

**Annual Report for Period:**09/2011 - 08/2012**Submitted on:** 06/20/2012**Principal Investigator:** Spence, Dianna J.**Award ID:** 1021584**Organization:** North Georgia College**Submitted By:**

Spence, Dianna - Principal Investigator

**Title:**

Discovery Learning Projects in Introductory Statistics

### Project Participants

#### Senior Personnel

**Name:** Spence, Dianna**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Dianna has been project coordinator and has directed the efforts of other project personnel. She has organized and been lead presenter for workshops and pilot instructor training. She has been the lead author on the student guide, directed the development of the other curriculum materials, and edited the final versions of all curriculum materials. She has been the primary contact to give directions to and make arrangements with all pilot instructors. She has written bi-monthly (and later quarterly) reports for the project's external evaluator.

**Name:** Bailey, Brad**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Brad has helped conduct workshops and pilot instructor training sessions. He has also been in charge of the quantitative data entry and data analysis.

**Name:** Hix, Sherry**Worked for more than 160 Hours:** Yes**Contribution to Project:**

Sherry worked with Dianna (PI) to revise the curriculum materials. She has also participated with Dianna and Brad (co-PI) to deliver instructor workshops at USCOTS and Joint Mathematics Meetings (JMM), as well as the workshops for the pilot instructors who are participating in this study.

**Name:** Phipps, Marnie**Worked for more than 160 Hours:** No**Contribution to Project:**

Marnie has helped to develop the qualitative protocols for use when the pilot instructors implement projects in their courses. She has also performed some preliminary coding and analysis of qualitative survey questions administered to instructors who attended the USCOTS workshop.

**Name:** Cooper, Thomas**Worked for more than 160 Hours:** No**Contribution to Project:**

Thomas helped write some of the material for the Student Guide that we developed to help facilitate projects in statistics classes.

#### Post-doc

#### Graduate Student

#### Undergraduate Student

#### Technician, Programmer

## Other Participant

### Research Experience for Undergraduates

#### Organizational Partners

#### Other Collaborators or Contacts

During the first year of the project, we held a one-day meeting (in April 2011) with our advisory panel to review our materials, instructional goals, instruments, research goals, and data analysis plans. The individuals on the panel were Jackie Miller (Ohio State University), Adam Molnar (Bellarmine), Kelly Price (Forsyth County Schools), Allan Rossman (Cal Poly), Julia Sharp (Clemson University), and Ellen Usher (University of Kentucky). Our external evaluator, Kenzie Cameron (Northwestern University) was also present for this meeting. Since that time, we have disseminated instruments and materials to the panel via e-mail for feedback.

#### Activities and Findings

#### **Research and Education Activities: (See PDF version submitted by PI at the end of the report)**

Project research activities:

- 1) Eight pilot instructors are participating in research by collecting data in a 'control' setting using instruments we have provided; teaching an 'experimental' section of statistics using our curriculum materials; and collecting a second set of data in this 'experimental' setting. A schedule for implementation of this plan was communicated to the pilot instructors, who confirmed their ability, authorization, and intent to participate. All pilot instructors collected and submitted their control data during the 2011-2012 academic year. Experimental sections will be taught during AY 2012-2013, with experimental data collected in conjunction with those courses. In preparation for teaching the experimental sections, Pilot instructors attended training sessions (conducted by Dianna, Brad, and Sherry) in April and May 2012 (see Presentations and Workshops, below).
- 2) Three instruments to measure student outcomes were revised. These are the instruments to measure student content knowledge, perceived usefulness of statistics, and statistics self-efficacy. We validated the revised instruments by administering them to 10 sections of undergraduate statistics students here at NGCSU, resulting in a data set of size 259. Reliability analyses and an exploratory factor analysis were conducted with this data set. No revisions to the instruments were deemed necessary.
- 3) An additional instrument was developed to measure attributes of the instructor. It is believed that characteristics of the instructor may mediate the outcomes associated with using the discovery projects to teach statistics. Two broad categories of characteristics were targeted-- a) Instructor orientation toward facilitating discovery learning; and b) Instructor pedagogical content knowledge in statistics. We validated this instrument by administering it to 19 instructors who participated in our workshop at USCOTS. The instrument also contained a qualitative component, which was coded and analyzed for exploratory purposes. This instrument was administered to our pilot instructors when they attended training. Analysis of these results is forthcoming.
- 4) A preliminary plan was developed for qualitative data collection and analysis to be carried out during and after the materials pilot phase. Grounded theory was identified as the framework for the qualitative inquiry; instructor journal prompts and interview questions were developed.
- 5) The curriculum materials originally authored in Phase I were overhauled, both in organization and content. The three main work products from this effort are the Student Guide, the Instructor's Guide, and the Technology Guide, as well as 3 instructor appendices and 5 other appendices for both students and instructors.
- 6) The advisory panel was convened (April 2011) to review the curriculum materials, the quantitative and qualitative research plans, and the instruments that have been developed so far. This one-day meeting was very productive: Refinements to the materials and instruments were identified; many of these refinements have since been implemented, and others are planned. Other materials have subsequently been sent to advisory panel members for feedback.

