PhD in Science/Mathematics Education (SMED)

College of Sciences and Engineering
Dean: Dr. Patrick Carriere

Ph.D. in Science /Mathematics Education (PHD/SMED)

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Ph.D. Curriculum and Instruction
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Ph.D. Higher Education Research and Administration
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Bagayoko, Diola *
Ph.D., Physics
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Ph.D. Math
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Ph.D. Curriculum and Instruction
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Ph.D., Analytical Chemistry
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PH.D in Numerical optimization methods
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PhD in Dairy Microbiology from
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Vincent Finley, Rachel *
PH.D. Computational Mathematics,
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Young, Luria*
Ph.D., Educational Leadership and Research
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* Graduate faculty who serve this program from the Departments of Biology, Chemistry, Computer & Information Science, Curriculum and Instruction, Engineering, Mathematics, Physics and Louisiana Board of Regents

Graduate Degree Offered

Ph.D. In Science/Mathematics Education

Overview
Southern University and A&M College Science and Mathematics Education Doctoral (SMED) program is an interdisciplinary doctoral program designed for individuals who have completed a bachelor's or master's degree in mathematics, computer science, a natural science, or engineering. Students accepted in the program who have not completed the master's degree in one of the content areas will earn a M.S. degree or complete a master's equivalency in mathematics, a natural science, computer science or engineering during their course of study. This program is designed to develop research skills that will lead to improvements in teaching and learning in science, technology, engineering, and mathematics (STEM), in environments ranging from the primary to postsecondary levels; and preparing researchers for a changing and growing STEM economy.

This program prepares graduates for a wide variety of careers, including:

✓ University-level teaching and research in science or mathematics education

✓ Teaching in the content area at undergraduate or community colleges

✓ School district science/mathematics curriculum administration

✓ Program development and exhibit design at informal science sites

✓ Leadership in science or mathematics' education professional organizations

✓ Instructional program development in industry

✓ Scientific writing and/or software development for science/mathematics education

✓ Independent consulting

Science/Mathematics Education

Graduates of the Ph.D. program in Science/Mathematics Education are qualified to teach in colleges and universities but do not automatically qualify for K-12 teacher certification. Students lacking but wishing to secure K-12 certification must conform to additional requirements. This will necessarily lengthen their program of study. The applicant should further note that employers in several of the career options may expect several years of prior successful teaching experience. Accordingly, it is essential that the applicant clearly describe his/her long-range goals in the initial application, so the Department can provide appropriate advisement and mentoring.

ADMISSION REQUIREMENTS

In addition to the general requirements for admission to the Graduate School, the applicant must:

- Hold a minimum of a bachelor's degree in one of the following fields: mathematics, computer science, a natural science, engineering, or curriculum and instruction with a science or mathematics concentration.
- Provide a curriculum vitae and any written evidence of research potential (publications, research reports, master's thesis, etc.)
- Submit official transcripts from all schools attended
- Prior classroom teaching experience, or completion of a practicum of such experience during the program.
- Successful completion of a comprehensive examination for admission to doctoral candidacy
- Successful defense of proposed research
- Completion of 12 credits of directed dissertation research.
- Completion and successful oral defense of the dissertation

PLAN OF STUDY

DOCTOR OF PHILOSOPHY (Ph.D.) IN SCIENCE/ MATHEMATICS EDUCATION
Content Area (24 semester hours)

Master's Degree in Biology, Chemistry, Physics, Mathematics, or Computer Science

OR

24 credit hours of coursework numbered 500 or higher in one of the above disciplines

Foundations (6 semester hours)

SMED 702 Cognitive Foundations of Learning Science/Mathematics ……………..3 credits
AND
SMED 705 Foundations of Science/ Mathematics Education...3 credits

Submit TOEFL scores (for international students, as required by the Graduate School.

In addition, applicants are encouraged to schedule a personal interview

through the Department of Science/Mathematics Education. (International students, and others for whom travel would be a hardship, may arrange a phone or e-mail interview.

GRADUATION REQUIREMENTS

Following is the minimum graduation requirements. In all cases, the student must complete an individualized program of study, which must be filed and approved during the first semester of study.

