Department of Curriculum & Instruction
University of Arkansas
STEM Program Annual Academic Assessment Report
May 2025

Overview

The STEM program in the Department of Curriculum and Instruction consists of a graduate elementary teacher education program that results in a Graduate Certificate in STEM Education for K-6 teacher education candidates and an undergraduate secondary teacher education program in Technology and Engineering Education program that results in an Arkansas teaching license in Industrial Technology Education. This report will outline the assessment reports for these two programs separately as they have little common coursework.

Graduate Elementary STEM Teacher Education Program Assessment Report

I. Introduction and History

The STEM education program in the Department of Curriculum & Instruction was created to help prepare a new cadre of elementary teachers with a robust understanding of Science, Technology, Engineering and Mathematics and the methods by which graduates from the program could influence K-6 students to thrive in STEM fields and careers through advanced instructional methods and focused curriculum experiences. The Graduate Certificate in STEM Education for K-6 (STEMGC) was launched in 2012 with the mission to provide future elementary teachers with the knowledge, skills, aptitudes, and tools necessary to make positive and lasting differences in the lives of their current and future students. The program rests on a foundation of providing a creative, and critical-thinking environment, where engaging STEM (Science, Technology, Engineering, and Math) content is delivered through real-world connections, problem/project-based learning, and performance-based assessment. The goal of the program is to nurture STEM confidence, the ability to deliver engaging STEM curriculum, as well as a passion for STEM learning among elementary teacher education candidates and practicing teachers. The STEMGC is housed in the Department of Curriculum and Instruction, where this certificate serves as a concentration area within the Childhood and Elementary Education degree programs.

II. Program Goals

As mentioned above, the ultimate goal of the STEMGC is to nurture STEM confidence, the ability to deliver engaging STEM curriculum, as well as a passion for integrated STEM learning among elementary teacher education candidates and practicing teachers. The STEMGC consists of five distinct graduate courses. The first course, STEM 40303/50303: Introduction to STEM Education, is designed to provide the candidate with an understanding of integrated STEM education as well as instructional strategies for teaching these subjects in the elementary and middle school classroom. The second course, STEM 40403/50203: Creativity and Innovation in STEM Education, is designed to provide knowledge and methods for solving technological problems and teaching engineering design. Elements of design and theory are applied through the development of design briefs. Candidates are also

expected to demonstrate technological competence in this course. This technological competence is demonstrated through the application of appropriate technological hardware and software as well as other web-based applications. Candidates utilize technology that enhances the instructional process during the completion of this course. The third course, STEM 52003: Problem-based Mathematics, is designed to provide the candidate with an understanding of the importance of mathematics for students' academic success, and the role integrated STEM education plays in that success. This course also focuses on equipping candidates with instructional strategies for teaching math in the elementary and middle school classroom utilizing an integrated instructional methodology. The fourth course, STEM 52103: Problem-based Science, is designed to provide the candidate with an understanding of integrated STEM education as well as instructional strategies for teaching science in the elementary and middle school classroom. The final course, CIED 50302: Curriculum Design, is designed to cause candidates to create and adapt curricula for students in regular and special K-6 classrooms. Theoretical bases and curriculum models are reviewed and applied. Concurrent clinical experiences in each area of emphasis are included.

III. Student Learning Outcomes

The STEM Graduate Certificate program includes the following major learning outcomes for teacher education candidates:

- Demonstrate a basic knowledge of the national standards in the fields of science, mathematics, and technology education; as well as basic knowledge of the Common Core Standards
- Demonstrate a basic knowledge of the national standards in the fields of science, mathematics, and technology/engineering education; as well as basic knowledge of the Common Core Standards
- Demonstrate the ability to solve problems, evaluate the efficacy of possible solutions, and discuss strategies and processes needed for effective problem solving;
- Demonstrate the ability to work in collaborative design teams to meet given criteria and solve design problems;
- Develop innovative and alternative teaching methods and learning activities that promote integrated STEM education
- Demonstrate knowledge of the historical background and development of the fields of science, mathematics, technology education, and engineering
- Demonstrate the ability to apply technical tools and resources to solve human problems
- Describe the goals, objectives and organization of the various sets of STEM standards
- Demonstrate confidence in the use and development of design models and engineering constraints
- Demonstrate the ability to work in collaborative design teams to meet given criteria and solve engineering-related problems;
- Demonstrate the ability to utilize the fundamentals of design and engineering in the development and delivery of curriculum

