The University of Georgia

University Council
Athens, Georgia 30602

March 18, 2016

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Dear Colleagues:

The attached proposal for a new Graduate Certificate in STEM Education will be an agenda item for the March 25, 2016, Full University Curriculum Committee meeting.

Sincerely,

William K. Vencill

William K. Vencill, Chair
University Curriculum Committee

cc: Provost Pamela S. Whitten
Dr. Rahul Shrivastav

Proposal for Graduate Certificate in STEM Education

I. Basic Information

1. Institution: University of Georgia Date: October 1, 2015

2. School/College: The College of Education

3. Department/Program: Department of Career and Information Studies
Department of Mathematics and Science Education

4. Certificate Title: STEM Education Certificate

5. Level: Graduate

6. Proposed Starting Date: Summer of 2016

7. Program Abstract:

We request permission to begin offering a Certificate in STEM Education beginning in the summer of 2016 for a total of 12 graduate credit hours. Education related to Science, Technology, Engineering, and Mathematics (STEM) is critical to success in the 21st century. The program areas in the Department of Career and Information Studies focus on Engineering and Technology in Education. The program areas in the Department of Mathematics and Science Education clearly focus on math and science education. Together, we are STEM in education and this why we want to offer this certificate jointly via these two departments. This proposal is for a certificate that serves the teacher audience. The primary audience for this certificate will be elementary and middle school teachers. There are 110,000 teachers in the state of Georgia, and all of them are our target audience. Students who enroll in this STEM certificate will be either current graduate students or newly admitted non-degree students. While we carefully chose the courses for this certificate to align with the needs of elementary and middle grades teachers, we will be able to offer this certificate using a blended learning model that will also make it accessible to current as well as prospective teachers. The mathematics and science education classes are currently taught as abbreviated short courses in the summer where teachers come to campus to take these two classes. The remaining two classes are online classes and teachers can take these two classes during the school year from their homes. This certificate will be very useful for teachers, especially in situations where a school is seeking designation as a STEM school. Further, once approved, this certificate will be the only one offered in the state of Georgia. In addition, this certificate will increase enrollments in our master's program since some students will start with the certificate and then decide to pursue a master's degree. Because of the emphasis on STEM nationally, there has been an increase in students pursuing STEM degrees, but these efforts must continue to meet the needs of our country and society because of the increasing need for employees in the STEM fields.

8. Letters of Support:
The four courses for this certificate come from two departments–Mathematics and Science Education and Career and Information Studies. The Learning, Design, and Technology (LDT) program area within the Department of Career and Information Studies will administer this certificate, so approval will come from the department head of CIS while the

supporting signature will be from the department head from Mathematics and Science Education.

II. Response to the criteria for all education programs

1. Purpose and Educational Objectives

A. Purpose and Educational Objectives

STEM Certificate - The purpose of this certificate is to provide teachers with the STEM strategies that they may effectively employ in the classroom. According to the 2020 Strategic Plan, objective IV.e. states, "Increase level of pre-college outreach with an emphasis on diverse populations and production of K-12 teachers, with an emphasis on preparing teachers in the STEM areas by 2020." This certificate helps us meet this objective. While each of the courses will provide emphasis that aligns closely with science, technology, engineering, or mathematics, the overall intent of the program will be to prepare teachers who can design and guide integrative STEM learning activities. These activities will facilitate learning across STEM content rather than in isolation. Our approach will transform STEM learning and make it more effective, applicable, and better prepare k-12 students to pursue STEM degrees.

B. Interdisciplinary Nature of the Proposed Program

All four of the courses for the certificate are currently being offered from four different programs in two different departments. It is by its very nature an interdisciplinary certificate. If you take the mission of Workforce education as the engineering program in K12 schools, then ESCI 6420 is the Science course, EDIT 4170E/6170E is the Technology course, ETES 4030E/6030E is the Engineering course, and EMAT 6420 is the Math course comprising the STEM certificate.

Certificate students will be added to these existing courses. We hope to begin the certificate this summer. Both EMAT 6420 and ESCI 6420 are scheduled to be taught this summer. EDIT 4150E/6150E will be offered in the fall of 2016. ETES 4030E/6030E will be offered in the spring of 2017, so the first certificates will be issued at the end of the spring 2017 semester. If the certificate is not approved by the summer of 2016, then students can begin in the fall of 2016 and finish with the EMAT and ESCI classes in the summer of 2017.

