**George Mason University**
**College of Education and Human Development**
**Advanced Studies in Teaching and Learning**

EDCI 660.DL1 CRN 80897 Integrated STEM Teaching
3 Credits, Fall 2019
Online

**Faculty**


Professor: Nancy Holincheck, Ph.D.
Office hours: Wed 3:00-4:15 by appointment and via phone/Skype
Office: Thompson 2607
Email: nholinch@gmu.edu
Phone: 703-993-8136
Skype: nancy.holincheck


**Prerequisites/Corequisites**
None.

**University Catalog Course Description**
Provides an interdisciplinary approach to integrating science, technology, engineering, and mathematics (STEM) into teaching practice across all disciplines. Explores aspects of STEM education through literature, recent national reports, discussion, and practice. Involves participation in problem-based and project-based learning activities, inquiry learning, while using technology to gain and display information.

**Course Delivery Method**
This course will be delivered online (76% or more) using a mostly asynchronous format (3 or fewer synchronous Collaborate sessions will be scheduled) via the Blackboard Learning Management system (LMS) housed in the MyMason portal. You will log in to the Blackboard (Bb) course site using your Mason email name (everything before @masonlive.gmu.edu) and email password. The course site will be available on [XX Date no later than one week before first day of semester].

**Under no circumstances, may 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*
To participate in this course, students will need to satisfy the following technical requirements:

- High-speed Internet access with standard up-to-date browsers. To get a list of Blackboard's supported browsers see: https://help.blackboard.com/Learn/Student/Getting_Started/Browser_Support#supported-browsers
  To get a list of supported operation systems on different devices see: https://help.blackboard.com/Learn/Student/Getting_Started/Browser_Support#tested-devices-and-operating-systems
- Students must maintain consistent and reliable access to their GMU email and Blackboard, as these are the official methods of communication for this course.
- Students will need a headset microphone for use with the Blackboard Collaborate web conferencing tool.
- Students may be asked to create logins and passwords on supplemental websites and/or to download trial software to their computer or tablet as part of course requirements.
- The following software plug-ins for PCs and Macs, respectively, are available for free download:
  - Adobe Acrobat Reader: https://get.adobe.com/reader/

- Windows Media Player: https://support.microsoft.com/en-us/help/14209/get-windows-media-player
- Apple Quick Time Player: www.apple.com/quicktime/download/

*Expectations*

- Course Week: Because asynchronous courses do not have a "fixed" meeting day, our week will start on Tuesday and finish on Monday. Synchronous Collaborate sessions will be scheduled according to student and instructor availability.
- Log-in Frequency:
  Students must actively check the course Blackboard site and their GMU email for communications from the instructor, class discussions, and/or access to course materials **daily**. In addition, students must log-in for all scheduled online synchronous meetings.
- Participation:
  Students are expected to actively engage in all course activities throughout the semester, which includes viewing all course materials, completing course activities and assignments, and participating in course discussions and group interactions.
- Technical Competence:
  Students are expected to demonstrate competence in the use of all course technology. Students who are struggling with technical components of the course are expected to seek assistance from the instructor and/or College or University technical services.
- Technical Issues:
  Students should anticipate some technical difficulties during the semester and should, therefore, budget their time accordingly. Late work will not be accepted based on individual technical issues.
- Workload:
  Please be aware that this course is **not** self-paced. Students are expected to meet *specific deadlines* and *due dates* listed in the **Class Schedule** section of this syllabus. It is the student's responsibility to keep track of the weekly course schedule of topics, readings, activities and assignments due.
- Instructor Support:
  Students may schedule a one-on-one meeting to discuss course requirements, content or other course-related issues. Those unable to come to a Mason campus can meet with the instructor via telephone or web conference. Students should email the instructor to schedule a one-on-one session, including their preferred meeting method and suggested dates/times.
- Netiquette:
  The course environment is a collaborative space. Experience shows that even an innocent remark typed in the online environment can be misconstrued. Students must always re-read their responses carefully before posting them, so as others do not consider them as personal offenses. *Be positive in your approach with others and diplomatic in selecting your words*. Remember that you are not competing with classmates, but sharing information and learning from others. All faculty are similarly expected to be respectful in all communications.
- Accommodations:
  Online learners who require effective accommodations to insure accessibility must be registered with George Mason University Disability Services.

**Learner Outcomes**

This course is designed to enable students to do the following:

1. Design and modify instruction based on STEM teaching and assessment theory, philosophy, educational research, and best practice.
2. Incorporate findings from STEM education research literature into instructional strategies to improve student learning.

