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The Golden LEAF STEM Initiative Evaluation

Year Two Report – Executive Summary

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THE GOLDEN LEAF STEM INITIATIVE EVALUATION YEAR TWO REPORT

Executive Summary

Student success in the core content areas of science, technology, engineering, and mathematics (STEM) has emerged as an essential component in the development of an American workforce that can compete in the global, 21st century economy. In response to this critical need states across the country, including North Carolina, have developed K–12 public school initiatives designed to inspire and prepare the next generation of scientists, mathematicians, and engineers.

In North Carolina the Golden LEAF Foundation (Golden LEAF) is a leader in these efforts to promote and sustain high quality STEM education in public schools. In 2010 the Foundation launched a STEM Initiative to support “successful models that increase STEM education for students in grades four through nine in rural, economically distressed, and/or tobacco-dependent counties of North Carolina.” The Foundation awarded grants to projects that:

- Were evidence-based and represented systemic approaches to STEM education, including in-school, out-of-school, or extended day and support programs providing assistance to students transitioning from elementary to middle and middle to high school.
- Represented collaborations among public schools and higher education, community, and relevant industry partners.
- Targeted improved preparation for and academic performance in advanced STEM curricula by minorities, females, and students from limited-resource families.
- Served students in 4th through 9th grades, placing priority on curricular approaches that were integrated, used project- and inquiry-based learning concepts, and/or prepared students for successful completion of Algebra 1 by 8th or 9th grade – a gateway to participation in advanced placement courses.
- Included strategies that incorporated content-specific professional development for teachers, and provided relevant career and work connections for teachers and students.

In the spring of 2011, fourteen grantees were selected and funded up to \$750,000 for a three-year period. In total, these grants impact 43 public school districts in North Carolina, 225 schools, approximately 1,190 teachers, and approximately 31,890 students.

The Golden LEAF STEM Initiative Evaluation

In 2011 the Golden LEAF STEM Initiative evaluation team was charged with completing a formative and summative evaluation and acting as a resource for the participating grantees who would be conducting some evaluation of their own. The evaluation of the Golden LEAF STEM Initiative would take place over the three-year grant implementation period, from 2011 through 2014. The research is now being conducted by the Consortium for Educational Research and Evaluation–North Carolina (CERE–NC), a partnership of the SERVE Center at the University of

North Carolina at Greensboro, the Carolina Institute for Public Policy at the University of North Carolina at Chapel Hill, and the Friday Institute for Educational Innovation at North Carolina State University. The evaluation does not separately examine the activities and outcomes of individual grants, but rather, it operates at the initiative-level, focusing on the overall commonalities of the 14 grants' activities and observing their common outcomes. The two primary objectives of the Golden LEAF STEM Initiative evaluation are described below.

Evaluation Objective 1: Describe the Overall Effectiveness of the Initiative

The evaluation team's first objective is to describe the overall effectiveness of the Golden LEAF STEM Initiative in achieving its goal of improving STEM education outcomes for 4th through 9th graders in rural North Carolina. For this purpose quantitative and qualitative data are being collected from multiple sources. Data are collected in order to answer four, primary evaluation questions. These are, "To what degree or in what ways were the Golden LEAF STEM Initiative grantees as a whole:

1. Faithful in implementing their STEM program's criteria and goals?
2. Effective in changing student STEM attitudes?
3. Effective in changing student STEM learning?
4. Effective in changing teachers' instructional practices?"

Results from three, annual periods of data collection are synthesized and compared annually. The goals of these analyses are to provide useful information about the impact of the initiative as a whole to Golden LEAF and to the grantees as they continuously build and improve their programs.

Evaluation Objective 2: Evaluation Capacity-Building

The second objective of the Golden LEAF STEM Initiative evaluation is to provide technical assistance on program evaluation strategies to the grantees as they work to continually improve their own individual programs. The evaluation team assists each of the grantees to:

- Develop and apply knowledge about education program evaluation; and
- Collect, interpret, and use formative data to improve their STEM programs.

Over the course of the three-year initiative various capacity-building events and activities take place: annual evaluation institutes, semi-annual webinars, the ongoing provision of formative data, access to online surveys, and access to one-on-one technical assistance from members of the evaluation team.