Presentations and Workshops:

Based on the materials and instructional strategies developed for the grant, the following presentations have been made to date:

- 1) Regional conference presentation at Georgia Mathematics Conference: 'Student Projects in Statistics: Finding Good Data and Measuring Student Outcomes' - October 2010
- 2) Teaching and learning webinar for CAUSEWeb: 'Facilitating Student Projects in Statistics' - December 2010
- 3) Poster presentation at Joint Mathematics Meetings of the AMS and MAA: 'Discovery Learning Projects in Introductory Statistics' - January

2011

- 4) Poster presentation at NSF CCLI Conference: 'Discovery Learning Projects in Introductory Statistics' - January 2011
- 5) A 3-day instructor workshop on facilitating discovery projects during the pre-conference sessions of USCOTS (United States Conference on Teaching Statistics) - May 2011
- 6) A 1-day instructor workshop during the pre-conference sessions of JMM (Joint Mathematics Meetings) - January 2012
- 7) A paper presentation at ICTCM (International Conference on Technology in Collegiate Mathematics): 'Technology-Rich Projects in Statistics' - March 2012

The external evaluator for this project also prepared an annual report of project activities and progress. This report is attached as a supplemental file.

### Findings:

#### I. Quantitative findings from validation of the 3 student instruments:

A Cronbach alpha of 0.894 was obtained for the Self-Efficacy Scale. A Cronbach alpha of 0.906 was obtained for the Perceived Utility Scale (with appropriate questions reverse-coded). For both of these scales, we also examined the Scale-Alpha-if-Item-Deleted; none of these alphas were higher than the scale alpha.

In the EFA, all items on the Perceived Utility Scale loaded on a single factor. Most items on the Self-Efficacy Scale loaded onto one factor, with one group of items loading on another factor; this group of items related to the planning and implementation of data collection and sampling. This outcome was not surprising, given that this skill reflects a distinct domain within the more general set of statistical skills on which students were asked to rate their self-beliefs.

The Content Knowledge portion of the student instrument had a KR-20 score of 0.662. Since the scale is only 17 items in length, and neither the difficulty nor the content of the items are consistent, this KR-20 score was deemed acceptable.

#### II. Quantitative findings from validation of the instructor instrument:

The instructor instrument consisted of 4 multiple-choice questions on pedagogical content knowledge (PCK), 2 multiple-choice questions about helping student construct surveys, and a set of 12 Likert-scale items that measure Disposition and Orientation (DO) toward facilitating students' discovery and independent work.

The KR-20 for the 4 PCK items is 0.796. Understandably, the two questions about survey construction really don't correlate at all with the four PCK questions; hence, the Cronbach alpha for the six multiple choice questions combined is 0.496.

When three of the Likert scale questions are adjusted to reflect reverse scoring, the DO scale has a Cronbach alpha of 0.553. Deleting Item 2 raises the Cronbach alpha to 0.653. With Item 2 removed, deleting first Item 1, then Item 6 leads to Cronbach alphas of 0.697 and 0.723, respectively.

#### III. Qualitative findings from validation of the instructor instrument:

##### Primary Research Question:

Are these teachers oriented toward discovery learning as indicated by the type and amount of guidance they give?

Based on the responses, participants were classified into four groups: 1) Fully open to discovery learning; 2) Moderately open to discovery learning; 3) Not open to discovery learning; and 4) Indeterminate. Features of responses in each category are discussed below.

##### 1) Fully open to discovery learning (8 responses)

? These instructors question more than one aspect of the student's proposed project.

? They question the students' knowledge of fundamental issues such as parameters versus statistics or type of t-test chosen.

? They also try to accommodate the student's ideas and guide her toward matching the data in some way. Accommodation and guidance by means of suggestion are two key indicators for openness to discovery learning.

##### Key aspects of coding:

? accommodation of student ideas

? guidance as to what she should consider when working through the project

? multiple components of the projects reviewed

One answer in this category was a bit tricky; one could interpret the response as extreme openness to discovery learning. Accommodating really is not the right word, as no guidance is given. The student is allowed the freedom to experience independent learning, even in the form of a failed initial attempt at the project.

2) Moderately open to discovery learning (5 responses)

? These instructors typically asked only one guiding question, but give no other guidance.

? These instructors focused primarily on how the students intended to match the cities.

Key aspects of coding:

? one dimensional comments

? minimal feed back given

&#8195;

3) Not open to discovery learning (4 responses)

? These instructors are not focused on the student's learning of statistics.

? They tell the student the steps or the direction they should take as opposed to questioning the student.

? These instructors are concerned with other ideas such as the topic under study (e.g, their comments reflect concern for understanding crime, rather than the student understanding how to interpret the information she found.)

Key aspects of coding:

? Focus on issues other than the students understanding of the statistical procedure itself

? Minimal questioning; more direct instruction to student about what they should do

4) Indeterminate (2 responses)

Not enough information was provided in these responses to discern a) the instructor's own content knowledge; and b) the instructor's orientation toward accommodating or guiding the student through any particular discovery.