- Demonstrate the ability to communicate engineering and design concepts with colleagues and students using oral, written, artifact-based, and graphic channels of communication
- Utilize the vocabulary, primary concepts, definitions, and models applicable to engineering and design
- Demonstrate the ability to utilize common curriculum, assessment, and instruction practices that may interfere with the cultivation of student understanding.
- Demonstrate the ability to use a backward design process and consider its value in helping to avoid common inadequacies in curriculum and assessment planning.
- Present a theory of the six facets of understanding and explore its theoretical and practical implications for curriculum, assessment, and teaching.
- Propose an approach to curriculum and instruction designed to engage students in inquiry, promote "un-coverage", and make the understanding of big ideas more likely
- Examine a continuum of methods for appropriately assessing the degree of student understanding
- Consider the role that predicable students' misunderstandings should play in the design of curriculums, assessment, and instruction.

IV. Process for Assessing Student Learning Outcomes

STEM Graduate Certificate program completers successfully complete the following major assessment events:

- Present a theoretically informed argument for embedding mathematical and scientific thinking strategies across the curricula
- Prepare for and present at numerous local STEM nights and maker experiences
- Utilize numerous hardware and software programs, including MakeDo, CorelDRAW, CO2 Laser, 3D Printer, TinkerCAD, Cura, MakeyMakey, Robots, Drones, coding technologies, etc.
- Redesign curricula to include STEM and integrated core content
- Develop and test multiple STEM design challenges
- Utilize STEM standards to develop project-based lessons and units
- Develop and make presentations at local elementary and middle schools and internship schools
- Develop, present and test integrated STEM curricular units and design challenges
- Develop and test informal STEM presentation for local schools and STEM events
- Develop and test formal STEM curricula for local elementary and middle school classrooms
- Develop and implement UbD integrated curriculum units
- Develop a plan for implementing Integrated STEM at future teaching sites
- Develop and implement learner profiles and class profiles
- Participate in curricular and instructional peer reviews

V. Program Assessment

A. Results of analysis of assessment of student learning outcomes

The faculty associated with the STEMGC meet weekly to discuss curriculum scope and sequence—making certain that courses cover the required content/standards without unnecessary overlap and repetition. Additionally, the faculty review student

course survey results each semester to identify any student concerns. Faculty also co-teach and shadow one another to make certain that each course in the program builds upon the content of the previous semester and remain true to the goals of the program. During the summer of 2024, a faculty change was implemented to address content and delivery issues in the STEM 52103: Project-based Science course. The course was delivered in the fall of 2024 and the results of the change vastly increased student assessment scores in the course.

B. Changes to degree/certificate planned or made on the basis of the assessment and analysis

The Graduate Certificate in STEM Education for K-4 was changed to Graduate Certificate in STEM Education for K-6 in 2020 to address changes in the ELED MAT program and to better align with that change.

C. Changes to the assessment process made or planned

Major assignments associated with the STEM 52103: Project-based Science course were completely changed during the fall of 2024 to better align the course content and assessments with the overall goals of the program and to address student outcomes data indicating repetition within the course.

VI. Curriculum

A. Degree Requirements

The Graduate Certificate in STEM Education for K-6 is a certificate program in the Graduate School and International Education at the University of Arkansas—Fayetteville. The Graduate School limits the total number of courses that can be included in graduate certificate programs (5 – 7) and limits the program to graduate students and senior undergraduates who will be pursuing a master's degree. The STEMGC program is offered in conjunction with the Master of Arts in Teaching (M.A.T.) degree in Elementary Education. The Elementary Education MAT program requires all candidates to select a concentration area as juniors in the undergraduate program. The STEMGC program is one concentration option within the Elementary Education MAT program. To be formally accepted and admitted to the STEMGC program, candidates must apply for admission to the program and the Graduate School during their senior year as an undergraduate.

