George Mason University
College of Education and Human Development
Elementary Education

ELED 421.002 – STEM in the Elem Classroom
3 Credits, Fall 2024
Tuesdays 1:30 pm - 4:00 pm Thompson Hall 2020 – Fairfax

Faculty
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Prerequisites/Corequisites
Admission to the Elementary Education program and successful completion of both Science Methods for the Elementary Classroom (ELED 453); Elementary Mathematics Methods (ELED 452) and/or recommendation of the STEM faculty.

University Catalog Course Description
Develops skills and abilities in integrated STEM teaching at the elementary level, applications of math, science and technology through engineering design, safety practices, and creation of integrated curricula. Examines STEM teaching based on contemporary theory, practice, and standards.

Notes: Requires field experience in public schools.

Course Overview
The primary goal of this course is to provide you with practical experience, theoretical background, and pedagogical skills that will allow you to be successful in your future career. The elementary classroom offers particular challenges in terms of the amount of content expectations placed on both teachers and students. Integrated STEM teaching provides a valuable way to make elementary teaching more efficient in terms of engaging children in multiple content and process standards that are couched in real-world challenges.

The NGSS call for "three-dimensional learning" in order to bring these real world challenges to life in the classroom. These dimensions are built on the three pillars that support each standard including Science and Engineering Practices, Crosscutting Concepts, and Disciplinary Core Ideas. These are also directly related to both content and process standards that comprise the NCTM standards. In particular, this STEM course will lean heavily on the following content standards: Number & Operations, Measurement, Data Analysis & Probability. The five NCTM process standards also directly relate to the scientific processes and engineering design practices: Problem solving, Reasoning & Proof, Communication, Connections and Representation. These principles lean heavily on engineering design and the incorporation of technology for both the design process and the collection of meaningful data to support claims with evidence.

These STEM standards and practices will drive the class experiences with the following key goals that will be carried out through the duration of the course: 1) to facilitate the development of pedagogical approaches to inquiry-based, integrated STEM practice, and 2) to develop confidence and understanding for interrelated STEM content. With respect to content, the course will develop STEM background knowledge with the goal of successful teaching in an elementary context, meaning that you will need to have a solid understanding of large-scale STEM topics and the interrelationships between those content areas beyond what is expected of elementary children.

Most children come to school with a keen interest in the world around them, but often by the end of elementary school only a small percentage of students have retained this interest in STEM content. This is generally attributed to the ways in which "school" contexts often ignore the beauty, complexity and joy that can come from engaging with content and connecting STEM content understanding to the everyday experiences of children. Consequently, we will conceptualize STEM engagement as an active process where we are consider our wonders, build new knowledge and discover as opposed to the memorization of 'facts.' For this reason, we will utilize constructivist/problem-based approaches to learning in an effort to scaffold STEM content that is too often presented as an exercise in the acquisition of vocabulary.

Course Delivery Method
This class is a face-to-face class meeting, with occasional online meetings. Under no circumstances, may candidates/students participate in online class sessions (either by phone or Internet) while operating motor vehicles. Further, as expected in a face-to-face class meeting, such online participation requires undivided attention to course content and communication. Technical Requirements and Expectations may include the access and use of Zoom, Interactive documents on either Google or Microsoft platforms.

Learning Outcomes
This course is designed to enable students to do the following:
   A. Build pedagogical content knowledge base in STEM inquiry-based investigation
   B. Conceptualize core principles regarding Engineering design, problem solving, evidence, explanation, inquiry, creativity and experimentation all help to frame STEM thinking
   C. Develop lesson plans demonstrating inquiry-based principles in integrated STEM
   D. Demonstrate age-appropriate safety standards when designing hands-on classroom experiences
   E. Examine STEM standards, curricula and methods at local, state, and national levels
   F. Develop viable assessment tools for STEM learning

Professional Standards
INTASC: Interstate Teacher Assessment and Support Consortium, Model Core Teaching Standards
#4. Content Knowledge. The teacher understands the central concepts, tools of inquiry, and structures of the discipline(s) he or she teaches and creates learning experiences that make the discipline accessible and meaningful for learners to assure mastery of the content.