Report Structure

This report summarizes all data and results for Year Two of the evaluation, collected from September 2012 through February 2013. Similar to the August 2012 report, this paper addresses

evaluation questions 2-4 by summarizing results from the following data sources: interviews with grant coordinators; focus groups with participating teachers; surveys administered to students; surveys administered to teachers; surveys administered to principals; classroom observations; and a program implementation rubric completed in Year Two by principals. Taken as a whole these results address the first evaluation question, regarding the faithfulness of the implementation of the initiative. The report is divided into five sections: Data Sources and Analyses, Findings, Capacity-Building Activities, Recommendations, and Next Steps.

Evaluation Results

To what degree or in what ways were the Golden LEAF STEM Initiative grantees as a whole effective in changing student STEM attitudes?

The Golden LEAF STEM Initiative grantees all share the common objective of improving student attitudes toward STEM subjects and increasing their interest in STEM careers.

- *Student engagement:* Consistent with findings from Year One, teachers reported that overall student engagement in STEM content was very high as a result of the hands-on, problem-based learning opportunities provided through the Golden LEAF STEM Initiative. Hands-on, problem-based activities specifically engaged students with a variety of learning styles, including visual and mechanically-inclined learners, and they also had a noticeable impact on engagement for struggling students and English as Second Language (ESL) students. Results from classroom visits also support the overall finding that the hands-on, inquiry-based STEM activities lead to higher student engagement compared to other lessons.
- *Student awareness of industry:* Findings from the 14 grant-coordinator interviews and the focus groups with participating teachers indicate that opportunities for students to visit STEM industries or tour facilities increased student awareness and interest in STEM industries.
- *Student self-confidence in knowledge of STEM content:* Findings from surveys indicate that, on average, students feel somewhat neutral or slightly agree with statements such as, “I feel good about myself when I do science” and “I am interested in what makes machines work.” The survey results indicate no significant change in student attitudes toward STEM between Year One and Year Two. Variation between students at different school-levels was slight. Upper elementary school students reported slightly higher confidence and interest toward mathematics, science, and engineering and technology, while high school students reported the least positive attitudes.
- *Student interest in STEM careers:* Student survey data indicate that students overall have moderate levels of interest in STEM careers. On average, across 12 STEM career areas, 41.6% of students reported that they were “interested” or “very interested” in such professional work. The greatest proportion of students indicated that they were “interested” or “very interested” in veterinary work (51.1%), while the smallest proportion of students reported that they were interested or very interested in careers in physics (32.1%). Interest levels in computer science were higher in Year Two than in

Year One, jumping from 37.4% interested or very interested in fall 2011 to 42.1% in fall 2012. Findings show that female students have slightly lower interest in STEM careers than males overall, including large differences in areas such as engineering, energy, and computer science. Female students' low interest in engineering correlates with the low levels of confidence and interest they reported elsewhere on the surveys. The differences in levels of interest in STEM careers between students of different races/ethnicities are smaller than the differences between male and female students, which is consistent with Year One findings. When comparing career interest by grade level, like in Year One, upper elementary school students reported higher levels of interest across all STEM career areas on average (49.9%) than both middle school students (38.7%) and high school students (35.8%).

- *Student attitudes toward 21st century learning skills.* Student attitudes toward 21st century skills remain consistent at a 4.0 mean composite score from Year One to Year Two. The survey data show that, also like in Year One, there is almost no variation among the students' attitudes toward 21st century skills when the learners are compared by gender, race/ethnicity, or school-level.

To what degree or in what ways were the Golden LEAF STEM Initiative grantees as a whole effective in changing student STEM learning?