### **Training and Development:**

During AY 2010-2011, Sherry Hix and Marnie Phipps both used the instructional strategies and curriculum materials developed through this work to teach undergraduate statistics for the first time, with Dianna (PI) as mentor.

Sherry also conducted some independent research regarding the alignment of this instructional approach with recognized standards for teaching mathematics; she applied this research when authoring revisions to the instructor's guide.

Marnie Phipps conducted research regarding grounded theory, which she used in identifying and planning qualitative protocols appropriate for the next phase of the project.

### **Outreach Activities:**

Dianna (PI) and Brad (co-PI) collaborated with Robb Sinn (former PI during Phase I of this project) on a proposal for a campus center for statistical research, called CUSTAR (Center for Undergraduate Statistical Research). The three proposed advisors for the center were Robb, Brad, and Dianna. Under the direction of the advisors, students would conduct statistical research service projects for both the campus and community, following a model similar to that of the authentic projects implemented in more traditional classrooms as a direct part of the research for this grant.

Benefits are envisioned not only for the students who conduct the research, but for members of the campus and community who become aware of the center and the types of research questions that can be pursued with the help of student researchers and their advisors.

This center has been well defined and proposed to the Dean of the school, and it has received positive reaction. Support for the center has been under consideration, but has been delayed due to the pending consolidation of our university with another local college.

Dianna has agreed to partner with academic coordinators at Da Vinci Academy, a local magnet school for middle school students who are inquisitive, creative, self-motivated, and often gifted. (Fewer than 50% of applicants are accepted to the school). The coordinators plan to introduce AP Statistics to their most advanced 8th grade math students and would like to use project-based learning. The materials developed for this grant are well-suited to their goals.

### **Journal Publications**

**Books or Other One-time Publications****Web/Internet Site****URL(s):**

<http://faculty.northgeorgia.edu/DJSpence/NSF/materials.html>

**Description:**

This site contains all the curriculum materials developed with support from this award. The materials will be used by pilot instructors to facilitate projects in their statistics classes. The materials are also disseminated to conference attendees and workshop participants.

**Other Specific Products****Product Type:**

**Teaching aids**

**Product Description:**

Student Guide: Discovery Projects in Introductory Statistics

Bound booklet, unpublished.

Authors: Dianna Spence, Sherry Hix, Thomas Cooper, Robb Sinn

Body: 22 pages

Appendices: 56 pages

**Sharing Information:**

Printed and bound copies have been given to each pilot instructor.

Electronic copies (pdf) are available at the URL provided under Internet Dissemination. Access to this website is unrestricted and is communicated to instructors at workshops, conferences, and through personal communication with colleagues in the field.

**Product Type:**

**Teaching aids**

**Product Description:**

Instructor Guide: Discovery Projects in Introductory Statistics

Bound booklet, unpublished.

Authors: Sherry Hix, Dianna Spence

Body: 14 pages

Appendices: 19 pages (instructor only) + 56 pages (student/instructor)

**Sharing Information:**

Printed and bound copies have been given to each pilot instructor.

Electronic copies (pdf) are available at the URL provided under Internet Dissemination. Access to this website is unrestricted and is communicated to instructors at workshops, conferences, and through personal communication with colleagues in the field.

**Product Type:**

**Teaching aids**

**Product Description:**

Statistics Project Technology Guide: Discovery Projects in Introductory Statistics

Bound booklet, unpublished.

Authors: Brad Bailey, Dianna Spence

22 pages

**Sharing Information:**

Printed and bound copies have been given to each pilot instructor.

Electronic copies (pdf) are available at the URL provided under Internet Dissemination. Access to this website is unrestricted and is communicated to instructors at workshops, conferences, and through personal communication with colleagues in the field.

### Contributions

#### **Contributions within Discipline:**

The curriculum materials and instructional strategies developed and refined during this project are designed to help instructors of statistics make the subject more meaningful to their students by facilitating discovery projects as part of the students' experience when learning about statistics. The materials have been expanded to include more inquiries and more sources of data that are relevant to students' lives.

The content knowledge instrument has been refined to reflect more precisely the benefits that students are expected to experience as a result of participating in these projects. The instrument measures content knowledge not only of procedures and concepts associated with linear regression and t-test analysis, but also of issues regarding data collection and sampling.

#### **Contributions to Other Disciplines:**

Colleagues in other departments at our institution have used our techniques and resources to implement similar projects in classes where statistical inquiry is emphasized. These disciplines include psychology, sociology, and criminal justice.

At conferences where we have presented our work, faculty in other disciplines have expressed interest in our materials for possible use in their classes. We have provided them information about how to access the curriculum materials that we have developed. The most common of these disciplines have been psychology and sociology.

#### **Contributions to Human Resource Development:**

We developed and refined one instrument to measure students' perceptions of the usefulness of statistics. We developed and refined another to measure students' beliefs in their ability to use and work with statistics. Both of these instruments will help identify: a) which students have dispositions that will lead to increased engagement in statistics; and b) what impact our discovery projects will have on these dispositions.