A minimum of 24 credit hours of graduate coursework in the content field (master's equivalency)

A minimum of 36 credits of graduate coursework beyond the master's degree or equivalency and 60 credits beyond the bachelor's degree, exclusive of dissertation research

Completion of core courses specified by the department OR

SMED 710 History and Structure of Science and Mathematics...................................3 credits

Research (15 semester hours)
SMED 739 Applied Statistics and Data Analysis......................3 credits

SMED 740 Quantitative Research in Science/ Mathematics Education………………..3 credits

SMED 741 Qualitative Research in Science/ Mathematics Education……….. ....3 credits

SMED 743 Science/Math Research design ....3 credits

Approved Research Elective ....3 credits

Curriculum (6 semester hours)

SMED 716 Science/Mathematics Curriculum (Secondary)..3 credits
AND
SMED 715 Science/Mathematics Curriculum (Elementary)......................................3 credits
OR
SMED 717 Science/Mathematics Curriculum (College) ......3 credits

Technology (3 semester hours)

SMED 720 Technology in Science/ Mathematics Education ....3 credits

Doctoral Seminar   0 credit
Required attendance at departmental seminars and relevant professional meetings.

Electives (9 semester hours)

Nine semester credit hours of graduate level courses taken while enrolled in the doctoral program, and approved by the Department

Dissertation (12 semester hours minimum)

SMED 799 Advanced Research .... 3–15 credits

SMED 800   Dissertation Research .... 3–15 credits

Minimum coursework requirements for the Ph.D. in Science/ Mathematics Education:

60 credits beyond the bachelor's degree, exclusive of dissertation

36 credits beyond the master's degree, exclusive of dissertation

COURSE DESCRIPTION

SMED 701. Developmental Psychology and Science/ Mathematics Education (Credit, 3 hours). An in-depth coverage of the fundamentals and recent developments in developmental psychology, and their implications for Science/Mathematics Education.

SMED 702. COGNITIVE FOUNDATIONS OF LEARNING SCIENCE/MATHEMATICS (Credit, 3 hours). An in-depth coverage of the fundamentals of cognitive psychology and recent developments in cognitive psychology, and implications for Science/Mathematics Education; the cognitive domain, memory and cognition, cognitive models of learning, applications to the design of computer/multimedia assisted delivery systems.

705. FOUNDATIONS OF SCIENCE/ MATHEMATICS EDUCATION (Credit, 3 hours). A graduate level survey of the history and basic foundations of educational paradigms in general, and those of science and mathematics education in particular; the evolution of modern theories of teaching and learning; and the various paradigms of research in Science/Mathematics Education.

SMED 710. HISTORY AND STRUCTURE OF SCIENCE AND MATHEMATICS (Credit, 3 hours). Basic history and philosophy of the applicable Science/Mathematics discipline; structure, sub-branches and their recent developments; implications of current topics in a discipline on the curriculum (content, delivery, feedback) at various levels of the educational pipeline; introductory survey of related trends in research on teaching and learning in the discipline.

SMED 715. Science/Mathematics Curriculum (Elementary) (Credit, 3 hours). A macroscopic and microscopic examination of elementary science and mathematics curriculum. General structure, strands, and themes; analysis of sample classroom activities, delivery methods and media; related assessment of learning outcomes; cognitive and behavioral bases for the general curriculum; contemporary trends for the elementary science/mathematics curriculum; concepts and process maps applied to the curriculum and to specific activities. The elementary level is covered as a part of a continuum.

SMED 716. Science/Mathematics Curriculum (Secondary) (Credit, 3 hours). A macroscopic and microscopic examination of secondary science and mathematics curriculum. General structure, strands, and themes; analysis of sample classroom activities, delivery methods and media; related assessment of learning outcomes; cognitive and behavioral bases for the general curriculum; contemporary trends for the secondary science/mathematics curriculum; concepts and process maps applied to the curriculum and to specific activities. The secondary level is covered as a part of a continuum.

SMED 717. SCIENCE/MATHEMATICS CURRICULUM (College) (Credit, 3 hours). A macroscopic and microscopic examination of college curriculum in the affected science/ mathematics disciplines; general structure, strands, and themes, and analysis of sample classroom activities, delivery methods and media, and related assessment of learning outcomes; cognitive and behavioral bases for the general curriculum; contemporary trends for the college science/mathematics curriculum; concepts and process maps applied to the curriculum and to specific activities. The college level is covered as a part of a continuum.

