Annual Report for Period: 09/2010 - 08/2011
Submitted on: 05/06/2011
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:

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

Name: Hix, Sherry
Worked for more than 160 Hours: Yes
Contribution to Project:
Sherry has been working with Dianna (PI) to revise the curriculum materials. She will also participate with Brad (Co-PI) to deliver a workshop at USCOTS this summer, based on the materials and instructional strategies being developed as part of this grant.

Name: Phipps, Marnie
Worked for more than 160 Hours: No
Contribution to Project:
Marnie has been developing the qualitative protocols for use in the next phase of the project (the nationwide pilot).

Post-doc

Graduate Student

Undergraduate Student

Technician, Programmer

Other Participant

Research Experience for Undergraduates

Organizational Partners

Other Collaborators or Contacts

We held a one-day meeting 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.

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 will participate 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 over the next 2 years has been communicated to the pilot instructors, and these instructors have confirmed their ability, authorization, and intent to participate.

2) In preparation for the materials pilot phase of the project, 3 instruments to measure student outcomes have been revised. These are the instruments to measure student content knowledge, perceived usefulness of statistics, and statistics self-efficacy. We have started the process of validating the revised instruments by administering them to 10 sections of undergraduate statistics students here at NGCSU, resulting in a data set of size 200-300 for validation. These data will be used for exploratory factor analysis and other analyses as appropriate during instrument validation.

3) An additional instrument is under development 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 are targeted-- a) Instructor orientation toward facilitating discovery learning; and b) Instructor pedagogical content knowledge in statistics.

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) Many revisions were made to the curriculum materials originally authored in Phase I, and additional revisions are scheduled to be implemented during summer and fall semesters, 2011. The three main work products from this effort are the Student Project Guide, the Instructor's Guide, and the Technology Guide.

6) The advisory panel was convened 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.

Presentations and Workshops:

Based on the materials and instructional strategies being 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 is planned for the pre-conference sessions of USCOTS (United States Conference on Teaching Statistics) - May 2011

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:

There are not yet any findings to report.

Training and Development:

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

Marnie Phipps has conducted research regarding grounded theory as she has identified and planned qualitative protocols appropriate for the next phase of the project.

Outreach Activities:

Brad and Dianna have joined in a proposal for a campus center for statistical research, called CUSTAR (Center for Undergraduate Statistical Research). There are three proposed advisors for the center: Dianna (PI), Brad (co-PI), and Robb Sinn (former PI during Phase I of this project). Under the direction of these 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 is now in the planning stages.

Journal Publications

Books or Other One-time Publications

Web/Internet Site

Other Specific Products

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 Phase I materials, and we have told them when to expect updated materials from our current (Phase II) work. Again, these disciplines have included 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 and currently being revised and validated (in Phase II) are resources that will be available for use in future research. These are the content knowledge instrument, the perceived usefulness of statistics instrument, and the statistics self-efficacy instrument.

In addition, another resource that may prove useful for researchers is the new instrument now being developed to measure instructor orientation 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 Web/Internet Site
Any Product
Any Conference

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.]

This grant project period began in September 2010; this report reflects feedback from the external evaluator (Kenzie A. Cameron, PhD, MPH) based on the progress of the research team from September 2010 – April 2011. The research team provided the external evaluator with bi-monthly Progress Reports outlining tasks completed and immediate goals for the subsequent two months. In addition, the external evaluator attended the Advisory Panel Meeting held Tuesday, April 5, 2011 on-site at NGCSU in Dahlonega, Ga.

The project team is to be commended for hosting an excellent Advisory Panel meeting, where they received critical feedback and input from Panel members. The immediate challenge for the project team is to distill the feedback received from the Advisory Panel and identify areas where the team plans to pursue suggestions, as well as to identify areas that may be beyond the scope of this proposal. The project team should remain aware of the fact that they will be unable to take all suggestions provided by Advisory Panel. I recommend that you keep notes on your discussions so you can later refer to decisions made and know the rationale behind each decision to avoid repeating the same process in the future if the question were to come up again.