#### **Contributions to Resources for Research and Education:**

The instruments developed in Phase I have been revised and validated. These are resources that will be available for use in future research: they are a specialized content knowledge instrument, a perceived usefulness of statistics instrument, and a statistics self-efficacy instrument.

In addition, another resource that may prove useful for researchers is the new instrument that we developed to measure instructor orientation. This instrument measures both pedagogical content knowledge for statistics and disposition toward facilitating discovery projects in statistics classes.

#### **Contributions Beyond Science and Engineering:**

This work is targeted toward improving the teaching of undergraduate statistics courses taught to students who will not necessarily major in a STEM discipline. Many plans of study require such a statistics course, including programs for business, education, psychology, and social sciences. A reasonable estimate is that at least three quarters of our undergraduates will be required to take such a course. Part of their liberal arts education should include a better appreciation for and a better understanding of statistical processes and statistical concepts. The public welfare will be much better served if we can produce graduates in all fields who have greater statistical literacy, a better appreciation of statistics, and more competence in both recognizing and using statistical constructs.

Our hope and our projection is that when the work from this project is analyzed, it will demonstrate: 1) that our techniques and materials have the capacity to improve statistical literacy and awareness among college graduates; and 2) what measures can be taken to ensure that this improvement is achieved more consistently and predictably.

### Conference Proceedings

### Special Requirements

**Special reporting requirements:** None

**Change in Objectives or Scope:** None

**Animal, Human Subjects, Biohazards:** None

**Categories for which nothing is reported:**

Organizational Partners

Any Journal

Any Book

Any Conference

## **GRANT OVERVIEW**

Funded by a 4-year National Science Foundation Grant Award (DUE-1021584), the Discovery Learning Projects in Introductory Statistics at North Georgia College & State University (NGCSU) focuses on extending the research and curriculum development from a National Science Foundation Phase I CCLI project (2007 – 2010). Specifically, the goals of the project include:

1. Promote vertical integration and wider university utility of Discovery Project Curriculum Materials
2. Revise quantitative instruments from Phase I and use these to analyze student outcomes
3. Use qualitative research to explore interactions among teachers, students and discovery projects
4. Widely disseminate improved curricular materials and quantitative/qualitative research results

[NOTE: Upon review of the proposal, and prior to being awarded funding, investigators were asked to remove entirely the plan to adapt the materials for use specifically in high schools, as well as to remove the portions of the proposal to include secondary teachers as pilot instructors. Thus, the original second portion of Goal #1 (adapting materials for early secondary curricula) is no longer relevant to the project.]

## **EVALUATION PERIOD**

This grant project period began in September 2010; this second annual evaluation report reflects feedback from the external evaluator (Kenzie A. Cameron, PhD, MPH) based on the progress of the research team from April 2011– March 2012. The research team provided the external evaluator with Progress Reports outlining Tasks completed and immediate goals for the subsequent two months. These reports were originally provided bimonthly (July 2011, September 2011, November 2011); it was mutually agreed that as of January 2012 the reports could be provided quarterly. Thus this annual report also includes progress as of the quarterly report received March 2012. Note that the external evaluator and the study team agreed that bimonthly reports from March 2011 and May 2011 were not necessary as there was an Advisory Panel meeting held Tuesday, April 5, 2011 on-site at NGCSU in Dahlonega, GA, which the external evaluator also attended.

## **EVALUATION YEAR 2**

The project team responded very favorably to the feedback they received from the Advisory Panel. A full day Advisory Panel meeting was held April 5, 2011, as reported in last year's evaluation. The project team received a significant amount of professional critique and feedback, and incorporated it as they continued the project. The team successfully distilled the feedback and identified areas of focus (e.g., revisions of the instruments), as well as areas that the team felt would be better addressed later on during the project period (e.g., qualitative protocol and analyses).



The control phase of the project was completed during Fall 2011 and Spring 2012. Of the 5 instructors participating as control sections in Fall 2011, 4 administered the instruments and returned them to the team. The 5<sup>th</sup> instructor was in a bad accident, resulting in hospitalization and missing the remainder of the semester. This instructor is teaching statistics in Spring 2012 so will complete the control phase with her Spring semester section. Data collected in the Fall semester has been scanned in and, as of March 2012, was in the process of being verified/corrected as needed. Those instructors participating in the control phase in Spring 2012 were sent all necessary instruments for completion in the Spring 2012 courses (in progress as of most recent quarterly report March 2012). Instructors are attending training for the treatment groups, and the treatment groups will commence with the classes taught in Fall 2012 and Spring 2013.

The Qualitative Protocol and plan were verified such that analyses will assess: how the materials sent by the pilot instructors relate to: 1) the "treatment" classes that the instructors teach during the next academic year with our projects and guidelines; 2) the outcomes of those treatment classes; 3) the instructors' descriptions of their experiences teaching those treatment classes, from the surveys and interviews; 4) the changes in the syllabus for those treatment classes; and 5) the instructors' responses to the qualitative items on the instructor survey, which was administered at the pilot instructor workshop. Instructors' CV, statement of teaching philosophy, and copy of the course syllabus were requested from instructors involved in control group sessions. As of May 1, 2012, 5 of 8 have been received.