SMED 720. Technology in Science/Mathematics Education (Credit, 3 hours). A survey of current educational technologies and their integration into teaching, learning, assessment, and instructional materials development; specific use of selected technologies (computers, multimedia, telecourses, interactive systems); identification of selected technologies; outcome assessments congruent with the technological integration into the content, delivery, feedback, and related research issues. This course, depending on a student's background, may require extensive supplemental work in thoroughly going through the delivery of instruction with selected technologies. Consultations with the instructor prior to enrollment are recommended. Basic computer literacy is mandatory.

SMED 721. Design in Science/Mathematics Education: Instruction and Outcome Assessment (Credit, 3 hours). This course focuses on the design of instruction (subject and skill content, organization, delivery methods, and related assessment of outcomes and effectiveness), taking into account, explicitly, the relevant cognitive and affective parameters and objectives; and the applications of concept and process mapping, for various grade levels. The integration of recent assessment techniques and of applicable technologies into the instructional delivery and assessment processes are an integral part of this course. Implications for research are explicitly addressed.

SMED 722. Instructional Design and Multimedia Technology (Credit, 3 hours). This course focuses on the use of interactive multimedia in teaching and learning and the development of multimedia learning objects for Science/Mathematics Education, targeting K-16 settings. It will provide students with a strong theoretical, experiential, and critical perspective of instructional design as it is applied in a variety of educational contexts and learning environments.

SMED 725: Critical Thinking in the Sciences and Mathematics (Credit, 3 hrs.). This course will address how critical thinking skills can be taught and acquired in the sciences and mathematics PK-16 classroom. Students will examine the type of thinking that takes place within a discipline, identify ways to raise questions using intellectual standards, evaluate knowledge through reasoning, and discuss the role of questions in thinking and learning. Current research on critical thinking in the sciences and mathematics will be studied.

SMED 726. Evolution and Science Education (Credit, 3 hours). This course is designed for students already knowledgeable about the theory of evolution. The course explores the history and philosophy of evolutionary thought, its impact on science and society, and particularly how the topic of 'biological evolution' is inculcated into the National Science Education Standards.

SMED 732. Topics in Number Theory (Credit, 3 hours). This course will briefly review fundamental concepts from Number Theory, with emphasis on intuition, proof, history, applications to modern algebra, discrete mathematics, coding, and the role of number theory in the school curriculum. Topics will include divisibility, the fundamental theorem of arithmetic, the Euclidean algorithm, congruence, number theoretic functions, Diophantine equations, systems of linear congruencies, topics in algebraic number theory, induction and well-

ordering.

SMED 735. Practicum in Mathematics Teaching at the Elementary, Secondary or College Levels (Credit, 3-6 hours). This practicum is "taught" or more accurately, guided and supervised, by a team of faculty members, at least one of whom is a graduate education faculty member and one of whom is a mathematics graduate faculty member. *(Prerequisites: SMED 705 or equivalent, 715, or 716, and 721.)*

SMED 736. Practicum in Science Teaching at the Elementary, Secondary or College Levels (Credit, 3-6 hours). This practicum is taught, or more accurately, guided and supervised, by a team of faculty members, at least one of whom is a graduate education faculty member and one of whom is a graduate faculty member in the affected science discipline. *(Prerequisites: SMED 705 or equivalent, 715, or 716, and 721.)*

SMED 737. Practicum with emphasis on Writing for Publication, (Credit, 3-6 hours). SMED 737 is designed for graduate students who have made significant progress in their degree programs and are thinking about larger; ongoing writing projects such as a prospectus; conference papers and presentations; and/or articles for publication. The course targets projects that are essential to a graduate student's success. While these projects are not part of the student's dissertation, they could possibly be used to enhance the dissertation experience.

