

George Mason University
College of Education and Human Development
Elementary Education
ELED 421 Section 004 – STEM in the Elementary Classroom (3 credits)

Fall Semester 2023
Fairfax Campus, Thompson Hall Room 2020
Thursdays 4:30 – 7:10 pm

Professor: Theresa Wills
Office Hours: By appointment
Office Location: Thompson 2400A
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Prerequisites: Admission to Elementary Education program

COURSE DESCRIPTION

A. Recommended 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.

B. University Catalog Course Descriptions

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.

C. Expanded Course Description

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 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.

D. Course Delivery Method: This class is a face-to-face class meeting, with an 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.

E. Course Schedule: This course will meet on Wednesdays. Faculty reserves the right to alter the schedule as necessary, with notification to students ahead of time. Please review the schedule below carefully for synchronous/asynchronous dates.

F. 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 the [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

This course will provide opportunities for students to enjoy and embrace the ideas that make us wonder about the world and our role within it. In many respects, STEM can be intimidating to learn in the ways it is presented in schools, media and the general public. Our goal is to unpack those social constructions of STEM practices to see it in a more realistic light. This class experience is merely a first step in your evolution toward becoming the kind of educator you wish to be. Lastly, you will be required to bring your curiosity to class for each session. Please make sure to nurture and feed it as we move through our work together.

LEARNER OUTCOMES

This course will enable students to:

- 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

KEY PROFESSIONAL STANDARDS ADDRESSED FOR PBA ASSESSMENTS

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.

COURSE DELIVERY

Face to face, field-based, with some on-line sessions

REQUIRED TEXTS & READINGS

Readings will be required weekly and be posted on blackboard prior to the beginning of class.

Optional Texts:

Inquire with course professor, if you are interested in finding titles with further ideas for teaching elementary STEM.

COURSE ASSIGNMENTS AND EXAMINATIONS

1. Attendance and Participation

10%

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. 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.

2. STEM/STEAM Identity Paper

10%

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?

3. STEM Wonders Journal

10%

Think about the STEM that you see in the everyday. Ask yourself questions, feel the movements and forces while you drive, look at the sky, watch your pet, engage with another human, think about your place in this world, go for a long walk and just think...no phone, no worries, just get lost in your thoughts. Remember this is homework so you have an excuse. Over the course of the semester...use a composition book/journal to make note of various things that you observe in the natural world around you and list, sketch, question, observe and record those things that capture your attention and imagination. These wonderings about the natural world are just that...what do you see, feel and think about those things that fascinate and frustrate you to think about. We will intentionally slow down and use old technology (paper and pencil) to engage with our wonders. Your wonders are yours and unique to how you envision the world around you. "Dance like nobody is watching" while you build your entries.

4. Discussion Board Reading Logs

10%

You will analyze each reading in terms of its connection to your school site and your unit. Record these responses in your longitudinal reading log for each reading. Use the following template:

3- Question

2 - Connections

1 - Surprise or Aha moment that you had.

These will help in the construction and support of both your science unit and differentiation plan.

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.

6. Wonder Inspired STEM/STEAM Task

20%

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 journal (or a new and different wonder) 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.

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.

GRADING POLICIES:

UNDERGRADUATE GRADING SCALE

Grade	Grading Scale	Interpretation
A+	97-100	<i>Represents mastery of the subject through effort beyond basic requirements</i>
A	93-96	
A-	90-92	
B+	87-89	<i>Reflects an understanding of and the ability to apply theories and principles at a basic level</i>
B	83-86	
B-	80-82	
C+	77 – 79	
C	73 – 76	
C-	70-72	<i>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.</i>
D	60-69	
F	<69	

**Note: A course grade less than a C- requires that you retake the course.*

WORK TIMELINESS EXPECTATIONS:

It is expected that all class assignments will be submitted on time to the correct location; therefore, **late assignments will not receive full credit**. Assignments turned in late will receive an automatic deduction of one letter grade making the highest possible score equivalent to 80% (B). All assignments must be submitted by the beginning of class (Eastern standard time) on the due date stated within the syllabus (see below) and should only be submitted via **Blackboard**.

If you are unable to complete an assignment due to an emergency or difficult circumstance, communication must be made with the instructor via email or in person. In situations that are deemed an emergency or a difficult circumstance, I will work with you to set a new submission date that will not be considered late.

OTHER EXPECTATIONS

All written papers are **expected to be double-spaced, with 1” margins, and in 12-point font** (Times New Roman, Calibri, or Arial). **APA format is expected**. If you do not have a 6th Edition APA manual, the OWL at Purdue is an excellent resource: <http://owl.english.purdue.edu/owl/resource/560/01/>

***Please Note:** The GMU Writing Center offers online support via email. They will provide feedback on your writing within one hour. Graduate and professional writing can be difficult; I encourage you to take advantage of this service. http://writingcenter.gmu.edu/?page_id=177

Professional Dispositions

Students are expected to exhibit professional behaviors and dispositions at all times.

Core Values Commitment

The College of Education and Human Development is committed to collaboration, ethical leadership, innovation, research-based practice, and social justice. Students are expected to adhere to these principles: <http://cehd.gmu.edu/values/>.