2. There must be a demonstrated and well-documented need for the program.

A. Explain why this program is necessary.

During the past fifteen years significant concerns about student learning and performance have emerged. Performance on international tests such as that

administered by the Programme for International Student Assessment (PISA) have demonstrated that students in the U.S. lag behind the rest of the world in science, mathematics, and reading. Politicians, leaders in technical professions, and other decision makers have taken note, and schools are placing increased emphasis on STEM content in their instructional programs. The list of groups and agencies calling for improvements in STEM instruction includes the National Science Board, U.S. Department of Education, American Association for the Advancement of Science, National Academies, and many others (2009, National Academy of Sciences).

Two main issues have emerged as reasons improved STEM education is needed. The 21st century has been characterized by an increasingly interconnected and competitive world. Barriers of distance and time have diminished to the extent that many of the activities that drive national economies can be accomplished anywhere on earth. For our own nation to remain competitive it is essential that students pursue various scientific and technical fields so that an adequate workforce is available to drive the economy. In addition, the scientific and technological literacy of the general population is a concern. In a democratic society, literate citizens are needed to make decisions and shape policy. Basic understanding needed to do this in the high-tech world of today requires increased levels of learning in STEM content areas.

Teachers in elementary and middle grades are being asked to provide increased emphasis on STEM instruction. To do this, significant professional development is needed—especially at the elementary school level. Elementary teachers often feel ill-equipped to delve more deeply into STEM content and also sometimes lack the expertise to design and implement problem-based learning activities that motivate and challenge students to excel in STEM learning. The STEM certificate being proposed is designed to enhance teacher competence and expertise in these areas and enhance the capacity of elementary and middle schools to meet 21st century needs and expectations.

B. Timeline

Semester/Year of Program Initiation: Summer 2016
Semester/Year Full Implementation of Program: Summer 2016
Semester/Year First Certificates will be awarded: Spring 2017
Annual Number of Graduates expected (once the program is established): 10
Projected Future Trends for number of students enrolled in the program: As knowledge of the certificate is expanded, we believe that this program will grow to 10 students completing the certificate each year.

3. Evidence of Student Demand

A. Documentation of the student interest in the program

There are many universities around the country that are now offering a STEM Certificate for teachers (e.g., Virginia Tech, New York Institute of Technology,

Arizona State, and many others). There is a growing need to train teachers in the STEM fields. As noted above, there are a growing number of schools that are working towards or have STEM Certification from the state. In order to do so, teachers need to have STEM qualifications, and this certificate can provide that.

LDT has revised the major in Learning, Design, and Technology (M.Ed.) with an Area of Emphasis in Instructional Technology to allow students to easily add the STEM Certificate to their degree programs (by taking an additional two classes). When existing students were surveyed, 53% of them would have taken this option. In addition, students in other Teacher Education programs would easily be able to add certificate courses to their programs.

LDT currently offers two other certificates at the graduate level. While interest was slow to develop, we currently have about 30 students in the eLearning Design certificate and we have about 10 students in the Instructional Technology for Teaching certificate. We believe that demand for the STEM certificate will be more like the eLearning Design certificate because of the combination of schools moving toward STEM and the fact that there are more than 110,000 teachers in the state of Georgia. With the certificate being offered in blended fashion where two classes can be completed in the summer in Athens and the other two during the school year, online, we expect that there will be many teachers interested in the certificate.

In addition, CIS faculty are currently working with schools in Jackson, Clarke, Barrow, Oconee, and Hart Counties with funded projects related to STEM. Teacher professional development is being provided and student learning in STEM content is being assessed. In most instances there are many teachers in these school systems who have been unable to participate in ongoing projects due to limited resources or other constraints. Providing a STEM certificate will enable many of these teachers to be prepared to better address STEM content with their students and facilitate improved learning in K-8 schools.

B. To what extent will minority student enrollments be increased and, or the equivalent to the proportion of minority students in the overall student body?

We will visit schools in the greater Atlanta and northeast Georgia areas that have diverse teaching staffs. We will actively recruit teachers from these schools to enroll in this certificate program.