B. Sequence of courses

All candidates in the STEMGC complete the following courses in order:

1. STEM 40303/50303: Introduction to STEM Education (Fall, senior year)
2. STEM 40403/50203: Creativity and Innovation in STEM Education (Spring, senior year)
3. STEM 52003: Problem-based Mathematics (Spring, graduate year during internship)
4. STEM 52103: Problem-based Science (Fall, graduate year during internship)
5. CIED 50302: Curriculum Design (Spring, graduate year during internship)

C. Outline of the process for the introduction of new courses

Course changes are initiated in the Department of Curriculum and Instruction and, following department review and approval, are sent to the office of the Dean of the

College of Education and Health Professions for review and approval. Following that approval, all major course change forms are sent to the Director of Curriculum Review and Program Assessment to begin the campus review process by the required groups. All course actions are reviewed by the University Course and Programs Committee prior to action by the Graduate Council and/or the Faculty Senate.

VII. Program Resources

A. Describe the institutional support available for faculty development in teaching, research, and service.

The University provides faculty professional development through the Wally Cordes Teaching and Faculty Support Center (TFSC). This Center was established in 1992 to assist the faculty with their scholarship of teaching and to act as a resource center for new teaching techniques and programs. The Center acts as central facility to assist departments, faculty, and teaching assistants in the continued improvement of learning and teaching. Additionally, all new faculty in the Department of Curriculum and Instruction are paired with a peer mentor to assist in continuing peer professional development.

B. Describe the professional development of full-time program faculty over the past two years including the institutional financial support provided to faculty for the activities.

The STEMGC faculty meet on an ongoing basis to assess and refine course offerings and opportunities in STEM. For example, the STEMGC faculty recently completed a book study on *STEAM Makers: Fostering Creativity and Innovation in the Elementary Classroom* by Jacie Maslyk. Additionally, STEMGC faculty regularly attend national and international conferences as a team. Faculty regularly attend the *International Technology and Engineering Educators Association* annual conference as well as the *Children's Engineering Conference*.

VIII. Program Information

A. State the number of undergraduate/graduate majors/declared students in each degree program under review for the past three years.

All undergraduate elementary and childhood education majors are required to complete the first course in the STEMGC program, STEM 40303 Introduction to STEM Education as a part of their undergraduate program. This averages slightly more than 100 students per year. Elementary education majors who are pursuing a Master of Arts in Teaching graduate degree may elect to also pursue the STEMGC. In May 2025, six candidates completed the STEMGC (See Appendix C). In the four previous years, another 54 candidates have completed the STEMGC (See Appendix C). Another 17 candidates will apply for and be fully admitted to the STEMGC in July, 2025—they just completing the second course in the program.

B. Provide the number of program graduates over the past three years.

During the past four years, 60 candidates have completed the STEMGC.

C. Describe goals for intended research and creative activities. Describe how these initiatives are assessed, analyzed, and utilized. Provide list of program research/scholarly productivity

Each candidate in the Graduate Certificate in STEM Education for K-6 completes an action research project as part of the ELED MAT program. This action research project is completed during the school-based internship with K-6 students from the internship school. These action research projects are assessed by graduate committees, STEM faculty, and cooperating teachers from the participating school. Although the results of these action research projects are designed to inform teaching practice, they are sometimes published. However, the primary scholarly publication productivity associated with the Certificate Program come from the faculty leaders and Ph.D. candidates associated with program. A partial list of publications (last five years) from program faculty and STEM Ph.D. candidates include:

Daugherty, M. K., Carter, V. (2024). Ways of thinking and STEM-based problem solving: Towards the future. In English, L.D. (Ed.), *Ways of thinking in STEM-based problem solving: Learning in a new era*. Taylor and Francis.

Cheek, L. R., Carter, V., Daugherty, M. K., Goering, C. Z. (2024). Essential practices and attributes of integrated STEM in elementary education: A Delphi panel approach. *Research in Integrated STEM Education, 2*(3), 206-235. https://doi.org/10.1163/27726673-bja00025

Cheek, L., Carter, V., & Daugherty, M. K. (2024). From numbers to narratives: Tapping the potential of mathematical talks and engineering design. *Technology and Engineering Education*. *2*(2), 14-19.

Daugherty, M. K., & Sahin-Topalcengiz, E. (2023). 21st Century Skills: Preparing Students for the Future. In Quality Teaching for Future: IX International Scientific Spring Symposium, Alecu Russo Balti State University, Republic of Moldova

Deaton, S., Daugherty, M. K., Carter, V., Orr, B., & Smith, M. (2023) Funds of Knowledge Impact on Career Preparation, Arkansas Association for Teacher Education Journal, 39-110.