Seven distinct phases were identified as elements of the qualitative research plan to guide the iterative data collection and analysis scheme. Based on feedback received from the Advisory Board meeting, the plan includes collecting and analyzing certain data elements from all 8 participating instructors (basic journal prompts and artifacts); collecting more in-depth study elements on 4-6 instructors; and follow-up interviews (with possible multiple site visits for class observations and students interviews) for 2-4 of the participating instructors.

In addition, a preliminary data collection related to the Qualitative Analysis was performed and analyzed using the data from the Teacher Orientation Instrument distributed at the May 2011 USCOTS Workshop. A total of 19 participants responded to the qualitative item (question 10) of the orientation survey. Preliminary analyses indicated that participants were not explicit about expressing or withholding approval when provided a case example in order to ascertain each instructor's openness to facilitating discovery learning. Analyses classified the respondents into four groups: (1) fully open to discovery learning, (2) moderately open to discovery learning, (3) not open to discovery learning, and (4) indeterminate.

**Overall Evaluation for Year 2:** Overall, the Discovery Learning Projects in Introductory Statistics remains on track for the long-term and intermediate goals set by the project team. The team effectively addressed the quantitative elements of the project, in particular the measurement issues, with revisions of the instruments. The Advisory Panel members responded to the revisions, and it was agreed that the

instruments were ready to move forward. The project team focused on revising the Student and Instructor Guides and prepared examples and extra Appendices to accompany the guides. The guides, in addition to being provided at the instructor training sessions, are available on-line at <http://faculty.northgeorgia.edu/DJSpence/NSF/materials.html>. The team has also developed more fully the qualitative elements of the proposed project, identifying and specifying an overall data collection and analysis plan (while still allowing for each of the identified seven phases to be shaped by the analysis of data from previous phases as the team proceeds through the study). The team remains an excellent example of academic collaboration and remains committed to, and passionate about, the proposed project.

### **Areas of Strength:**

Specific areas of strength related to this project include:

- Collaborative nature of project team, evidence of respect and collegiality among team members
- Team members assigned to project tasks based upon individual strengths, prior experience
- Organizational processes, including:
  - identification of overall project goals
  - identification of intermediate goals
  - Reports of progress, challenges, future plans
- Advanced attention to dissemination needs. Although the bulk of the dissemination of materials and processes related to this project was planned for late Year 2 continuing, the team has consistently identified opportunities to present their findings and their work at national and international conferences, including developing and leading a 3-day pre-conference workshop prior to the USCOTS meeting. The workshops allowed the team to refine their instruments and presentation of materials, which gave them, essentially, a dress rehearsal for the training for the treatment instructors.
- Measurement of Instructor Orientation: the Advisory Panel provided extensive feedback on the measurement of instructor orientation. The project team paid careful attention to this feedback and revised the instrument as well as the Instructor Guide as a result.
- Greater development of a qualitative research plan, which took into account recommendations from the Advisory Board meeting in May 2011, as well as being responsive to last year's evaluation. The team has provided an overarching view of the intended seven qualitative phases of the project, while retaining the ability to shape and inform the later phases of the project by the analyses and results from earlier phases. The seven-phase qualitative research plan has identified the critical qualitative elements of the overall project and meets the expectations of progress for qualitative research.

### **Areas of concern/needing increased attention (Challenges):**

Areas where the project team should place increased focus:

- The project team will want to insure their ability to conduct all planned treatment groups in the 2012 – 2013 academic year, as they are behind schedule. Of note, the delay is in particular related to the careful attention and feedback the Advisory Panel provided the project team, as well as the project's team integration of the feedback into their instruments (finalizing the instruments took longer than expected). I believe that the instruments are much better due to this delay, thus in the end the research is likely to be stronger.
- Dissemination: although dissemination has been constant and impressive throughout the project, some elements that were initially intended to be disseminated earlier in the project remain on hold. There appear to be reasons for such delay; however, the project team may wish

to reassess the timeline of some of the materials (e.g., submission of the instrumentation journal article) to ensure it remains on their radar, or is at least identified as becoming a priority at some point during the project.

**Overall Specific Recommendations:**

- Continue the excellent work related to the quantitative measures and analysis
- Continue to spend focused time developing your qualitative design and analysis, including interview protocols and analysis. Consider providing a revised timeline for the qualitative analyses with upcoming quarterly reports (as some of the originally proposed timeframes for the qualitative elements understandably have shifted due to the shift in time frame for the control and treatment groups).
- Ensure that your final quantitative and qualitative measurements are both synergistic and complementary
- Consider developing a revised timeline for multiple elements of the project (e.g., instrumentation manuscript, treatment collection of treatment group data, interviews of treatment instructors) to better match the current reality of the project. In my experience, no project ever follows the exact timetable planned; the fact that this project is not exactly following the original timeline is not of concern to me. But I do believe that having a revised timetable for the proposed work would be valuable to all members of the team and would allow you to identify more accurate milestones for data collection and analysis. It will also allow the team to proactively identify times during the year where some members may be overextended to ensure there is sufficient assistance available for continued progress on the project.
- Continue the excellent forward progress and team collaboration