GMU Policies and Resources for Students

Policies

- Students must adhere to the guidelines of the Mason Honor Code (see <https://catalog.gmu.edu/policies/honor-code-system/> <http://oai.gmu.edu/the-mason-honor-code/>).
- Students must follow the university policy for Responsible Use of Computing (see <http://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 Tk20 should be directed to tk20help@gmu.edu or <https://cehd.gmu.edu/aero/tk20>. Questions or concerns regarding use of Blackboard should be directed to <http://coursesupport.gmu.edu/>.
- For information on student support resources on campus, see <https://ctfe.gmu.edu/teaching/student-support-resources-on-campus>

For additional information on the College of Education and Human Development, Graduate School of Education, please visit our website [See <http://gse.gmu.edu/>]

Emergency Procedures

You are encouraged to sign up for emergency alerts by visiting the website <https://alert.gmu.edu>. There are emergency posters in each classroom explaining what to do in the event of crises. Further information about emergency procedures exists on <http://gmu.edu/service/cert>

Detailed weekly schedule will be provided at the start of the course.

ASSESSMENT RUBRICS:

STEM Unit Rubric (40% of total grade)

Assessment Summary: The project is meant to facilitate your understanding for the design and teaching of an inquiry-based science unit. This will require research into both inquiry-based lesson planning and science content. The goal is to bring powerful learning theory to life in classrooms and design science experiences that both excite and engage elementary children.

Description and standard addressed	Exceeds Expectations – 3	Meets Expectations – 2	Does Not Meet Expectations – 1	Does Not Meet Expectations – 0
A. Lesson Framework (pedagogical process & procedure, narrative description) INTASC: # 8 ACEI: #1.0 CAEP: #1a, 1b (10 pts)	Utilizes inquiry-based lesson model (5E's), clearly describes pedagogical process that embodies inquiry. Clearly described, highly usable and innovative ideas with original elements; uses a myriad of excellent and well-respected sources properly referenced within narrative descriptions.	Utilizes inquiry-based lesson model (5E's), clearly describes pedagogical process that embodies inquiry. Effectively describes, usable and effective ideas; uses dependable sources that properly referenced within narrative descriptions.	Difficult to use; does not have complete components; and/or is not self-explanatory. Does not utilize reputable sources within narrative descriptions and/or more needed clarity within narrative.	No consistent format nor serious professional commitment to student needs.

<p>B. Aligned Standards, Objectives, Activities & Resources</p> <p>INTASC: # 7; ACEI: #3.1 CAEP: # 3c, 3d & 3f; 4b & 4c</p> <p>(5 pts)</p>	<p>All are student-oriented objectives and stated in observable student learning outcomes; spans all levels of student thinking; all are appropriate for the lesson. Standards, objectives and lesson activities all seamlessly align and support one another.</p>	<p>All are student-oriented objectives and stated in observable student learning outcomes; covers some levels of student thinking; most are clearly connected directly to lesson activities; there exists alignment between standards, objectives and activities.</p>	<p>A mix of student- and teacher-oriented objectives or not stated in terms of observable student learning outcomes; has only minimal levels of student thinking; has way too little or many objectives; and/or some are inappropriate for lesson. Standards, objectives and activities not clearly aligned.</p>	<p>Missing</p>
<p>C. Assessment</p> <p>INTASC: #6 ACEI #4 CAEP: #3a, 4a</p> <p>(5 pts)</p>	<p>Innovative, well-supported assessment strategies clearly linked to objectives; demonstrates all stated objectives, copies of assessments included. Will include diagnostic, formative and summative approaches throughout the unit.</p>	<p>Assessment clearly linked to objectives; demonstrates nearly all stated objectives, copies of written assessments are attached. Will include diagnostic, formative and summative approaches throughout the unit.</p>	<p>Assessment is not clearly linked to objectives; demonstrates some stated objectives, and/or copies of written assessments are not attached. Does not include all three types of assessment.</p>	<p>Missing</p>
<p>D. STEM content</p> <p>INTASC: #4 ACEI #2.2, 2.3 CAEP: 1a, 3c, 4c</p> <p>(10 pts)</p>	<p>Content utilized in lesson plan is accurate, complete (as defined by listed standards); incorporates innovative, exciting and scientifically accurate approaches; multiple connections are made to students everyday lives and accessible.</p>	<p>Content utilized in lesson plan is accurate, complete (as defined by listed standards); incorporates These approaches make attempts to connect to students everyday lives.</p>	<p>Content utilized in lesson plan is inaccurate in some places, key content is not addressed (as defined by listed standards); incorporates mostly scientifically accurate approaches; little effort to connect to students everyday lives.</p>	<p>Missing</p>

<p>E. Nature of Science, inquiry, evidence, proof and Safety INTASC Content #5 ACEI #2.2, 2.3 CAEP: 1a, 4c</p> <p>(5 pts)</p>	<p>Lesson supports essential enactment of STEM processes consistent with accepted notions of NOS and mathematics. These include wonder, evidence, investigation, testing, concluding based on findings, etc. These approaches are well-supported with research literature. There also exists keen attention to issues that could arise and clearly provides appropriate safety measures.</p>	<p>Lesson supports enactment of science processes consistent with accepted notions of NOS and mathematics. These include wonder, evidence, investigation, testing, concluding based on findings, etc. There also exists keen attention to issues that could arise and clearly provides appropriate safety measures.</p>	<p>Lesson tries to support enactment of science processes consistent with accepted notions of NOS and mathematics, but misses on key approaches or those approaches are absent. (including wonder, evidence, investigation, testing, concluding based on findings, etc.) There is not enough attention paid to issues that could arise and do not clearly provide appropriate safety measures.</p>	<p>Missing</p>
<p>F. Technology Plan</p> <p>INTASC #5 ISTE: #I</p> <p>(5 pts)</p>	<p>Provides excellent description for technology use that connects subject matter with multiple forms technology that advance student learning through creative, and innovative ways.</p>	<p>Strong description for technology use that connects subject matter with technology approaches that advance student learning through creative, and innovative ways.</p>	<p>Description for technology lacks specifics and does not clearly offer ways to advance student learning in creative, innovative and meaningful ways.</p>	<p>Missing</p>