SMED 739. APPLIED STATISTICS (Credit, 3 hours). This course is designed to promote conceptual understanding of advanced statistical procedures used in the educational and behavioral sciences, and to enhance the computational skills necessary to carry out these procedures. Both theoretical and practical issues will be addressed. Including statistical reasoning, statistical methods for computerized data analysis; understanding, evaluating and interpreting research findings in professional literature and the selection of appropriate statistical methods. *(Prerequisites: Math 586 or an equivalent statistics course, or by permission of the instructor.)*

SMED 740. QUANTITATIVE RESEARCH IN SCIENCE/MATHEMATICS EDUCATION (Credit, 3 hours). This course surveys the quantitative methods in Science/Mathematics Education research. Emphasis is placed on applications of basic statistical methods to the design and conduct of research. The validity of basic statistical inferences and related confidence levels are rigorously treated. Linear models and their implementation using the computer are operationally treated. *(Prerequisite: SMED 739)*

SMED 741. QUALITATIVE RESEARCH IN SCIENCE/ MATHEMATICS EDUCATION (Credit, 3 hours). This course is designed to expose every graduate student to the qualitative dimensions of research in science/mathematics education. Limitations of the quantitative approaches in research on conceptual understanding and on the interplay of the cognitive and affective domains are initially discussed. This is followed by the fundamentals of qualitative research in science/ mathematics education and the different and complementary natures of quantitative and qualitative approaches.

SMED 743. Science/Mathematics Research Design (Credit, 3 hours). The first half of this course is devoted to fundamentals of research design for qualitative and quantitative research. The second half of the course entails actual practicum in designing specific research projects. *(Prerequisites: SMED 740 and 741.)*

SMED 750. Advanced Quantitative Methods in Science/ Mathematics Education Research (Credit, 3 hours). Theories, models, and methods for the analysis of quantitative data; advanced experimental design and statistical inference; correlation and regression methods; factor analysis; survey of multivariate methods. Explicit applications to research in science/mathematics education. *(Prerequisites: SMED 740 and 741)*

SMED 755. Advanced Qualitative Methods in Science/ Mathematics Education Research (Credit, 3 hours). Intended mainly for students whose dissertation research entails significant qualitative research, this course explores in detail contemporary methods of qualitative research in science/mathematics .education, with applications to realistic cases. *(Prerequisites: SMED 740 and 741.)*

SMED 760: Informal Science Education (Credit, 3 hrs.). The principles and practice of structuring and assessing science learning activities outside of the traditional classroom and formal curriculum. Included are analyses of the enrichment experiences available through science museums, zoos, planetaria, aquaria, nature trails, science fairs, television, science-related websites, youth groups, and summer camps. The challenges of accommodating individuals with special needs and a spectrum of personal interests and learning styles are addressed.

SMED 770: SPECIAL TOPICS IN SCIENCE/MATHEMATICS EDUCATION (Credit, 3 hours; may be repeated). An in depth treatment of topics of timely interest in science and/or mathematics education. Specific topics will be announced in advance and will be described in a focused syllabus.

SMED 780. Research in Mathematics Education (Credit, 3 hours). This course includes a brief historical survey of educational research, with a focus on factors leading to the development of modern research in mathematics education. Topics include the factors affecting internal and external validity, the structure of research designs and methods considered appropriate for research in mathematics education, the factors affecting curricular and research activities in mathematics education prior to 1975, and a careful study of two documents from NCTM's Research Agenda: Effective Mathematical Teaching and Setting a Research Agenda.

SMED 790: Independent Study in Science Education (Credit, 3 hours). This course provides an opportunity for students to independently examine a topic of relevance under the direction of a faculty member. The student and faculty member meet prior to the beginning of the course to develop a contract describing the specific work to be done and the performance standards to be met. *(Prerequisite: only by permission of the SMED department.)*

SMED 791: Independent Study in Mathematics Education (Credit, 3 hours). This course provides an opportunity for students to independently examine a topic of relevance under the direction of a faculty member. The student and faculty member meet prior to the beginning of the course to develop a contract describing the specific work to be done and the performance standards to be met. (Prerequisite: only by permission of the SMED department.)

SMED 799. ADVANCED RESEARCH. (Credit, 3–15 hours). Research for doctoral students before admission to candidacy. Designed for students in the doctoral program who have successfully completed 80 percent of the doctoral level courses. Students will develop a proposal

and focus on the scholarly investigation of a research and/or dissertation topic. Not open to students who have already been admitted conditionally.

SMED 800. DISSERTATION RESEARCH (Variable credits, 3–15 hours; may be repeated). Directed development of the written dissertation and preparation for the oral defense. (Prerequisite SMED 799.)

Note: With departmental approval as part of the filed course of study, up to two courses taken outside the department may be used to fulfill the requirements for the Ph.D. degree in Science/ Mathematics Education.