**External Evaluator's Conclusion:** The Discovery Learning Projects in Introductory Statistics Project Team is making excellent progress toward their overall goals, as well as toward intermediate goals. Despite the fact that some elements have been delayed, I remain fully convinced that the team will be able to complete the project in the proposed time period. The project is slightly behind the original proposed timetable in terms of implementation of treatment groups, but the rationale for this delay is strong. Quite simply, it makes sense to conduct the control groups within one school year and the treatment groups within another school year as often outside influences such as institutional or national policies take effect each academic year. In addition, the initial delay with the control groups was based on recommendations and careful attention to Advisory Panel feedback from April 2011. The study team seems to be in good position to continue to make excellent strides toward project completion, and as a matter of fact has already completed some tasks originally slated in Years 3 and 4, which also leaves them some extra time/room to make up any work remaining from Year 2.

With the completion of the revisions of the Student and Instructor Guides, as well as the accompanying Appendices, I am particularly interested in seeing the results as the team moves forward. They continue to demonstrate their commitment to the project, as well as their dedication to ensuring that the project

achieves its stated goals, even with some delays. Again, the team remains outstanding in its attention to dissemination of the curricular materials and eventual results.

Appendix 1: Record of reports from Study Team to External Evaluator

Appendix 2: Scheduled Tasks/Goals and Progress Year 2

Appendix 3: Biography of External Evaluator: Kenzie A. Cameron, PhD, MPH

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**APPENDIX 1: Record of reports from Study Team to External Evaluator**

Since the start of the project, the following progress reports have been received:

- September 2010 Bi-Monthly Report (initial report/project overview)
- November 2010 Bi-Monthly Report
- January 2011 Bi-Monthly Report
- July 2011 Bi-Monthly Report\*\*
- September 2011 Bi-Monthly Report
- November 2011 Bi-Monthly Report
- March 2012 Quarterly Report

\*\*Note that the external evaluator and the study team agreed that bimonthly reports from March 2011 and May 2011 were not necessary as there was an Advisory Panel meeting held Tuesday, April 5, 2011 on-site at NGCSU in Dahlonga, GA, which the external evaluator also attended. At the meeting the entire Advisory Panel was provided an extensive update (with accompanying written documentation) of the progress of the project to date.

**APPENDIX 2: Scheduled Tasks/Goals and Progress Year 2**

**SCHEDULED TASKS/GOALS and Progress**

**Key:**

**Goals**

- #1 Promote vertical integration and wider university utility of Discovery Project Curriculum Materials
- #2 Revise quantitative instruments from Phase I and use these to analyze student outcomes
- #3 Use qualitative research to explore interactions among teachers, students, and discovery projects
- #4 Widely disseminate improved curricular materials and quantitative/qualitative research results

*If goal or status is presented in the table in light grey text, that indicates that the progress was achieved/completed during Year 1 (Academic Year 2010 – 2011) and thus was reported on the External Evaluation for Year 1. The first table below notes progress specifically toward initially defined Year 2 goals; the next table reports a running summary of progress toward all goals (including Year 1 progress). Items in the table appearing with a strike through them indicate items proposed in the original grant submission but removed based on recommendation of funder.*

<b>Year 2: Academic Year 2011 – 2012</b>			
<b>Goal</b>	<b>Task/Measurable Objective</b>	<b>Responsible Project Personnel</b>	<b>Status as of 05/01/2012</b>
#2, #4	Instrumentation journal article to disseminate analytic tools to research community (to be submitted to <i>Applied Measurement in Education</i> )	Spence, Bailey, Sinn	<b>IN PROGRESS/ON TEMPORARY HOLD:</b> Current focus is on control and treatment group implementation; drafts in progress
#2	Collect control group data from all pilot test sites <ul style="list-style-type: none"> <li>• 8 colleges and universities</li> <li>• <del>3 high school AP Statistics classes</del></li> <li>• <del>20 early secondary math classes</del></li> </ul>	Bailey	<b>IN PROGRESS:</b> Control sections conducted in Fall 2011 (4) and Spring 2012 (4) semesters