#5. Application of Content. The teacher understands how to connect concepts and use differing perspectives to engage learners in critical thinking, creativity, and collaborative problem solving related to authentic local and global issues.

#6. Assessment. The teacher understands and uses multiple methods of assessment to engage learners in their own growth, to monitor learner progress, and to guide the teacher's and learner's decision making.

#7. Planning for Instruction. The teacher plans instruction that supports every student in meeting rigorous learning goals by drawing upon knowledge of content areas, curriculum, cross-disciplinary skills, and pedagogy, as well as knowledge of learners and the community context.

#8. Instructional Strategies. The teacher understands and uses a variety of instructional strategies to encourage learners to develop deep understanding of content areas and their connections, and to build skills to apply knowledge in meaningful ways.

Technology (ISTE NETS): International Society for Technology in Education / National Educational Technology Standards

Standard I. Teachers use their knowledge of subject matter, teaching and learning, and technology to facilitate experiences that advance student learning, creativity, and innovation in both face-to-face and virtual environments.

CAEP Standards:

1.a – Candidates use their understanding of how children grow, develop and learn to plan and implement developmentally appropriate and challenging learning experiences within environments that take into account the individual strengths and needs of children.

1.b – Candidates use their understanding of individual differences and diverse families, cultures, and communities to plan and implement inclusive learning experiences and environments that build on children's strengths and address their individual needs.

3.a – Candidates administer formative and summative assessments regularly to determine students' competencies and learning needs.

3.c – Candidates plan instruction including goals, materials, learning activities and assessments.

3.d – Candidates differentiate instructional plans to meet the needs of diverse students in the classroom.

3.f – Candidates explicitly support motivation and engagement in learning through diverse evidence-based practices.

4.a – Candidates use a variety of instructional practices that support the learning of every child.

4.b – Candidates teach a cohesive sequence of lessons to ensure sequential and appropriate learning opportunities for each child.

4.c – Candidates explicitly teach concepts, strategies, and skills, as appropriate, to guide learners as they think about and learn academic content.

Required Texts

Readings will be required weekly and be posted on the Learning Management System (LMS) prior to the beginning of class.

Course Performance Evaluation

Students are expected to submit all assignments on time in the manner outlined by the instructor.

- **Assignments and/or Examinations**
    1. Attendance and Participation   20%

It is expected that you attend all scheduled classes and asynchronous online meetings outlined within the syllabus. Absence from class to observe a religious holiday, to serve jury duty, or to participate in required military service, and medical emergencies are exceptions to the above policy with documentation. If you anticipate being absent for any of these reasons, please make arrangements in advance. This is a time intensive course and missing time will most certainly impact your ability to meet the goals of the course. In addition, this class operates with the assumption that knowledge is socially constructed and the most meaningful learning opportunities are those where you have the opportunity to offer and explore diverse perspectives with peers; therefore, you are expected to contribute to both class and online discussions and activities as well as genuinely listen to peers as they do the same. In addition, you should be prepared for each class, which means having completed all assigned readings and tasks for that class. This includes engagement with and construction of a class journal to be used for all notes, questions and class activities. Students must adhere to the Professional Dispositions (later in syllabus) for full credit.

2. STEM/STEAM Identity Paper   5%
Write a two-page paper discussing STEM/STEAM identity using your personal story, a story from someone else, and your readings. What is your STEM/STEAM story? What is a STEM/STEAM story of a person you know? Do your stories align? What will the STEM story be for your students? What does it mean to have a STEM/STEAM identity? What does a school look like with a STEM/STEAM identity? What could promote building a STEM/STEAM identity in a student/teacher/school? Late papers will have a 10% deduction per day late.

3. STEM Wonders and Why Journal   10%
Think about the STEM that you see in the everyday. Ask yourself questions about the world around you and then seek out answers using a variety of multimedia. Students will submit their journal weekly using the STEM Wonders and Why Journal Template. Late journals will have a 10% deduction per day late.

