the answer is Yes.

(3) Stakeholder: Granting agency. Q: *Was a broad and sustainable national impact achieved?*
  A: The widespread focus group sites indicate a broad impact and existence of a website for at least the next five years as contracted at the end of the project suggests some sustainability. Whether the web site rollout of materials and subsequent facilitation supports lead to broad and sustained impact is yet to be determined.

(4) Stakeholders: Administrators, TAs, TA trainers.
  Q: *Is TA training facilitated and improved?*
  A: The overwhelming response from this group is that the materials are helpful and better discussion starters than most existing materials. Examples of comments from focus group testers of materials:

> Comment 1. Last Thursday I did the group work case with my graduate students in the [teaching seminar] class. It went very very well and students were super positive about the experience.
>
> Comment 2. In my position as a peer instructor (not faculty or a course coordinator), I felt free to share my own experience as an instructor, but made sure not to "teach." This is normal protocol for social scientists in seminars, but perhaps harder for mathematicians. The instructors in my group had fun with this-- a truly equal discussion is a rarity in our department. To this end, I was not standing at any point-- I was sitting.

Comment 3. As a future community college teacher, I like the use of video cases…, seeing authentic situations helps me look at the way I teach compared to how someone else teaches. This exposure to the different teaching styles and seeing the different outcomes allows me to gain more insight into the way I want to teach and the way I want my students to learn.

Comment 4. I was surprised (pleasantly) by the emphasis of the use of cases as a training tool for graduate students, as opposed to professional development for existing mathematics professors. I imagine that cases would be highly effective for this purpose as well as a highly effective tool for preparing graduate students.

(5) Stakeholders: TAs, new faculty:
Q: *How am I ever going to use this?*
A: TAs and faculty who work with them (e.g., as course coordinators) reported two ways to use the cases. First, they said there were good ideas for teaching in the materials, and cited the activities that the case instructors were using as things they might use in their own classes. Secondly, especially for the less experienced teachers, just the chance to talk about teaching was a valued way to use the cases (see comment 2 above).

Objective 4. Scaffold sustainability. The project director and senior personnel spent the project years cultivating relationships with many institutions around the country in order to support sustainability. The sessions at national meetings that showcased materials included successful recruitment of sites for focus group piloting of materials (see list, p. 1). Contacts were made with faculty at universities on both coasts as well as the Central and Southern United States in order to have feedback from a diverse set of users (master's-only as well as doctoral granting institutions). After the project consultant from Georgia dropped out of the project in Year 1, the project did not incorporate a significant site among the south eastern universities. Given feedback from facilitators, a clear next step in extending sustainability is further development of facilitator preparation/workshop activities.

Papers and workshops produced by project personnel, related to the project. In reverse chronological order

* addresses novice instructor learning
** addresses undergraduate student learning outcomes
Green font for mathematics faculty collaborators.
Purple font for graduate student collaborators.
Black font for mathematics education faculty and project personnel.

Hauk, S., Tsay, J.J., Judd, A. B., & Davis, M. K. (2011). Case study of a PhD mathematician teaching college algebra. *Educational Studies in Mathematics*. *78*(2), 205-299; DOI:10.1007/s10649-011-9323-4.

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*Yestness, N., Hauk, S., & Awill, N. (2010, February). Teaching assistants and mid-term evaluation feedback from students. In S. Brown (Ed.), *Proceedings of the 13th conference on Research in Undergraduate Mathematics Education* (Raleigh, NC). Electronic proceedings.

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*Hauk, S., Mendoza-Spencer, B., & Toney, A. (2009, February). Teaching this beautiful math. In M. Zandieh (Ed.), *Proceedings of the 12th conference on Research in Undergraduate Mathematics Education* (Raleigh, NC). http://rume.org/crume2009/Hauk_SHORT.pdf
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Conclusion

In summary, as of this writing (summer 2011) the materials are almost ready for editorial review by the potential publisher. Some aspects of the project have been stalled by slow cooperation at the institutional level. Focus groups began in year two and continued in out years. Field testing was folded into the focus group work. Communication continued to be an important aspect in the development of the video cases and the development team faced and addressed many communication challenges.