



University System of Georgia (USG) STEM Initiative

Annual Report Form for FY2014 (AY2013-2014)

I. STEM Initiative Program Overview

A. *Program Implementation and Operation* – This section covers the operation of your institution's STEM Initiative Program:

1. Identify and explain the **key programs and projects** (i.e. mini-grant program, FOCUS-derived project, etc.) that comprise the STEM Initiative at your institution. (You will be asked more detailed questions about these later.)

Scholarship of STEM Teaching and Learning Conference. Georgia Southern University hosted a one-day conference on Friday, March 7, 2014, along with a pre-conference poster session and reception on Thursday evening, March 6. The conference included 19 poster presentations, 65 concurrent sessions, and two keynote sessions along with scheduled networking opportunities. Keynote speakers included Mr. David Pogue, anchor columnist for Yahoo Tech, and a panel of educators, including Dr. Jeff Matthews, Mrs. Molly MacAuliffe, Mrs. and Sheila Hughes-Harmony. A special keynote speak was Dr. Kama Bobb, USG STEM Coordinator. This year's conference attracted 233 participants.

We have strategically expanded conference participation in response to guidance received from our conference Advisory Board and the BOR Office of Educational Access and Success. In 2012, the conference focus was on university faculty and their STEM teaching effectiveness. In 2013, the conference was expanded to include K-12 educators and targeted the K-20 STEM pipeline. In 2014, the goal was to attract business and industry representative and more K-12 educators to facilitate the formation of STEM education partnerships as well as to enhance STEM teaching and learning across the K-20 continuum.

An assortment of technologies was used to support conference activities and to enable participants to revisit conference sessions, contact session presenters, and access STEM teaching and learning resources. The primary conduit for accessing information about the conference as well as related

resources is the conference website (<http://stem.georgiasouthern.edu>). A number of concurrent sessions were video or audio recorded and are accessible at the website. Also found at the website is information about how to join the “Conference Community” using Google + along with details about keynote speakers, presenter handouts and PowerPoint slides, conference posters, and the complete conference program. Additionally, accessible through the website are links to STEM websites at other University System of Georgia institutions and resources organized through a pull-down menu under the headings of (a) science, (b) technology, (c) engineering and (d) mathematics.

The 2015 conference will highlight the need for an educated STEM workforce by aligning with Georgia’s College and Career Readiness initiative and the Bulloch County School’s Pathways to Success initiative. This focus will expand the conference participation to include STEM business and industry leaders in addition to university faculty and K-12 educators.

The strategic growth of our STEM conference from 2012-2014 is as follows:

2012 – primarily university faculty

2013 – primarily university faculty and K-12 educators

2014 – university faculty, K-12 educators, and business and industry leaders

2015 – university faculty, K-12 educators, and business and industry leaders

We anticipate that the 2015 conference will attract as many participants as the 2014 conference. It is our intention that many of the new participants will come from the areas of engineering and kinesiology, and the STEM business and industry sector. Our expansion in these sectors will require additional communication and advertising along with the services required to accommodate a conference of more than 200 participants. We also anticipate the need to bring in keynote speakers that address the needs and concerns of Georgia K-12 and higher education communities, enhance the level of technology associated with conference participation and follow-up, and update the conference website and links.

Research on Scholarship of STEM Teaching and Learning Conference. The purpose of the research is to investigate in-depth one model of professional development that varies along the dimensions of content, context, and design, and determine its influence on university STEM faculty members’ pedagogical content knowledge and their teaching practice through surveys, interviews, and campus visits. With the 2014 conference, we began a third cycle of data collection and analysis, with each round consisting of two phases. All participants in the study were STEM faculty members at Georgia higher education institutions and volunteers, consistent with the requirements of the University’s IRB approval process.

Two proposals were submitted and accepted in 2014 to present findings of the research at two international conferences in 2015—Association for Science Teacher Education (ASTE) and American Educational Research Association (AERA). The ASTE proposal, that summarizes the research methods and findings, is presented below. Members of the research team associated with the

preparation of the proposals included Jessica Render, Robert Mayes, Katie Brkich, Christopher Brkich, and Tom Koballa.