Cheek, L. R., Carter, V., & Daugherty, M. K. (2022). STEL practice and the integration of tinkering and take-apart in the elementary classroom. *Journal of Technology Studies, 47*(2), 60-71.

Kerr, G.R., and Daugherty, M.K. (2022). Connections between STEM Education and Multimodal Literacy Instruction. *Southeast Asian Journal of STEM Education, 3(1), 13 – 30.*

Daugherty, M. K., Kindall, H., Carter, V., & Cheek, L. (2022). Developing integrated STEM challenges to foster 21st Century skills. *Southeast Asian Journal of STEM Education, 3(1), 41 – 62.*

Cheek, L.R., Carter, V. & Daugherty, M.K. (2022). Design Fixation in STEM Teacher Education. *Technology and Engineering Teacher*, (81)5, Cover, 10 – 15.

Swagerty, L., and Daugherty, M.K. (2021). Affecting children's attitudes toward STEM. *Southeast Asian Journal of STEM Education, (2)2, 173 – 188.*

Daugherty, M.K., Carter, V. & Sumner, A. (2021). Standards for technological and engineering literacy and STEM education. *Technology and Engineering Teacher*, (*80*)5, 32-37.

Deaton, S., & Daugherty, M.K. (2020). FCS: Meeting the Needs of Students through Project Based Learning. *Journal of Family and Consumer Sciences, (24)*8. 57-62.

Daugherty, M.K. & Holter, C. (2020) Why the standards changed and what it means to you? *The Elementary STEM Journal, (25)*1, 8-12.

Deaton, S., Carter, V, Daugherty, M.K. (2018). Getting back to the roots of family and consumer sciences education: FACS and STEM integration. *Journal of Family and Consumer Sciences, 110(1), 55-58.*

Daugherty, M. K., Kindall, H. D., Carter, V., Swagerty, L. M., Wissehr, C., & Robertson, S. (2017). Integrating informational text and STEM: An innovative and necessary curricular approach. *The Journal of STEM Teacher Education. 52*(1), 3-16.

Daugherty, M. K., & Carter, V., (2017). The nature of interdisciplinary STEM education. *Springer International Handbook of Technology Education.* 1-13.

Sagely, M., Beshears, B., Carter, V., & Daugherty, M. K., (2017). Lighting up the holidays. *Children's Technology and Engineering, 22(1),* 8-11.

IX. Graduate Elementary STEM Teacher Education Program: Conclusion

A. List the strengths of the program.

The Graduate Certificate in STEM Education for K-6 is designed to prepare future teachers with the confidence and skills to deliver additional levels of science, technology, engineering and mathematics in their future classrooms. As a rule, elementary teachers have been historically reluctant to deliver large amounts science and math content in their elementary classrooms. We have overcome this problem by developing confidence among the candidates and teaching them methods and instructional techniques that deliver both STEM content while maintaining their focus on literacy—literacy-based STEM. We utilize integration, engineering design methods, Understanding by Design (UbD) curriculum theory, and project-based learning as primary instructional constructs in the five-course sequence. By using this methodology, we have been able to produce a cohort of elementary and middle school teachers with the efficacy, content knowledge and confidence to deliver rigorous and relevant STEM content in the classroom.

B. Program improvements accomplished over the past year.

Faculty leaders within the program continually adapt course curriculum, course expectations, as well as curricular scope and sequence. The STEM faculty meet regularly to assess course outcomes, student assessment feedback and sequencing issues. New curricular units, reference materials, and external learning experiences are continually added to the five courses associated with the program.

C. Additional information that will facilitate an understanding of the program/department operations, status, goals, and achievements.

Faculty associated with the Graduate Certificate in STEM Education for K-6 are very dedicated to the continuous improvement of the program and the success of graduates from the program. Candidates and graduates from the program are deeply engaged in STEM and routinely return to borrow equipment and materials for their internship sites as well as their classrooms after completing the program. We are routinely contacted by school administrators seeking additional information about the program as well as requests to offer in-service programs and after-school events at their schools.

<u>Undergraduate Technology and Engineering Education program assessment report</u>

I. Programs Offered:

The program in Career and Technical Education offers a degree program leading to a Bachelor of Science in Education for the preparation of teachers, supervisors, and administrators in career and technical education. One of the Career and Technical Education concentrations is Technology Education.

The concentration in Technology Education prepares students to teach technology, pre-engineering, or other technical subject matter at the high school, middle-level, or community college. Additionally, the program prepares students to enter mid-level technical/management careers in business and industry.