<b>Year 2: Academic Year 2011 – 2012</b>			
#2	Conduct training for college pilot instructors	Spence, Bailey, Hix	<b>IN PROGRESS:</b> First pilot workshop held 4/27/2012
#2	Coordinate treatment groups for college instructors	Bailey, Spence	<b>IN PROGRESS:</b> one-day training sessions held April 27, 2012 AND May 7, 2012
#2	Collect treatment group data from college instructors	Bailey	<b>PLANNED for FALL 2012, SPRING 2013:</b> control groups completed Spring 2012
#3	Conduct interviews and observations in pilot instructor classrooms; code and analyze all data	Phipps, Cooper, Hix	<b>PLANNED for FALL 2012, SPRING 2013:</b> control groups completed Spring 2012; interviews related to treatment sections
#2	Analyze preliminary quantitative data (college sites)	Bailey, Sinn, Spence	<b>PLANNED for FALL 2012, SPRING 2013:</b> control groups completed Spring 2012
#4	Disseminate teaching materials/methods and preliminary results at local and national conferences: <ul style="list-style-type: none"> <li>• 1-day pre-conference workshop conducted at the Joint Mathematics Meetings in January 2012</li> <li>• Poster presentation at MAA-NSF joint poster session at the Joint Meetings (January 2012)</li> <li>• Presentation on the use of technology in the implementation of statistics projects presented at the International Conference on Technology in Collegiate Mathematics (ICTCM), March 24, 2012 (manuscript submitted for proceedings)</li> </ul>	Bailey, Hix, Spence	<b>ON-GOING:</b> dissemination began in Year 1 ahead of schedule, is continuing

**Additional Tasks Completed Year 1-2 of Grant:**

**ADM = Administrative**

<b>Years 1 - 2: Academic Year 2010 – 2012</b>			
<b>Goal</b>	<b>Task/Measurable Objective</b>	<b>Responsible Project Personnel</b>	<b>Status as of 05/01/2012</b>
ADM	ADMINISTRATION: Advisory panel meeting scheduled and held (04/05/2011)	Briggs, Sinn	<b>ON TIME:</b> Confirmed as of 11/08/2010
ADM	Advisory Panel planning	Spence, Bailey	<b>COMPLETE</b>
ADM	Confirm availability of 8 pilot instructors	Spence	<b>ON TIME:</b> Confirmed as of 11/08/2010
ADM	Reconfirm availability of pilot instructors for Spring 2012	Spence	<b>ON TIME:</b> Completed as of 10/7/2011
ADM	Brief lead project personnel for other curriculum development revisions; define schedule of work for revisions	Hix	<b>ON TIME:</b> Confirmed as of 11/08/2010
ADM	TECHNOLOGY/ADMINISTRATION: Software and scanner ordered and delivered	Spence, Bailey	<b>ON TIME:</b> Received as of 11/08/2010
ADM	Keypoint software training	Spence, Bailey	<b>ON TIME:</b> completed 12/15/2010
ADM	IRB resubmission, updated	Spence	<b>COMPLETE:</b> IRB approval received 9/23/2011
ADM	TECHNOLOGY/METHODS: ordering NVivo software	Phipps, Spence	<b>COMPLETE:</b> July 2011
#1	Revise collegiate instructor and student guides so that either linear regression projects or t-test projects can be done first and so that either project could be implemented stand-alone	Spence, Sinn	<b>ON TIME:</b> COMPLETE Year 1
#1	Revise Technology Manual	Bailey	<b>ON TIME:</b> First draft complete as of 11/08/2010
#1	Update Technology manual so that all formulas and special characters are readable	Bailey	<b>ON TIME:</b> COMPLETE
#1	Prior to scheduled pilot, beta test updated project designs in NGCSU statistics classes	Spence, Bailey	<b>COMPLETED:</b> Carried out in Fall 2010 and Spring 2011
#1	Develop streamlined version of the Discovery Project Guides for “early high school” statistics curricula	Hix, Cooper	(Per request of funding agency, plan to adapt materials for use in high schools was removed)

Years 1 - 2: Academic Year 2010 – 2012			
<i>Goal</i>	<i>Task/Measurable Objective</i>	<i>Responsible Project Personnel</i>	<i>Status as of 05/01/2012</i>
#1	Development, Revision, and finalization of revised Student guide; Instructor Guide, Appendices	Spence, Hix, Cooper	<b>COMPLETE as of April 2012</b> Available on-line
#2	Revisions to content knowledge instrument	Spence, Sinn, Bailey	<b>REVISIONS ON TIME/COMPLETED:</b> as of July 2011
#2	Revisions to self-efficacy instrument	Spence, Sinn, Bailey	<b>REVISIONS ON TIME/COMPLETED:</b> as of July 2011
#2	Revisions to perceived usefulness instrument	Spence, Sinn, Bailey	<b>REVISIONS ON TIME/COMPLETED:</b> as of July 2011
#2	<del>Adapt instruments for secondary setting</del>	<del>Hix, Cooper</del>	(Per request of funding agency, plan to adapt materials for use in high schools was removed)
#2	Development, revision, and finalization of instructor orientation instrument	Spence, Bailey, Sinn	<b>COMPLETE:</b> revised and reviewed by Advisory panel summer 2011; completed by July 2011
#2	Instructor instrument administered to instructors who participated in the 3-day USCOTS workshop	Bailey, Hix	<b>COMPLETE:</b> workshop conducted May 17-19, 2011
#2	Validate all instrumentation at NGCSU (pre-pilot)	Spence, Bailey, Sinn	<b>COMPLETED:</b> July 2011 All three instruments administered to students in all sections of statistics at NGCSU at the end of Spring 2011 (n = 259)
#2	Prepare pilot tester training	Spence, Bailey, Sinn	<b>COMPLETED:</b> trainings held April 27, 2012 and May 7, 2012
#3	Qualitative responses of workshop participants collected for review and coding (preliminary data collection from USCOTS Workshop)	Phipps	<b>COMPLETED:</b> Responses collected May 2011; Analysis completed August 2011
#3	Develop overall plan for qualitative Research Component	Phipps	<b>COMPLETE:</b> plan complete, interviews to coincide with teaching of treatment sessions, analyses to follow