Program Abstract

This study examines how attending a statewide SoTL (scholarship of teaching and learning) conference focused on university-level STEM (science, teaching, engineering, and mathematics) education impacted faculty attendees' pedagogical practices. To assess impact, we conducted interviews and on-site observations with selected faculty attendees.

Introduction/Challenge to Science Education

Within the current climate of fiscal austerity, public colleges and universities charged with preservice teacher education face increased pressure to ensure their faculty receive the best possible professional development experiences providing the greatest positive impact on their teaching practices at the lowest possible cost (Jolley, Cross, & Bryant, 2014). Given additionally the roles that university STEM (science, teaching, engineering, and mathematics) faculty play in providing teacher candidates with their content education, examining the ways in which conference attendance impacts the instructional practices of university STEM faculty presents an important and yet largely unexamined area of inquiry. Nancy van Note Chism and Borbala Szabo (1998) argued over fifteen years ago that less than one fifth of studies on professional development examined impacts on pedagogical practices, and more recently Cristine Smith and Marilyn Gillespie (2007) stated that—because of this continuing lacuna—those interested in university faculty professional development heretofore had to take their cues from K-12 education. Given that there exist substantial holes in the literature surrounding the effectiveness of conferences as a means of professional development, we purport that examining STEM university faculty attendees' conference experiences and the ways in which they implement lessons learned at these conferences in their classrooms stands to fill an important gap in the literature on science educator professional development.

Theoretical and Methodological Frameworks

In conducting this ongoing research study, we adopted the theoretical and philosophical framework of pragmatism (Dewey, 1938; James, 1907/2012; Peirce, 1958), as this allowed us—and continues to allow us—substantial flexibility in the approaches we have taken to analyze our participants' experiences and the impact these experiences have had on their pedagogical practices in their university-level STEM classes. As this ongoing research study is largely exploratory in nature, adopting a theoretical framework dictating that the methods which prove useful in generating experience and knowledge are those which should be employed is most appropriate. Operating on this premise, the methods of naturalistic inquiry (Erlandson, Harris, Skipper, & Allen, 1993; Guba & Lincoln, 1982; Lincoln & Guba, 1985, 1986) provide what Mirka Koro-Ljungberg and associates (2009) term *epistemological consistency*—that is to say, that the actual methods of data collection and analysis are consistent with the philosophical framework underlying the research study in question. Though some scholars have questioned previously whether naturalistic inquiry constitutes a sufficiently rigorous approach to merit designation as scientific—Richard Owens (1982) details some of the critiques while providing answers and Douglas Holt (1991) 1991 looks to gut the approach of its trustworthiness based on a perceived lack of transparency—many others (e.g., Lincoln & Guba, 1985, 1986) have long argued that providing sufficient transparency to the choices one makes in pursuing one's research questions and justifying these choices works substantively to establish the trustworthiness of a research study.

In the following section of this proposal, we will detail the ways in which we structured our initial research inquiries, how these informed our early data collection, and how the results from these inquiries shaped subsequent research inquiry iterations and data collections. In the full paper, we will further discuss how our emergent study meets the trustworthiness standards of *credibility*, *transferability*, *dependability*, and *confirmability* (Erlandson, et al., 1993). And, we will also address the limitations of using naturalistic inquiry to conduct educational research while simultaneously acknowledging its strengths and appropriateness as a method in the case of this research.

Data Collection and Analysis Methods

David Erlandson and associates (1993) recommend, when conducting naturalistic inquiry, to collect data from numerous sources in a variety of ways, and that the data researchers collect naturally informs the emergent design of the research study. Because we were interested in understanding how the participants at Georgia Southern University's annual *Scholarship of STEM Teaching and Learning* conference experienced, benefitted from, and applied the lessons they learned from this conference to their instructional practices as University System of Georgia science, technology, engineering, and mathematics faculty, we delivered to all attendees an initial survey instrument posing a variety of questions. Some of the prompts posed Likert-style questions soliciting responses regarding the worth participants assigned to the sessions they attended and others posed open-ended questions soliciting their opinions on how these sessions might influence or impact their instructional practices.