We also hope that this certificate is not only successful in its own right, but that it will also serve as a tool to attract students to our master's and doctoral programs. By expanding our reach, we will have a greater ability to reach minority students and to recruit them directly to our regular degree programs.

4. The design and curriculum of the program must be consistent with the appropriate disciplinary standards and accepted practice.

The courses included in this certificate align well with the STEM content expected of K-8 students in the Common Core Standards for Mathematics, the Next Generation Science Standards, and the Standards for Technological Literacy. Attention was also given to research by the National Academy of Engineering examining STEM integration in K-12 school programs and other work that has identified STEM content appropriate for elementary and middle school environments.

A. Curriculum Outline

Instructional Technology for Teaching Certificate

EDIT 4150E/6150E	Introduction to Digital Learning	3 Credits
ETES 4030E/6030E	Robotics for Teachers	3 Credits
ESCI 6420	Science for PreK-8th Grade	3 Credits
EMAT 6420	Mathematics Methods for PreK-Grade 8	3 Credits
Total		**12 Credits**

Semester	Course
Summer 2016	EMAT 6420
	ESCI 6420
Fall 2016	EDIT 4150E/6150E
Spring 2017	ETES 4030E/6030E

EDIT 4150E/6150E Introduction to Digital Learning (3 Graduate Credits)

- Explore and become familiar with emerging technology and reflect on their application in educational settings.
- Use various software applications and apply their use to real contexts.
- Use various integration models in an applied setting (such as your own classroom).
- Articulate your learning and experiences using current and appropriate technologies.

ESCI 6420 Science for PreK-8th Grade

- What is the nature of science and scientific knowledge?
- What do teachers do when they teach science?
- How can a teacher provide learning environments that will promote active learning, student responsibility and autonomy?
- How can children participate as “citizen scientists”?
- What can be done to encourage females and minorities in science?

- How can a teacher or student assess learning with understanding?
- What "tools" can assist a teacher in becoming a "reflective" practitioner and students in becoming "reflective" learners?
- What resources are available for early childhood science educators?
- How can science be integrated across the curriculum?
- How can science be taught using outdoor learning environments?
- What is meant by "culturally relevant" science teaching and learning?
- How can we foster sustainable education practices in the early childhood classroom?

EMAT 6420 Mathematics Methods for PreK-Grade 8

- Help you become aware of children's mathematical thinking, how it differs from adult thinking, and how it impacts mathematics teaching.
- Expose you to mathematical knowledge for teaching (MKT) and the content, methods, and materials appropriate for preK-8 mathematics instruction. Become familiar with the ideas espoused by the NCTM Principles to Action (2014), NCTM Principles and Standards for School Mathematics (NCTM, 2000), and Common Core State Standards for Mathematics (CCSSM, 2010), Common Core Georgia Performance Standards (CCGPS, 2011).
- Help you become aware of students' and teachers' responsibilities in the mathematics classroom and how this affects planning for and teaching mathematics.
- Cause you to examine your beliefs about the goals and content of preK-8 mathematics instruction.
- Provide you with alternative methods of assessment and ways of planning instruction based on assessment.
- Develop a critical view of mathematics curriculum, textbooks, and other instructional materials.
- Examine and develop ways to teach diverse student populations, with attention to factors such as culture, race, gender, socioeconomic status, language, and ethnicity.
- Examine the nature of schooling, including teaching, grouping, testing, and policy issues, and its impact on the mathematics education of diverse students.

ETES 4030E/6030E Robotics for Teachers

- Identify grade-appropriate science, technology, engineering, and mathematics (STEM) content that can be enhanced with robotics activities.
- Design learning activities incorporating robotics that enhance STEM content specified by current Georgia Department of Education standards for grade-appropriate instruction.
- Explain the function of robotics controllers, sensors, and actuators.
- Describe the underlying principles of robotic control systems and programming.
- Analyze basic robotics tasks and develop hardware and software solutions.
- Describe and assemble basic logic structures used in programming robotics systems to accomplish specified tasks.
- Describe and critique robotics hardware and software available for school use.