Overall Evaluation: Overall, the Discovery Learning Projects in Introductory Statistics is on track for the long-term and intermediate goals set by the project team. Some aspects of the project, in particular elements of both quantitative and qualitative measurement, have taken the project team longer than anticipated to address, but the project team has identified strategies to ensure continued timely progress (e.g., establishment of small group meetings among varied members of the project team, planned extra focus in Summer 2011 by additional project personnel). The team is an excellent example

of academic collaboration and evidences the passion needed to continue to pursue their 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
    - Bi-monthly reports of progress, challenges, future plans
- Measurement of Content Knowledge and Statistics Self-Efficacy (Instruments fairly well developed, undergoing final revisions based on feedback from Advisory Panel meeting in April 2011
    - Based on feedback from Advisory Panel (some of it "wordsmithing," some of it more on a conceptual level), suggest the research team ensure sufficient time is set aside in the next few months to ensure that instruments are ready for distribution.
    - Topics discussed included wording of existing items; discussions of how to avoid response set bias when self-efficacy items tend to avoid negatively worded items (so as to avoid measuring self-doubt as opposed to self-efficacy); other potential descriptive items that may be important to measure (type of project student completed, student major, etc.); consider measuring past experience or perceived knowledge to then serve as a covariate that could explain differences between class cohorts

Areas of concern/needing increased attention (Challenges):

Areas where the project team should place increased focus:

- Measurement of Instructor Orientation: Per Advisory Panel feedback, project team will need to identify more specifically which elements of instructor orientation they want to be able to measure (e.g., instructor ability? instructor disposition?) as well as how to best measure these constructs (e.g., survey of instructors? survey of students' perceptions of instructor's ability?). There were numerous suggestions made by the Advisory Panel; one of the challenges will be defining very specifically what the project team wishes to measure for this project, recognizing that attempting to include too many constructs will likely make such measurement too diffuse and less informative.
- Qualitative Assessment: These measurements are currently the least well defined of all project measurements, partially due to the timelines (e.g., the project team made a decision to focus time on the quantitative measurement first, followed by focusing on the qualitative measurement). The greatest challenge here for the project team will be to identify the

boundaries of their measurement, and to discuss and verify their rationale for such boundaries. The Panel provided divergent and extensive feedback, not all of which will be able to be incorporated into the project (nor need it be).

Overall Specific Recommendations:

- Specify and solidify your quantitative analysis plan (ensure you have measures to allow you to answer the questions you are posing, verify which measures you will employ during this study vs. which may be best dealt with in future studies)
- Focus time on developing your qualitative design and analysis
    - Discuss and agree upon as a project team the specific domains you wish to address through qualitative assessment
    - Identify if the primary function of the qualitative assessment is to be an adjunct to other quantitative measures (e.g., instructor orientation) or an implementation assessment
    - Ensure you are able to identify how the instructors implemented the Discovery Projects within their own courses (including instructor interest in implementing again in future)
- Ensure that your final quantitative and qualitative measurements are both synergistic and complementary
    - As a team, you will want to identify (1) what you indicated you would do in the proposal, (2) what additional aspects you may be able to measure based upon what you believe you have bandwidth to do and what your budget allows you to do, and (3) what specific questions you believed will be best answered through the qualitative assessment
    - Once you have narrowed the qualitative and quantitative assessments ensure that your qualitative data really gives you the reasoning and rationale behind your quantitative data, particularly as a goal of the project is to better explain the differences found among instructors in Phase I of the study
- 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. Although there are some instances where progress has been slightly delayed, there are also many examples of areas, such as dissemination, where the team is ahead of their planned schedule.