4. Reading Logs   10%
You will analyze each reading in terms of its connection to your school site and your unit. Students will submit their log weekly using the STEM Reading Log Template. Use the following template:
>   3 – Questions that emerged from the reading
>   2 – Connections from your experiences that relate to the reading
>   1 – Surprise or Aha moment that you had related to the reading
>   Note: Reading Logs must show evidence that students have read and interpreted the readings. Overly generalized logs that do not show evidence of the content of the readings will not be accepted. Ten reading log grades are scored as 1-point for full credit or 0-points for no credit for a total of 10 points. Late grades are not accepted for reading logs.

5. Inquiry-Based/STEM/STEAM Unit Project   40%

The goal of this project is to construct and teach (at least a portion of) an integrated STEM/STEAM inquiry unit within your field site. This project will feature integrated content surrounding the four content areas involved in the course. We will design this work around the 5 E model of lesson planning. The unit will entail building a detailed and well-supported narrative description for the approach that will be employed. The lesson sequence will build STEM content understanding in engaging and dynamic ways for students within your field site and provide some key theoretical and research-based support for the content, approach and activities constructed. The unit will be scored via the rubric provided later in the syllabus as part of the PBA for STEM. Templates and approaches will be provided during the course. Late components will have a 10% deduction per day late.

6. Wonder Inspired STEM/STEAM Task   15%
This project is designed to evoke and engage future teachers in the possibilities that STEM/STEAM content holds for elementary contexts as well as for yourselves. Prior science and math experiences often generate negative feelings associated with memorization and mind-numbing procedural approaches, which is not the norm in contexts that study these problems. The goal of this project is to pursue an idea that you find interesting. You will choose a STEM/STEAM topic from your wonder and why journal and pursue some answers, ideas, and most importantly further questions related to that wonder. The goal is not necessarily to prove something but to understand something to a greater degree and then consider all the new questions that come along with that wondering and investigating. Projects will be presented over 2 class periods. Students requesting an extension to present on the second day will result in a 10% deduction. However, if students are prepared on the first day, but are assigned the second day, there is no late deduction.
The project will entail the following:
- An engaging hands-on interactive presentation that will highlight:
a) the wonder itself
b) the information identified to make more sense of that wonder (diagrams, sketches, etc.)
c) list key STEM/STEAM concepts behind that content (definitions, models, etc.); this will also include Math, Science, Technology and Engineering Practices, NGSS/CCM/VDOE/ISTE Standards, Crosscutting Concepts, and Disciplinary Core Ideas.
d) list further questions related to that wonder,
e) creation of an engaging, hands-on, interactive inquiry-based investigation, reasoning routine, or game that you might consider using in a classroom context (and that you will present to the class)
f) A written two-page reflection on the process of turning a wonder into an investigation that includes a vision for you as a STEM/STEAM teacher built on this experience (wondering/planning/enacting), the readings, class discussions, challenges, and opportunities.

● **Other Requirements**
ELED Attendance Policy:
In accordance with the GMU Attendance Policies (University Catalog, 2023-2024), "Students are expected to attend the class periods of the courses for which they are

registered. In-class participation is important not only to the individual student, but also to the class as a whole. Because class participation may be a factor in grading, instructors may use absence, tardiness, early departure, or failure to engage in online classes as de facto evidence of nonparticipation."

If you must be absent from class, inform the instructor prior to the beginning of the class session. Missed classes (or portions of classes) will result in a loss of 5 participation points. Unless there are extenuating circumstances that have been shared with the instructor, <u>more than two missed classes will result in a failing grade</u> and you must retake the course.

Absence from class to observe a religious holiday, to serve jury duty, or to participate in required military service are exemptions to the above policy with documentation. If you anticipate being absent for any of these reasons, please make arrangements at least 48 hours in advance.

In addition, you are expected to be on time to class each week unless 48 hours advance notice has been provided to the instructor.