Years 1 - 2: Academic Year 2010 – 2012			
<i>Goal</i>	<i>Task/Measurable Objective</i>	<i>Responsible Project Personnel</i>	<i>Status as of 05/01/2012</i>
#3	Design teacher and student interview protocols (qualitative)	Phipps, Cooper	<b>IN PROGRESS/ON-GOING (delayed from Year 1)</b>
#3	Develop complete outline of contents of Instructor and Student Guides; draft at least 2 sections in each guide	Hix, Spence	<b>ON TIME:</b> Outline complete as of 04/05/2011: more than 2 sections drafted
#4	DISSEMINATION: Teaching and Learning Webinar for CauseWeb	Spence, Bailey	<b>AHEAD of schedule:</b> December 2011 <b>(dissemination originally scheduled Year 2)</b>
#4	DISSEMINATION: Proposal for pre-conference workshop at USCOTS submitted and accepted; workshop conducted May 2011	Spence, Bailey, Hix	<b>AHEAD OF SCHEDULE:</b> 3-day workshop conducted May 2011
#4	Revise general teaching article for re-submission to JSE	Spence, Bailey	<b>AHEAD OF SCHEDULE/IN PROGRESS:</b> outline complete, draft in progress (as of March 2012)
#4	DISSEMINATION: Manuscript accepted for publication in <i>The Journal of Mathematical Behavior</i>	Spence, Sharp (Clemson colleague), Sinn	<b>AHEAD OF SCHEDULE/ACCEPTED:</b> <b>Summer 2011</b> Published September 2011

Curriculum materials available on-line: <http://faculty.northgeorgia.edu/DJSpence/NSF/materials.html>

### **Appendix 3: Biography of External Evaluator**

Kenzie A. Cameron, PhD, MPH. Dr. Cameron is Research Associate Professor in the Division of General Internal Medicine and Geriatrics of Northwestern University Feinberg School of Medicine and a Member of the Robert H. Lurie Comprehensive Cancer Center at Northwestern University. She is a Core faculty member of the Agency for Healthcare Research and Quality-funded Center for Advancing Equity in Clinical Preventive Services at Northwestern, through which she the lead faculty member for the Survey and Qualitative Research Elements of the Research Methods and Analytic Core (RMAC). In addition, she holds a secondary appointment the Department of Preventive Medicine of Northwestern University Feinberg School of Medicine.

Dr. Cameron's research expertise includes message design, persuasion research, innovative studies of multimedia interventions, and behavior change. She has consistently used mixed-methodologies in her research, and has mentored other faculty members and fellows in both qualitative and quantitative study design and analysis. She has experience designing and conducting dozens of in person, telephone, Internet and mail surveys, and has used individual interviews, including cognitive interviews, and focus groups in her research methodologies. She completed a K01 Career Development Award through the Centers for Disease Control and Prevention, designing a multimedia intervention to promote influenza vaccination among African Americans ages 65+, a product which won the Public Health Education and Health Promotion Section's (American Public Health Association) Electronic Materials Award in 2008. She is Principal Investigator on a National Cancer Institute R01 through which she is conducting a randomized controlled trial of a physician and physician-patient intervention to increase colorectal cancer screening among patients seeking care at Federally Qualified Health Centers in the Chicago area. She is Principal Investigator on an AHRQ-funded center project related to understanding rates of pneumococcal vaccination among African American seniors and received funding from the National Institute on Aging (an R21 related to the development and testing of print messages related to seasonal influenza/vaccination) and has served as Co-Investigator on numerous grants awarded by the American Cancer Society, the Foundation for Informed Decision Making, the American Cancer Society – Illinois Division; the American Recovery and Reinvestment Act, the Agency for Healthcare Research and Quality, and the Hospital Research and Educational Trust. She and has worked extensively with colleagues in the Spinal Cord Injury and Disorders QUERI at the Hines Veterans Administration on studies related to influenza vaccination, pneumonia vaccination, and MRSA patient education and prevention.

Dr. Cameron has also received numerous teaching awards and fellowships, including an Excellence-in-Teaching Citation (Michigan State University, one of six graduate students awarded this honor in 1998), Lilly Teaching Fellowship (University of Georgia 2000 – 2002), J. Hatten Howard, III Teaching Award (University of Georgia 2003, awarded to faculty members in the Honors program who exhibit special promise early in their careers), Department of Medicine Teaching Award (Northwestern University Feinberg School of Medicine, 2007), Searle Teaching Fellows Program (Northwestern University 2010 – 2011), and she is a member of the Feinberg Academy of Medical Educators (Northwestern University Feinberg School of Medicine, 2011 – continuing).