Based on the initial responses conference participants gave in their paper and online surveys, we employed purposive sampling to identify participants who both scored the sessions they attended very favorably and noted an intent to implement lessons learned during these sessions in their own instructional practices. Michael Patton (2002) notes that such an approach is particularly useful in identifying extreme cases which may be especially enlightening. Because the conference focused on presenting on and discussing the effective teaching practices of university STEM faculty—with a view to cyclical and ongoing pedagogical professional development—the conference organizers felt it important to use data-driven models of organizational improvement to deliver a continuously improving and effective conference experience to attendees (see Chappuis, 2009; Stiggins & Chappuis, 2005 on assessment for learning as a model of data-driven instructional improvement). Identifying such extreme positive cases allowed us to follow up purposively with the conference participants we agreed could provide us with the greatest insight as to the kinds of sessions they felt we should continue to include in our program. From the initial narrowing of the participant field we conducted telephone interviews of approximately one hour each—which we had transcribed verbatim—and used these to follow up with campus visits, in which we collected further interview data and observational fieldnotes and artifacts. From these data, we explored the extent to which conference attendees reported on how their participation at the *SoTL STEM* conference impacted their university-level STEM instructional practices.

In the first year of the study, 26 participants provided initial consent to participate, and of these, 8 participated in telephone interviews and either subsequent campus visitations or a follow-up focus group interview. Binding each case at the participant level, we employed Yin's (2009) analytic method of cross-case analysis, which subsequently allowed us to table the impact our participants' attendance at the *SoTL STEM* conference had on their instructional practices. This tabling provided us the means within exploratory conditions to consider whether our constructed cases constituted "subgroups or categories of general cases—[in turn] raising the possibility of a typology of individual

cases that can be highly insightful” (p. 160) as a basis for examining the impactful experiences of future conferencegoers.

Substantiated Findings

In attending the *SoTL STEM* conference—which held as one of its central purposes the showcasing of effective university-level STEM pedagogies—the research study participants discussed a variety of impacts conference participation had on their professional practices and experiences. These impacts occurred in four distinct major areas, which—while having some overlap—we have separated out on account of the focus participants respectively placed on these.

Modified Instructional Practices

One of the areas in which participants reported the impacts of conference attendance naturally related directly to their instructional practices. As the conference focuses on *SoTL*, this is a natural outgrowth. Farooq Khan, Professor Chemistry at the University of West Georgia, reported making a substantial shift in his teaching practices after attending a session in which the presenter showcased interactive instructional methods using whiteboards. Having complained previously that “students no longer write in their notebooks” (Focus Group, 8 Mar 2014)—that is to say, that students in his engineering and chemistry classes would not take lecture notes—he adopted the presenter’s approach of using individual whiteboards to participate actively in their learning. Noting that he “came back inspired by what [the presenter] had been able to do with existing tools... so that one can use one’s class time more effectively” (Farooq Interview, 23 May 2012), Professor Khan was able to make his engineering and natural sciences lecture sessions substantially less lecture-based, more interactive, and more student-centered, with increased levels of reported student engagement.

Modified Assessment Practices

A second area in which participants reported the impacts of conference attendance runs as a corollary to their instructional practices, but we regard these as being distinct. In her introductory-level college classes, Delena Gatch—Professor of Physics at Georgia Southern University—noted that following the conference’s keynote address, she felt inspired to modify her assessment practices to better meet her students needs, even going so far as to “throw out some extra credit at the end of the semester that [she is] not known for doing” (Delena Interview, 24 May 2012). Delena reported that previously for her large-scale classes she typically would give only three major tests. But having had a positive experience with the event keynote, reports now providing a wide variety of formative assessment opportunities—including grades for homework, 11 in-class activities, and laboratory work along with regularly scheduled tests (Site Visit Notes, 14 December 2012). The keynote speaker, whom she remembered saying “You give the test, you accept the student, they’re not perfect, and you do it again” (Focus Group, 8 March 2013), allowed her to make a rather substantial impact on her assessment practices, which she consequently noted made a substantial difference in her students’ learning.