- *Students' problem-solving skills increase.* The strongest focus group results related to student learning in Year Two indicate that students' problem-solving skills are increasing. Teachers in almost every focus group described how the authentic, hands-on, inquiry-based lessons were teaching students problem-solving skills that the young people had never developed before. Many teachers described how the inquiry-based, hands-on activities were giving way to higher-quality learning for students. Teachers described how these challenging, problem-based instructional strategies were also building students' confidence.
- *New materials and instruction better address mechanical and visual learners.* The second strongest finding from the 14 focus groups with participating teachers suggests that the hands-on, inquiry-based STEM activities address a wider variety of learning styles among students. Teachers implementing labs, experiments, and computerized simulations through the Golden LEAF STEM Initiative described how these hands-on, problem-based lessons not only favored most learners, but they especially connected with the mechanical learners and strongly visual learners – students who learn best from practical, applied experiences.
- *Students continue to develop communication and collaboration skills.* Findings across multiple data sources suggest that students participating in the Golden LEAF STEM Initiative continue to have frequent opportunities to work together on meaningful tasks and develop communication skills. Almost all of the STEM education kits, labs, investigations, and curricula incorporate small group collaboration and team work.
- *Students improve their reading skills and willingness to read more challenging STEM material.* When asked whether they had noticed any changes in student learning as a result of the new STEM activities and/or instructional strategies, a number of teachers

remarked that students' literacy skills were improving. Students were also gaining interest and seeking out new information on their own.

- *Students expect to do well; about half reported plans to take advanced mathematics and science.* Overall, the vast majority of students felt that they would do at least "okay" (50.1 – 43.1%) if not "very well" (43.5 – 47.1%) in their ELA, math, and science courses. Survey findings indicate that students' performance expectations did not vary much by gender, ethnicity, or school-level. Regarding mathematics specifically, results show that overall 48.2% of students intended to take advanced classes in mathematics, with slightly more females (50.0%) reporting that they had such plans than males (46.5%). When asked whether or not they intended to take advanced classes in science, overall 42.6% of students indicated that they would.

To what degree or in what ways were the Golden LEAF STEM Initiative grantees as a whole effective in changing teachers' instructional practice?

- *Teachers use hands-on, inquiry-based teaching strategies.* Results from multiple data sources indicate that the curricular materials, lab materials, technology, professional development, and other instructional supports provided by the 14 Golden LEAF STEM Initiative grants are helping increase the frequency with which teachers use hands-on, inquiry-based, student-centered teaching strategies. The three most commonly used STEM instructional activities by teachers who responded to the surveys were: (1) "Students work in small groups" – 64.0% of teachers reported this happens "Usually" or "Every Time" during instructional meetings; (2) "Students engage in content-driven dialogue" – 62.1%; and (3) "Students complete activities with a real-world context" – 53.5%. Principals estimated that their faculties as a whole used project-based instruction almost monthly.
- *Teachers integrate subjects; need opportunities to integrate more.* In focus groups teachers described that while some progress was being made with regard to the integration subjects during instructional meetings, many subjects were still taught separately without reference to each other. They explained that too many teachers work in isolation from many of their colleagues and lack information about other curricula. On average, principals across school-levels reported that roughly 25% of teachers made explicit efforts to integrate science, technology, engineering, and mathematics. The teachers want to be able to integrate more, but need some additional resources and/or time.
- *Teachers benefit from time to collaborate; need more.* In focus groups many teachers described how they consider time with each other one of their most valuable resources and most beneficial professional activities. One grant convened all middle and high school mathematics teachers in the district for four, half-day collaborative planning and professional development days. The mathematics teachers had opportunities to share content and instructional strategies both horizontally across subjects and vertically across grade- and school-levels.
- *Professional development is generally of high quality; need more time to evolve.* Principals report that teachers participated in roughly 15 hours per year of STEM-related professional development which addressed integrated content, community/industry

partnerships, connections with postsecondary education, pedagogy, and/or digital learning. Teachers reported that the most beneficial professional development sessions either allowed the educators to conduct the STEM activity or lab as a student, were led by other teachers, or described in deep detail how a particular tool or strategy can work in a classroom. Many teachers face implementation fatigue with regard to professional development. Several groups of participating teachers raised this issue. The educators explained that while they were thankful for the professional development, they were also concerned about the lack of sufficient time for them to implement the content or new tools.