Field Accommodations

If you believe you need ADA accommodations during your field placement and/or internship experience, please contact Mason's Disability Services office (DS). Specific accommodations for fieldwork and internships may be different than academic accommodations; however, like academic accommodations, they are not retroactive. Connecting with DS is a student-initiated interactive process. DS will collaborate with the department and possibly the placement site to provide reasonable accommodations that are individualized and based on documentation, functional limitations, and a collaborative assessment of needs. For more information, please refer to the Disability Services website: https://ds.gmu.edu/field-placement/.

Field work is required for this class. Failure to complete the total number of assigned hours will result in a failing grade.

- **Grading**

UNDERGRADUATE GRADING SCALE

Grade	Grading Scale	Interpretation
A+	97-100	Represents mastery of the subject through effort beyond basic requirements
A	93-96	
A-	90-92	
B+	87-89	Reflects an understanding of and the ability to apply theories and principles at a basic level
B	83-86	
B-	80-82	
C+	77 – 79	
C	73 – 76	
C-	70-72	Denotes an unacceptable level of understanding and application of the basic elements of the course. Grade does not meet the minimum requirement for licensure courses.
D	60-69	
F	<69	

Use of Generative AI

Use of Generative AI tools should be used following the fundamental principles of Mason's Academic Standards. This includes being honest about the use of these tools for submitted work and including citations when using the work of others, whether individual people or Generative AI tools.

Professional Dispositions (CEHD Student Guide)

Throughout study in the College of Education and Human Development, students are expected to demonstrate behaviors that reflect the positive dispositions of a professional. See https://cehd.gmu.edu/current-students/cehd-student-guide.

This class will model a Collaborative Team (CT) that is incorporated in public schools. Students must use professional language when in class. This includes using asset language when discussing student concerns and professional language when discussing schools, teachers, teaching, and teaching policies. Inappropriate language during class time will result in a decrease of participation grade.

Class Schedule

Note: Faculty reserves the right to alter the schedule as necessary, with notification to students.

Date	Topics	Readings & Assignments
August 27	What is STEM education 5e's STEM Routines STEM challenge	Read - The 5e model Optional - Science Identity Matters Optional - Institutionalized

	STEM identity Syllabus	efforts to increase the participation of black women and girls in stem STEM identity paper due next class
September 3	Tools for STEM education Unpacking the M in STEM Math Challenge	Select one: Galanti (2022) on blackboard The Greedy Triangle - Teacher's Guide Reading Log 2 Begin Wonder Journal
September 10	Unpacking the E in STEM Engineering challenge	STEM lessons using Fairy Tales Reading Log 3 Wonder Journal 2 Begin IB STEM project
September 17	Unpacking the S in STEM Campus Tour for erosion STEM challenge	Skim: Lollipop Activity Create a slide with your lollipop activity. This counts as your reading log. Just paste the slide into your log and have it ready for next class. Reading Log 4 Wonder Journal 3
September 24	Turning a STEM image from the internet into a STEM lesson for the classroom - Unpacking how to plan for a STEM lesson	STEM Road Map: A Framework for Integrated STEM Education Browse one of the roadmaps (K-2 or 3-5) and find an activity that you enjoy - read that activity with more detail. Reading Log 5 Wonder Journal 4
October 1	Unpacking the T in STEM AI and Coding Simulations	Coding vs AI Reading Log 6 Begin work on Wonder Project

October 8	Attend a STEM event	STEM fest ACE-STEM Natural History Museum American History Museum X-STEM Reading Log 7
October 15	STEM Wonder Presentations Lesson Planning with AI	Chat GPT and Generative AI Reading Log 8 Wonder Task Project Due Continue working on IB STEM project
October 22	STEM Wonder Presentations Lesson Planning with AI	Tonight's reading comes from AI. Ask it 3 questions that you have about AI and how it can be helpful, yet have limitations for teachers. This counts as the (3) in your 3-2-1. Reading Log 9 Wonder Task Reflection IB STEM Project check in
October 29	STEM lesson planning	Reading Log 10 - Using AI Wonder Task - Reflection IB STEM project - upload Engage, Explore & Explain
November 12	STEM lesson planning	Reading Log 11 - STEM resources Upload reading logs 1-10 on Blackboard IB STEM project - upload Elaborate & Evaluate
November 19	Creating a Demo Lesson using the same STEM task	Girl Scout Badge - Balloon Powered Lesson Think about this: How does this activity use the 5E's? What makes this different from a typical lesson plan? Reading Log 12 Implement IB STEM project