Modified Teaching Philosophies

When it comes to their teaching practices, academics tend to have very clearly defined opinions regarding online instruction—either for or against. Leslie Jones—Professor of Biology at Valdosta State University—noted previously that, “It would be a cold day in you-know-where for me to devote time to online learning” (Site Visit, 15 November 2012). However, after having heard others discuss their successes with online instruction as a supplement to traditional face-to-face instruction—she noted that she “really want[ed] to design a new non-majors science course on integrated science or the nature of science and take an integrated approach to all the content

areas” (Interview, 4 June 2012). As a result of her participation in a session focused on online organic chemistry, she stated that the “online inspiration I got has really taken off and I am moving a great deal of my energy and research in that direction” (Email Correspondence, 21 October 2012). Furthermore, she noted a tremendous increase in her students’ performance—particularly on their high-stakes tests (Site Visit Notes, 15 November 2012).

Personal Job Satisfaction

Perhaps consequently associated with the modifications they made to their instruction, their assessment, and to their general philosophies of education, participating faculty also noted a marked increase in their personal job satisfaction. Referring to the adjustments she made to her grading policy—adopting a more compassionate stance and aligning it more with a framework of assessment for learning—Professor Gatch noted that her adjustments allowed her to feel that she was “a touch of a human being under this professor” (Focus Group, 8 March 2013), something which she noted she had previously lost. Likewise, Professor Khan noted that his attendance at the *SoTL STEM* conference provided him excitement and job satisfaction that no other conference had provided previously. He stated he “just went to conferences, attended talks... [but] went back to my campus and never, ever implemented anything” (Focus Group, 8 March 2013)—but having attending the *SoTL STEM* conference and having been inspired, Professor Khan felt reinvigorated knowing “that some of the work that I’m thinking falls in line with ideas that other individuals have” with regards their teaching (Interview, 23 May 2012).

Discussion and Contributions to Science Teacher Education

In organizing science education and science teacher education conferences, organizers should move toward requiring participants to consider the practical and pragmatic pedagogical applications of their work. As university-level STEM faculty seek to meet their scholarship requirements, their unit heads should also prompt them to demonstrate how they have implemented what they learned into their teaching practices. Not only will this ensure university-level STEM faculty improve upon the quality of their instructional practices, it will ensure that the funds allocated to conference participation as a vehicle for professional development do not become subject to funding cuts.

Presentation Target Audience

Within the context of ASTE, this session has particularly broad appeal as it focuses on helping conference organizers and faculty attendees in making the most out of their conference professional development experiences—not just at ASTE but at all science education and science teacher education conferences. By encouraging university STEM faculty to attend sessions with a view to adopting and implementing that which they learned during these presentations in their own classroom practices—rather than merely providing them venues in which to present their own scholarship and practice to others—will see the value of dollars spent on their professional development increase proportionally. Given that over 40% of faculty professional development budgets are allocated to conference attendance and travel and account for 11% of professional development activities (Smith & Gillespie, 2007), those who allocate these funds will find higher and more satisfactory returns on their investment (McAlpine, Amundsen, Clement, & Light, 2009). Presented with evidence that conference participation as a means of academic professional development produces demonstrable impacts on university STEM faculty instruction, funding agents will not be presented with conditions which encourage them to cut such professional development budget allocations for conferencegoing (Murray, 2002).

References

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2. Identify **key personnel** associated with your institution's STEM Initiative program and briefly describe **each person's role**. Be certain to include all personnel whose salaries have been paid, either fully or partially, by STEM Initiative funds. Include any faculty or staff receiving course release time or some comparable form of compensation to participate.