II. Results of analysis of assessment of Student Learning Outcomes

- **How many students in the program: 2 Candidates**
- **How many graduated in last 3 years: 2 Candidates**
- **How many expected to graduate this year - 0**

III. Any changes to certificate/minor/licensure made on the basis of the assessment and analysis

- None

IV. Any changes to the assessment process made or planned.

- Responding to the Arkansas Department of Elementary and Secondary Education's adoption of the new Praxis Test - Technology and Engineering Education (5053), the TEED program will be working on updating course content to better align with the new candidate assessment. This test replaced the Industrial Technology (5051) exam. The new start date is September 1, 2024. DESE will utilize an overlap year for these tests. The overlap year allows the Office of Licensure to accept either the old test or new one until September 1 of the following year (2025 in this case).

TEED Program Goals and Objectives

The goal of the Technology Education concentration within the Career and Technical Education Program is to attract quality teacher candidates to teach technology education in grades 7-12.

The career and technical education (CATE) program in the College of Education and Health Professions is designed to provide the student a knowledge base that will prepare him/her to possess a broad background in career and technical education. The goals of the Technology Education (TEED) concentration in career and technical education (CATE) are to:

1. Provide a high-quality curriculum that prepares students for careers in technology and engineering education.

2. Produce TEED teachers who are knowledgeable, skillful, supportive, and professional scholar- practitioners in diverse education settings.

3. Enhance the curriculum with up-to-date technology that is used in the TEED classroom and the workplace.

To accomplish these goals, the CATE/TEED curriculum is based on the Council for the Accreditation of Educator Preparation (CAEP) standards and the Charlotte Danielson's Framework for Learning.

V. TEED Student Learning Outcomes

1. Students will be able to effectively plan and prepare a unit of study demonstrating knowledge of content and pedagogy, knowledge of students, selecting instructional outcomes, demonstrating knowledge of resources, designing coherent instruction and assessing student learning. (CAEP Standard 1: Content and Pedagogical Knowledge; Danielson Domain 1: Planning and Preparation)

2. Students will be able to demonstrate strong classroom management skills by designing an environment of respect and rapport, establishing a culture for learning, managing classroom procedures, managing student behavior and organizing physical space. (CAEP Standards 1 & 2; Danielson Domain 2: Classroom Environment)

3. Students will possess strong teaching skills through the design of instruction, communicating with students, using questioning and discussion techniques, engaging students in learning, using assessment in instruction and demonstrating flexibility and responsiveness in the classroom. (CAEP Standard 1: Content and Pedagogical Knowledge, Standard 2: Clinical Partnerships and Practice, Standard 3: Candidate Quality, Recruitment, and Selectivity, Standard 4: Program Impact; Danielson Domain 1: Planning and Preparation, Domain 2: Classroom Environment, and Domain 3: Instruction)

4. Students will demonstrate professional responsibilities by reflecting on teaching in terms of accuracy and instruction, maintaining accurate records, communicating with families, demonstrating professionalism, and participating in professional communities. (CAEP Standard 3: Candidate Quality, Recruitment, and Selectivity; Danielson Domain 4: Professional Responsibilities).

VI. Process for Assessing each Student Learning Outcome

Student Learning Outcome	Evidence
1. Planning and Preparation	Lesson Plans Formative Observation Praxis II Content Praxis II Pedagogy ILPPA Portfolio Summative Evaluation GPA
2. Creating an Environment of Respect and Rapport	Lesson Plans Formative Observation Portfolio
3. Using Assessment in Instruction	Summative Evaluation Lesson Plans Praxis II Pedagogy Formative Observation ILPPA Portfolio Summative Evaluation
4. Professional Responsibilities	GPA Praxis II Pedagogy Formative Observation Portfolio Summative Evaluation

VII. Undergraduate Secondary TEED Education: Program Conclusion

The technology education concentration in the career and technical education program is currently the only teacher preparation program in the state and continues to prepare teacher candidates for an area that is shortage area both in the state and the nation. TEED candidates have a 100% success rate on the current Industrial Technology (5051) Praxis exam and the goal for the next year is to provide course changes to help navigate the update of the new Praxis - Technology and Engineering Education (5053). As mentioned previously, the TEED program will be working on updating course content to better align with the new candidate assessment.