- *Some teachers benefit from visits to STEM industries.* Several Golden LEAF STEM Initiative grants used their funds to provide participating teachers with unique opportunities to visit local STEM industry facilities and meet STEM industry professionals. Results suggest that these experiences are very beneficial to STEM educators. The teachers gain new and deeper understandings of the types of jobs and competencies demanded in today's workforce. This better equips them to share this information with students and teach these skills. Results from the STEM Program Implementation Rubric indicate that even though teachers participating in some of the Golden LEAF STEM Initiative grant activities had opportunities to go on study trips, most teachers, in general, did not – on average some teachers (approaching 50% of their faculty) participate in an applied learning experience about once every two years. Findings from the T-STEM Surveys suggest that only about half (46.9%-52.4%) of participating teachers had general knowledge about STEM careers.
- *Teachers' feel confident in their own teaching abilities, but are divided on whether the classroom efforts of teachers, in general, impact student learning.* Year Two results from the T-STEM Surveys show that when asked about aspects of their instructional practice, educators participating in the Golden LEAF STEM Initiative had a strong sense of confidence and self-efficacy (on average 82.4% of all teachers "agreed" or "strongly agreed" with each item). At the same time, results from items about outcome expectancy indicate that 48.5% of participating teachers "agree" or "strongly agree" that the efforts of educators make a difference for student learning.

Additional Findings

In addition to findings from across data sources related to changes in student attitudes, student learning, and teacher instructional practices, other results emerged from data collection.

- *Students' postsecondary plans.* Overall 86.7% of students participating in the Golden LEAF STEM Initiative who responded to the survey indicated that they planned to attend college. Of those, 22.7% reported that they planned to attend a community college first and 77.3% a four-year college or university.
- *Principals' leadership for STEM.* Pilot findings suggest that on average principals of schools participating in the Golden LEAF STEM Initiative believe that they focus most on STEM professional development, both for their STEM teachers specifically and/or for their entire faculty (91.4% "agreed" or "strongly agreed"). Results indicate that principals also focus somewhat heavily on maintaining technical infrastructure to support

STEM teaching (84.2% agreed or strongly agreed). Participating principals believe that they spend the least time and energy working on advocacy and networking related to STEM (57.3% agreed or strongly agreed).

Capacity-Building Activities

The second of the two objectives of the Golden LEAF STEM Initiative evaluation is to provide technical assistance to increase the capacity of schools and districts for data-informed decision-making. In order to accomplish this goal the evaluation team has carried-out several activities: hosted annual face-to-face institutes; held semi-annual webinars; created initiative-level and grantee-level survey results reports; provided one-on-one reference support; built the foundation for a Golden LEAF STEM Initiative evaluation online community of practice; and engaged national and state education leaders in discussions about the on-going evaluation and capacity-building work for the Golden LEAF STEM Initiative.

Discussion

Summary of Findings

The data collected for this report demonstrate that the Golden LEAF STEM Initiative, consisting of the individual work of the 14 grants across North Carolina, made significant progress toward its goals in Year Two. Findings from all data sources taken together suggest that, compared to Year One:

- Student engagement in STEM learning was roughly as high;
- Students' problem-solving skills increased;
- Student development of collaboration skills was roughly as high;
- Students had more opportunities to visit various STEM industry facilities;
- Teachers increased their use of hands-on, inquiry-based instruction;
- Teachers integrated STEM subjects at roughly the same frequency;
- Teachers had meaningful opportunities to collaborate with one another and beneficial professional development opportunities at roughly the same frequency; and
- School communities' awareness and commitment to STEM education increased.

Recommendations

- Continue to implement hands-on, problem-based STEM curricula and activities; increase instructional emphasis on rigor.
- Continue to raise student awareness of STEM careers; increase opportunities for students and teachers to engage with STEM industries; further relationships between schools and industry (education and work); focus on females in engineering.

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- Continue providing opportunities for STEM teachers and other teachers to collaborate both within departments and across grade-levels; focus on ways to support cross-curricular integration.
- Increase professional development opportunities that are hands-on, content-specific, grade-level specific, facilitated by lead teachers, and that provide immediate classroom solutions; provide more time for teachers to plan, experiment, and implement what they've learned.
- Find ways to have safe, professional conversations about teaching philosophies and beliefs; address differing outcome expectancies.
- Continue to invest in sustainability planning; continue to collect data about the progress of programs and use them to strategically plan for the future.

CERE–NC looks forward to continuing its investigation of the impacts of Golden LEAF-supported initiatives on STEM outcomes in North Carolina schools.