Dr. Joy Darley – conference coordinator

Dr. Tom Koballa – director and research coordinator

Ms. Jessica Rinder – graduate student supporting research

Ms. Erica Bolton – graduate student supporting conference planning

Dr. Robert Mayes – research team member

Dr. Katie Brkich – research team member

Dr. Christopher Brkich – research team member

Advisory Board – Dr. Martha Abell, Georgia Southern University; Dr. Sharmistha Basu-Dutt, University of West Georgia; Dr. Mohammad Davoud, Georgia Southern University; Dr. Sarah Formica, University of North Georgia; Dr. Charles Kutal, University of Georgia; Mr. Michael Robertson, Technology Association of Georgia; Dr. Judy Awong-Taylor, Georgia Gwinnett College; Dr. Adrian Epps Kennesaw State University; Dr. Brian L. Gerber, Valdosta State University; Dr. Ann Levett, Savannah-Chatham County Schools; Mr. Charles Wilson, Bulloch County Schools; Dr. Nathan Moon

3. Identify **partnering departments, offices, or centers** participating in the STEM Initiative at your institution. Briefly discuss their relationship with the STEM Initiative and note any relevant contributions.

College of Science and Mathematics, Georgia Southern University

College of Engineering and Information Technology, Georgia Southern University

College of Education, Georgia Southern University

Center for Continuing Education, Georgia Southern University

Institute for Interdisciplinary STEM Education, Georgia Southern University

- B. *Program Successes* – This section covers the key accomplishments of your institution's STEM Initiative program during FY2013:

1. Explain how your program has made progress toward Goal 1, **improving the readiness of P-12 students** for STEM in college. (You may wish to draw upon service learning programs, among other efforts. You also may wish to describe bridge programs or similar efforts directed at incoming freshmen.)
2. Explain how your program has made progress toward Goal 2, **improving student success and completion rates**, by discussing how your program, a) **increased STEM majors**, b) **supported student retention and progression in STEM**, and c) **increased STEM degree completion**.
3. Explain how your program has made progress toward Goal 3, **improving the pre-service P-12 STEM teacher preparation and production**.

4. Discuss **other key successes** of your institution's STEM Initiative program.

See the section on *Research on Scholarship of STEM Teaching and Learning Conference* in response to A1.

- C. *Program Challenges* – This section covers challenges that continue to face your institution's STEM Initiative program:

1. What challenges has your program encountered in **increasing the number of STEM majors**?

2. What challenges has your program encountered in **increasing STEM degree production**?

3. Are there any **program-specific** (i.e. mini-grants, service learning opportunities) challenges that your program has encountered?

4. Are there any **other challenges** that your program has encountered that you have not described (i.e. departmental buy-in, personnel issues)

Attracting STEM business and industry leaders to the conference has been a challenge. Based on recommendations of the Advisory Board, STEM business and industry leaders will be invited to perform specific duties associated with the conference, including concurrent session presenters and keynote speakers.

- D. Did you implement the STEM Initiative program at your institution **as described in your project proposal** for FY2013? Please describe any notable changes from the proposal that you made (additional project components, project deletions).

II. Data Sheet Addendum

- A. If you reported **engineering majors** in FY2013 (Row 12), please identify relevant subfields (mechanical engineering, electrical engineering, engineering technology, etc.) and specify the number of majors in each.

- B. If you reported majors in the field **“Other”** (Row 13), please identify those degree programs and specify the number of majors in each.
- C. If you reported **engineering degrees awarded** (Row 73), please identify the specific degrees (i.e. BS in mechanical engineering, BS in electrical engineering, etc.) and specify the number of awardees for each.
- D. If you reported **degrees in the category “Other”** (Row 74), please identify the specific degrees and specify the number of awardees for each.
- E. If you have any **additional notes** to offer relevant for the data sheet, please enter those here.

Below is a summary of the changes in STEM enrollment and STEM degrees awarded from FY13 to FY14.