Appendix 1: Scheduled Tasks/Goals and Progress Year 1

Appendix 2: Biography of External Evaluator: Kenzie A. Cameron, PhD, MPH

APPENDIX 1: Scheduled Tasks/Goals and Progress Year 1

SCHEDULED TASKS/GOALS and Progress

Year 1: Academic Year 2010 – 2011			
Goal	***Task/Measurable Objective***	***Responsible Project Personnel***	***Status as of 04/05/2011***
#1	Revise collegiate instructor and student guides so that either linear regression projects of t-test projects can be done first and so that either project could be implemented stand-alone	Spence, Sinn	**ON TIME:** COMPLETE
#1	Prior to scheduled pilot, beta test updated project designs in NGCSU statistics classes	Spence, Bailey	**IN PROGRESS:** Carried out in Fall 2010 and continuing 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)
#2	Refine Phase I instruments measuring student gains in performance and attitudes toward statistics	Spence, Bailey, Sinn	**IN PROGRESS:** Drafts of revisions complete, final versions in progress following feedback from Advisory Panel
~~#2~~	~~Adapt instruments for secondary setting~~	~~Hix, Cooper~~	(Per request of funding agency, plan to adapt materials for use in high schools was removed)
#2	Develop teacher orientation instrument	Spence, Bailey, Sinn	**IN PROGRESS:** initial drafts completed, significant revisions needed
#2	Validate all instrumentation at NGCSU (pre-pilot)	Spence, Bailey, Sinn	**ON HOLD:** instruments still under revision
#2	Prepare pilot tester training	Spence, Bailey, Sinn	**ON HOLD:** to be developed when curriculum materials are complete; target completion in time to conduct training Spring 2012
#3	Design teacher and student interview protocols	Phipps, Cooper	**IN PROGRESS**

Additional Tasks Completed: **ADM = Administrative**

Year 1: Academic Year 2010 – 2011				
Goal	***Task/Measurable Objective***	***Responsible Project Personnel***	***Timeline of Goal/Task***	***Status as of 04/05/2011***
ADM	ADMINISTRATION: Advisory panel meeting scheduled and held (04/05/2011)	Briggs, Sinn	November 2010	**ON TIME:** Confirmed as of 11/08/2011
ADM	Confirm availability of 8 pilot instructors	Spence	November 2011	**ON TIME:** Confirmed as of 11/08/2011
#1	Revise Technology Manual	Bailey	November 2011	**ON TIME:** First draft complete as of 11/08/2011
ADM	Brief lead project personnel for other curriculum development revisions; define schedule of work for revisions	Hix	November 2011	**ON TIME:** Confirmed as of 11/08/2011
ADM	TECHNOLOGY/ADMINISTRATION: Software and scanner ordered and delivered	Spence, Bailey	November 2011	**ON TIME:** Received as of 11/08/2011
ADM	Keypoint software training	Spence, Bailey	January 2011	**ON TIME:** completed 12/15/2011
#1	Development of revised Student guide	Spence, Hix, Cooper	March – August 2011	**IN PROGRESS:** On-going as of 04/05/2011
#3	Preparation of Qualitative Component	Spence, Phipps	January – August 2011	**IN PROGRESS:** On-going as of 04/05/2011
#3	Development of Qualitative Research Protocols	Phipps, Spence	March – August 2011	**IN PROGRESS:** On-going as of 01/24/2011
ADM	TECHNOLOGY/METHODS: ordering NVivo software	Phipps, Spence		**IN PROGRESS:** Researching versions, cost, feature packages