- Prepare recommendations for robotics hardware, software, and learning activities given a set of learning objectives and budget and time constraints.
- Describe the instructional approaches that could benefit from use of robotics to support learning of STEM content.
- Identify significant streams of research on use of robotics to enhance learning in instructional settings.
- Assess the effectiveness of including robotics in STEM learning activities.

B. Identify which aspects of the proposed curriculum already exist and which constitute new courses.

All courses already exist.

C. Identify model programs, accepted disciplinary standards, and accepted curricular practices against which the proposed program could be judged. Evaluate the extent to which the proposed curriculum is consistent with these external points of reference and provide a rationale for significant inconsistencies and differences that may exist.

During the planning phase for this certificate, colleges and universities were surveyed, particularly peer and aspirant institutions for similar certificate programs. There were a wide range of programs that offer these specialized training certificates, and ours generally conforms to many of these. While our certificate will align with others that are offered, the quality of our faculty and their expertise will allow us to compete and provide a much better alternative to others. Also, we will be focusing on the state of Georgia where the University of Georgia already is popular.

Here is a sampling of programs:

- John Hopkins offers a STEM certificate. However, their program is composed of 4 courses from a selection of Science and Math courses, ignoring the technology and engineering domains.
- The University of Cincinnati offers a STEM certificate that is composed of 5 courses, one is Math, one is science, one is technology, one is an overview of STEM, and one is a practicum.
- University of Texas San Antonio has a STEM certificate that does not include math, science, engineering or technology courses. Instead, one course is on teaching students with diverse needs and three are general STEM courses.

We looked at programs such as these and decided that our curriculum is more in line with STEM education with a course from each discipline. This is a stronger approach which gives teachers math, science, engineering and technology content taught by experts along with strategies for integrating them into their classrooms to encourage STEM learning.

Unfortunately, while there are many universities that offer STEM Certificates for teachers, there are no established standards for the curriculum. We instead examined other institutions' curricula and aligned ours to these existing certificates.

D. If program accreditation is available, provide an analysis of the ability of the program to satisfy the curricular standards of such specialized accreditation.

Program accreditation is not required for the STEM Certificate. We have contacted the Georgia Department of Education to begin to establish this sort of accreditation, but so far nothing has been established. We are actively working on a teacher credential that meets requirements for the STEM Program Certification for Elementary and Middle Schools.

5. Faculty resources must be adequate to support an effective program

A. Define the size, experience, and specialization of the full time faculty needed to support an effective program. Identify the extent to which such faculty resources currently exist at the institution. Specify how many FT faculty will provide direct instructional support to the program.

Faculty who teach courses in this certificate program are all full-time regular faculty. Faculty whose expertise aligns to the content will teach the courses.

B. List each faculty member directly involved in the program: name, rank, degrees, academic specialty, background; special qualifications related to this program; relevant professional and scholarly activity for the past 5 years; projected responsibility in this program and required adjustment in current assignments.

Below is a list of faculty who have agreed to teach the certificate courses. These faculty are active in their respective fields as well as in the college in providing leadership in Science, Math, Engineering, and Technology. Other faculty who express an interest and whose scholarship aligns to these programs may also join the program faculty.

Name/rank	**Degree**	**Academic specialty/ background**	**Special Qualifications**	**Scholarly activity past 5 years**
Dr. T. J. Kopcha, Associate Professor	Ph.D.	Technology integration in K12 and higher education	Experience as full-time technology mentor at K12 school; teaches technology integration to grads and undergrads	Three top-tier journal publications on technology integration; additional scholarly and practitioner presentations

Dr. Michael Orey, Associate Professor	Ed.D.	Application of learning and advanced instructional models to eLearning and other technology advances	Teaches theory and design for eLearning, Technology Integration and Information Technology	Publications, conference presentations, panels, presentations in eLearning, Technology integration and information technology
Dr. Roger Hill, Professor	Ph.D.	Technology in workforce education and engineering	Designed and provided instruction for integrative STEM course for UGA undergraduate elementary education majors; extensive experience with STEM projects funded and implemented in local school systems	Publications, conference presentations
Dr. Deborah Tippins, Professor	Ph.D.	Elementary Science Methods	Selected at the Outstanding Science Teacher Educator in 2009. She is an expert in methods of teaching science at the elementary level often employing innovative and emerging methodologies.	Publications, conference presentations
Dr. Dorothy White, Associate Professor	Ph.D.	Elementary Math Methods	Has designed and taught methods of teaching math at the elementary, middle school, and high school levels. She has worked as a Professor in Residence at Clarke Middle School, so she has instant credibility with teachers at all levels.	Publications, conference presentations

C. Added faculty

No additional faculty will be required for this program.