- Overall STEM enrollment increased 4.77%. However, it only increased 2.94% when accounting for the addition of Athletic Training and MED and EDS in Secondary Education in FY14 reporting.
- STEM Education enrollment increased 147.22% (FY14: n=89; FY13: n=36). However, It dropped 2.78% (FY14: n=35; FY13: n=36) when accounting for the addition of the MED and EDS in Secondary Education in FY14 reporting.
- Overall STEM degrees awarded increased 14.18%. However, the increase was 11.32% when accounting for the addition of Athletic Training and the MED and EDS in Secondary Education in FY14 reporting.
- STEM Education degrees awarded increased 83.33% (FY14: n=22; FY13: n=12). However, the number remained the same (FY14: n=12; FY13: n=12) when accounting for the addition of the MED and EDS in Secondary Education in FY14 reporting.

III. Programmatic Components

A. *Faculty Mini-grants*

1. Please provide a list of the mini-grants provided by your institution as part of its STEM Initiative for FY2013. You may use the following table or some alternate format, but please be sure to provide all of the information requested:

| Project Title | Faculty Investigators | Award Amount | Brief Description (4-5 sentences) | Key Research/Pedagogical |
|---------------|-----------------------|--------------|-----------------------------------|--------------------------|
|---------------|-----------------------|--------------|-----------------------------------|--------------------------|

| | | | | Outcomes |
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2. State the **funding rate** for mini-grants at your institution (i.e. number of grants funded vs. total number of proposals received)? Discuss how proposals were **judged and awarded**.

3. For any of the mini-grants listed, do you **have evaluation data or other evidence suggesting the efficacy of the projects**? Also, please discuss the broader impacts for these projects (i.e. changes to instructional approaches, changes to departmental policies, etc.).

B. Service Learning Opportunities (i.e. FOCUS-derived projects)

1. Briefly describe the **operation of your institution's service learning opportunity** or FOCUS-derived project for FY2013, including the following:

a. Name of project(s) or other branding

b. Key Partners for your Project (i.e. Departments/Schools at your institution, participating P-12 schools/school districts, area businesses, etc.)

c. Data regarding participants (students taking part in project, number/classes of P-12 students engaged through project, number of teachers taking part, etc.)

d. Primary activities and their operation

- e. Any outcomes data demonstrating the project's efficacy or effectiveness.

C. Institution-Specific Projects

1. **Identify your institution-specific project(s)** outlined in your proposal for FY2013 (i.e. 4-Year Undergraduate Research Experience, Academy for Future Teachers, MESA, summer bridge programs, peer learning communities, STEM tutoring/learning centers, etc.). Discuss any specific branding.
2. Provide data regarding the **level of participation** in each of these projects (i.e. number of faculty participants, number of student participants). Discuss their **scope** (i.e. oriented toward incoming freshmen, upperclassmen, STEM majors, education majors, all students, etc.)
3. Discuss the **activities and operation** of your institution-specific project(s), including any efforts to connect multiple projects for synergistic impacts.
4. Provide any available **outcomes data demonstrating the efficacy or effectiveness of the project(s)**.

IV. Future Efforts

- A. Please discuss **dissemination efforts** for best practices or research findings identified through participation in the USG STEM Initiative.

Multiple journal manuscript that report on the findings of the multi-year investigation are in preparation. Papers that reported on preliminary findings will be presented at the Association of Science Teacher Education (ASTE) and American Educational Research Association (AERA) conferences in 2015. Conference presentations made in 2014 are identified below.

Koballa, T. Brkich, K, and Render, J. (2014, September). Scholarship of STEM Teaching and Learning Conferences: Exploring the impact on university-level STEM faculty pedagogy. Paper presented at the conference of the Southeast Association of Science Teacher Education, Savannah, GA.

Render, J., and Koballa, T. (2014, March). Scholarship of STEM teaching and learning conference and follow-up: Efforts to enhance STEM teaching at Georgia universities. Poster presentation made at the Georgia Sothern University Research Symposium, Statesboro, GA.

- B. Please identify any **external grants** (e.g. NSF, Department of Education, private/foundation) for which you have applied based on support received for the STEM Initiative. Indicate whether any applications have been successful.

- C. Will your institution's STEM Initiative program for FY2015 involve **any notable changes** from your FY2014 program? If so, please explain any changes and the rationale for them.