November 26	Hour of CODE Robotics Programming in the primary grades	Programming in the primary grades : beyond the hour of code Focus on "Tips for teaching Code with Leveled Apps" Reading Log 13 Implement IB STEM project
December 3	MIX training on Fairfax Campus	Reading Log 14 Submit IB STEM project
December 10		All late assignments due by midnight.

CEHD Commitments
The College of Education and Human Development is committed to fostering collaboration and community, promoting justice and equity, and advancing research-informed practice. Students are expected to adhere to, and contribute to, these commitments, the CEHD Mission, and Core Values of George Mason University. More information can be found here:
https://cehd.gmu.edu/about/culture/

GMU Policies and Resources for Students
Policies
- Students must adhere to Mason's Academic Standards (see
  https://catalog.gmu.edu/policies/academic-standards/)

- Students must follow the university policy for Responsible Use of Computing (see
  https://universitypolicy.gmu.edu/policies/responsible-use-of-computing/).

- Students are responsible for the content of university communications sent to their Mason email account and are required to activate their account and check it regularly. All communication from the university, college, school, and program will be sent to students **solely** through their Mason email account.

- Students with disabilities who seek accommodations in a course must be registered with George Mason University Disability Services. Approved accommodations will begin at the time the written letter from Disability Services is received by the instructor (see
  https://ds.gmu.edu/).

- Students must silence all sound emitting devices during class unless otherwise authorized by the instructor.

Campus Resources

- Support for submission of assignments to VIA should be directed to viahelp@gmu.edu or https://cehd.gmu.edu/aero/assessments.

- Questions or concerns regarding use of your LMS should be directed to:
  - Blackboard Learn: https://its.gmu.edu/knowledge-base/blackboard-instructional-technology-support-for-students/
  - Canvas: https://its.gmu.edu/service/canvas/

- For information on student support resources on campus, see: https://ctfe.gmu.edu/teaching/student-support-resources-on-campus
  - TimelyCare: https://caps.gmu.edu/timelycare-services/
  - Writing Center: https://writingcenter.gmu.edu/

- For additional information on the College of Education and Human Development's Student Success Resources, please visit: https://cehd.gmu.edu/students/.

Notice of mandatory reporting of sexual assault, sexual harassment, interpersonal violence, and stalking:

As a faculty member, I am designated as a "Non-Confidential Employee," and must report all disclosures of sexual assault, sexual harassment, interpersonal violence, and stalking to Mason's Title IX Coordinator per University Policy 1202. If you wish to speak with someone confidentially, please contact one of Mason's confidential resources, such as Student Support and Advocacy Center (SSAC) at 703-380-1434 or Counseling and Psychological Services (CAPS) at 703-993-2380. You may also seek assistance or support measures from Mason's Title IX Coordinator by calling 703-993-8730, or emailing titleix@gmu.edu.

Common Policies Affecting All Courses at George Mason University
Updated August 2024

These four policies affect students in all courses at George Mason University. This Course Policy Addendum must be made available to students in all courses (see Catalog Policy AP.2.5).

Additional policies affecting this course, and additional resources or guidance regarding these policies, may be provided to students by the instructor.

Academic Standards

Academic Standards exist to promote authentic scholarship, support the institution's goal of maintaining high standards of academic excellence, and encourage continued ethical behavior of faculty and students to cultivate an educational community which values integrity and produces graduates who carry this commitment forward into professional practice.

As members of the George Mason University community, we are committed to fostering an environment of trust, respect, and scholarly excellence. Our academic standards are the foundation of this commitment, guiding our behavior and interactions within this academic community. The practices for implementing these standards adapt to modern practices, disciplinary contexts, and technological advancements. Our standards are embodied in our courses, policies, and scholarship, and are upheld in the following principles:

- **Honesty:** Providing accurate information in all academic endeavors, including communications, assignments, and examinations.