6. Library, computer or other instructional resources needed

A. Describe available library resources.

Online access to some library resources will be required, but no library resources beyond those already available will be necessary to offer these courses.

B. Document the extent to which there is sufficient computer equipment, instructional equipment, lab, etc.

We will use the current online infrastructure (eLC) and building infrastructure to offer these courses. No additional technology will be required.

7. Physical facilities necessary to fully implement program

No new or dedicated physical facilities are required to implement the program.

8. Expense to the institution (including personnel, operating, equipment facilities, library) to implement program.

The courses in this program have the capacity to accommodate students who pursue the certificate. Because of this, there are no additional expenses expected in the offering of this certificate. We will use existing course rotations to meet the need. EMAT and ESCI courses are already planned to be taught in the summer of 2016, as are the EDIT and ETES classes in the fall and spring.

A. Funding Plan – Detailed funding to initiate the program and subsequent annual additions required to fully implement the program are needed below. Estimates should be based upon funding needed to develop an effective and successful program and not upon the minimal investment required to mount and sustain a potentially marginal program.

	First Year	Second Year	Third Year
(1) Personnel	_____	_____	_____
(2) Operating Costs	$500	$500	$500
(3) Capital Outlays	_____	_____	_____
(4) Library Acquisitions	_____	_____	_____
(5) Total	$500	$500	$500

B. Student Support

There will be no student support for certificate students.

9. Commitments of financial support needed

   A. Identify sources of additional funds needed to support the program.

      There will not be any additional sources of funding.

   B. It is important to include the long-range plans for additional or expanded facilities necessary.

      There will not be any additional resources required. If demand exceeds 30 students a semester, we may need to offer special sections, but this will be worked out within departmental budgets.

10. Provisions must be made for appropriate administration of the program within the institution and for the admission to and retention of students in the program in keeping with accepted practices.

    Program administration will reside in the Learning, Design, and Technology program within the Department of Career and Information Studies. Dr. Janette Hill is the coordinator of the LDT program and Dr. Michael Orey manages the certificate programs. All students who are interested in the certificate will need to apply to the certificate program (even if they are already UGA students) so that we can assure that they enroll in all required classes and can notify the Graduate School when they have completed the requisite courses. Those students who are not currently enrolled at UGA must apply directly to the certificate program through the UGA Graduate School application. We will use the Graduate School's admissions standards for non-degree students. We will not impose any further requirements.

    While the courses include a variety of projects, the primary assessment of the student's performance will be course grades. Once a student has completed all four courses with a cumulative GPA of 3.0 or better, the LDT certificate manager will notify the Graduate School that the student has successfully completed the certificate.

    All students admitted to the program will be assigned to Dr. Orey to make sure that they stay on track to complete their certificate. As part of their advising, students will be informed as to any status change as the result of poor performance. Students in this certificate will be held to the same Graduate School requirements for academic probation and dismissal for academic reasons. Students enrolled in the certificate program as non-degree students will be required to register every third semester according to Graduate School policy. In addition, every effort will be made to keep students informed that if they wish to transfer into one of the degree programs, that only 9 credits can transfer in. The advisor will serve as a mentor at the program level; faculty will mentor students at the course level providing any necessary assistance and encouragement to help students be successful in the certificate program.

    Any currently enrolled student who chooses to pursue this certificate must notify the program coordinator of the Learning, Design, and Technology program so that they can be assigned an advisor who can then help ensure successful completion of the courses.

Because students can begin the certificate in any semester, we will not use a cohort model for this program.

Finally, in order for this program to be successful, we will need to market the program. Our primary mechanism for marketing will be to create an email detailing the certificate and distribute this email to the various listservs of teachers throughout the state. We will initially use this strategy to enlist teachers in the state. If the certificate is successful, we can then pursue other marketing strategies to expand the audience beyond the state.