Year 1: Academic Year 2010 – 2011				
Goal	***Task/Measurable Objective***	***Responsible Project Personnel***	***Timeline of Goal/Task***	***Status as of 04/05/2011***
#2	Revisions to content knowledge instrument	Spence, Sinn, Bailey	January 2011	**IN PROGRESS:** as of 01/24/2011
#2	Revisions to self-efficacy instrument	Spence, Sinn, Bailey	January 2011	**ON TIME/COMPLETE:** as of 01/24/2011 **IN PROGRESS:** Per Advisory Panel 04/05/2011: revisions remain
#2	Revisions to perceived usefulness instrument	Spence, Sinn, Bailey	January 2011	**REVISIONS ON TIME/COMPLETE:** as of 01/24/2011 **IN PROGRESS:** Per Advisory Panel 04/05/2011: revisions remain
#2	Development of instructor orientation instrument	Spence, Sinn, Bailey	January 2011	**IN PROGRESS:** as of 04/05/2011 ***Note: High priority in terms of amount of work remaining***
#4	DISSEMINATION: Teaching and Learning Webinar for CauseWeb	Spence, Bailey	NA	**AHEAD of schedule:** December 2011 **(dissemination originally scheduled Year 2)**
#4	DISSEMINATION: Proposal for pre-conference workshop at USCOTS submitted and accepted	Spence, Bailey	Academic Year 2011 – 2012	**AHEAD OF SCHEDULE:** conference in May 2011
#4	DISSEMINATION: Instrumentation article on development and validation of original Phase I instruments To be submitted to *Applied Measurement in Education*	Spence, Sinn	March 2011	**IN PROGRESS:** Lit review, methods, results sections drafted; requires connective tissue, refinement, and concluding discussion

Year 1: Academic Year 2010 – 2011				
Goal	***Task/Measurable Objective***	***Responsible Project Personnel***	***Timeline of Goal/Task***	***Status as of 04/05/2011***
#2	Create Self-efficacy and Perceived Utility Instruments in survey designer	Bailey	March 2011	(on hold – wait until final version of instruments complete)
#1	Update Technology manual so that all formulas and special characters are readable	Bailey	March 2011	**ON TIME: COMPLETE**
#2	Complete Revised Content Knowledge Instrument	Spence, Bailey, Sinn	March 2011	**IN PROGRESS:** Draft completed, per Advisory Panel 04/05/2011, consider some edits to instrument
#2	Complete Instructor Orientation Document	Spence, Bailey, Sinn	March 2011	**IN PROGRESS:** *Opted to obtain feedback from advisory panel meeting (04/05/2011)*
#3	Develop complete outline of contents of Instructor and Student Guides; draft at least 2 sections in each guide	Hix, Spence	March 2011	**ON TIME:** Outline complete as of 04/05/2011: more than 2 sections drafted
#3	Develop overall plan for qualitative Research Component	Phipps, Spence	March 2011	**IN PROGRESS:** not yet complete as of 04/05/2011
ADM	Advisory Panel planning	Spence, Bailey	April 2011	**COMPLETE**
#4	Instrumentation article to be submitted to AEM	Sinn, Spence	March 2011	**IN PROGRESS:** not yet complete as of 04/05/2011
#4	Revise general teaching article for re-submission to JSE	Spence, Bailey	Summer 2012	**ON HOLD:** plan to incorporate revised projects into re-write
#4	Plan for UCOTS (US Conference on Teaching and Statistics) pre-conference workshop	Spence, Bailey	March 2011	**AHEAD of schedule (scheduled Year 2)**
#4	*Curriculum materials*	*Dix, Cooper, Spence*	*Working thru fall*	**IN PROGRESS** as of 04/05/2011

Appendix 2: Biography of External Evaluator

Kenzie A. Cameron, PhD, MPH. Dr. Cameron is Research Assistant Professor in the Division of General Internal Medicine of Northwestern University Feinberg School of Medicine and a Member of the Robert H. Lurie Comprehensive Cancer Center at Northwestern University. She is Affiliated Faculty of the Center for Healthcare Equity with secondary appointments in the Institute for Healthcare Studies at Northwestern University and 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 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. Dr. Cameron 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 Recovery and Reinvestment Act, 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 was recently named a member of the Feinberg Academy of Medical Educators (Northwestern University Feinberg School of Medicine, 2011 – continuing).