- **Acknowledgement:** Giving proper credit for all contributions to one's work. This involves the use of accurate citations and references for any ideas, words, or materials created by others in the style appropriate to the discipline. It also includes acknowledging shared authorship in group projects, co-authored pieces, and project reports.

- **Uniqueness of Work:** Ensuring that all submitted work is the result of one's own effort and is original, including free from self-plagiarism. This principle extends to written assignments, code, presentations, exams, and all other forms of academic work.

Violations of these standards—including but not limited to plagiarism, fabrication, and cheating—are taken seriously and will be addressed in accordance with university policies. The process for reporting, investigating, and adjudicating violations is outlined in the university's procedures. Consequences of violations may include academic sanctions, disciplinary actions, and other measures necessary to uphold the integrity of our academic community.

The principles outlined in these academic standards reflect our collective commitment to upholding the highest standards of honesty, acknowledgement, and uniqueness of work. By adhering to these principles, we ensure the continued excellence and integrity of George Mason University's academic community.

Student responsibility: Students are responsible for understanding how these general expectations regarding academic standards apply to each course, assignment, or exam they participate in; students should ask their instructor for clarification on any aspect that is not clear to them.

Accommodations for Students with Disabilities

Disability Services at George Mason University is committed to upholding the letter and spirit of the laws that ensure equal treatment of people with disabilities. Under the administration of University Life, Disability Services implements and coordinates reasonable accommodations and disability-related services that afford equal access to university programs and activities. Students can begin the registration process with Disability Services at any time during their enrollment at George Mason University. If you are seeking accommodations, please visit https://ds.gmu.edu/ for detailed information about the Disability Services registration process. Disability Services is located in Student Union Building I (SUB I), Suite 2500. Email: ods@gmu.edu. Phone: (703) 993-2474.

Student responsibility: Students are responsible for registering with Disability Services and communicating about their approved accommodations with their instructor *in advance* of any relevant class meeting, assignment, or exam.

FERPA and Use of GMU Email Addresses for Course Communication

The Family Educational Rights and Privacy Act (FERPA) governs the disclosure of education records for eligible students and is an essential aspect of any course. **Students must use their GMU email account** to receive important University information, including communications related to this class. Instructors will not respond to messages sent from or send messages regarding course content to a non-GMU email address.

Student responsibility: Students are responsible for checking their GMU email regularly for course-related information, and/or ensuring that GMU email messages are forwarded to an account they do check.

Title IX Resources and Required Reporting

As a part of George Mason University's commitment to providing a safe and non-discriminatory learning, living, and working environment for all members of the University community, the University does not discriminate on the basis of sex or gender in any of its education or employment programs and activities. Accordingly, **all non-confidential employees, including your faculty member, have a legal requirement to report to the Title IX Coordinator, all relevant details obtained directly or indirectly about any incident of Prohibited Conduct** (such as sexual harassment, sexual assault, gender-based stalking, dating/domestic violence). Upon notifying the Title IX Coordinator of possible Prohibited Conduct, the Title IX Coordinator will assess the report and determine if outreach is required. If outreach is required, the individual the report is about (the "Complainant") will receive a communication, likely in the form of an email, offering that person the option to meet with a representative of the Title IX office.

For more information about non-confidential employees, resources, and Prohibited Conduct, please see University Policy 1202: Sexual and Gender-Based Misconduct and Other Forms of Interpersonal Violence. Questions regarding Title IX can be directed to the Title IX Coordinator via email to TitleIX@gmu.edu, by phone at 703-993-8730, or in person on the Fairfax campus in Aquia 373.

Student opportunity: If you prefer to speak to someone *confidentially*, please contact one of Mason's confidential employees in Student Support and Advocacy (SSAC), Counseling and Psychological Services (CAPS), Student Health Services (SHS), and/or the Office of the University Ombudsperson.