3. Engage in STEM learning within Problem-based learning, Model Eliciting Activities, and Project-based learning activities and identify how these activities might be implemented in K-12 classrooms for STEM Integration.
4. Examine the STEM Integrated School Models and identify key elements that might be adapted into K-12 STEM classrooms.
5. Review and become fluent in recent research findings that are widely accepted to advise colleagues in STEM classroom practice.
6. Design and modify STEM instruction that is responsive to differences among learners.
7. Identify equity issues within STEM Education and how STEM focused classrooms can help address these issues.

**Professional Standards**
Upon completion of this course, students will have met the following sets of professional standards:

***National Board for Professional Teaching Standards Alignment***:
EDCI 660 is designed as a course for practicing teachers, particularly those in the Advanced Studies in Teaching and Learning (ASTL) Program. This course is thus aligned with the NBPTS Propositions, also the first five ASTL learning outcomes, specifically:

- Proposition 1: Teachers are committed to students and their learning; *(ASTL Learning Outcome 1)*
- Proposition 2: Teachers know the subjects they teach and how to teach those subjects to students; *(ASTL Learning Outcome #2)*
- Proposition 3: Teachers are responsible for managing and monitoring student learning; *(ASTL Learning Outcome #3)*
- Proposition 4: Teachers think systematically about their practice and learn from experience; *(ASTL Learning Outcome 4)*
- Proposition 5: Teachers collaborate with other professionals to improve school effectiveness. *(ASTL Learning Outcome 5).*

EDCI 660 is aligned with two of the additional outcomes that guide the ASTL program:

- Principle 6: Teachers account for the needs of culturally, linguistically, and cognitively diverse learners *(ASTL Learning Outcome 6);* and
- Principle 7: Teachers are change agents, teacher leaders, and partners with colleagues *(ASTL Learning Outcome 7)*

**Required Texts**

1. Myers, A., & Berkowicz, J. (2015). *The STEM shift: A guide for school leaders*. Thousand Oaks, California: Corwin Press.

2. National Research Council. (2011). *Successful K-12 STEM education: Identifying effective approaches in science, technology, engineering, and mathematics*. Washington, D.C.: National Academies Press. [Note: Available online as a free download from National Academies Press.]

3. Weld, J. (2017). *Creating a STEM culture for teaching and learning*. Arlington, Virginia: National Science Teachers Association.

**Course Performance Evaluation**
Students are expected to submit all assignments on time via the Blackboard Assignments page.

| | ***Points*** |
|---|---|
| **Participation and Professionalism** | 30 |
| **Discussion and Critique of STEM Education Research Article** | 15 |
| **Student-centered Teaching & Learning in STEM: PBL/MEA/Maker Try-it Reflection** | 15 |
| **Integrated STEM Lesson Plan and Video** | 15 |
| **Classroom Practices for STEM Equity: Research and Policy Literature Review** | 25 |
| ***Total Points*** | **100** |

**Assignments**

**1. Participation and Professionalism (30%)**

EDCI 660 operates under the assumption that knowledge is socially constructed and the most meaningful learning opportunities include those where learners have the opportunity to offer and explore diverse perspectives with peers. To do this, it is expected that you will regularly contribute to and engage in discussion forums, as well as to genuinely 'listen' to peers as they do the same. While agreement is not mandatory, consideration and respect for others are.

Thus, you must be "present" throughout all discussions and activities. It is expected that you actively build upon your prior knowledge to connect, question, and extend the discussion with all new posts by citing readings, material in the weekly modules content, and augment these with your personal and educational experiences. In addition to quality participation in discussion forums, each week will include tasks to be completed which are related to each week's content. Attendance and participation in all scheduled Collaborate sessions is expected. Please refer to the student expectations and student participation portion of the course rubric in this syllabus for grading criteria.

**Please note: As this is an online course, the majority of our class discussion will be in the form of the electronic discussion board. Each module will begin on a Tuesday and run through the following Monday. To this end, initial postings for each discussion forum should be completed by *11:59 pm on Friday (EST)* so that class members will have until Monday to interact with the posted material and engage in "conversation."

We will use Blackboard to communicate regularly in this class. You will be asked to post assignments and responses, read classmates' postings, and actively participate in discussions. Blackboard serves as an important vehicle for discussing ongoing work on your major project with group members. Please refer to the Participation Rubric in this syllabus for evaluation criteria.

**2. STEM Education Research Article Analysis (15%)**

A valuable skill for a STEM teacher is to be able to access and discern information from the latest STEM education research journals to use for their practice. This assignment is given to develop your skills in locating and analyzing research that is of interest to you. For this assignment you will:

A. Choose one STEM education research article and critique it using the Rubric for Article Critique and the Guide for Analyzing a Research Article found at the end of this syllabus. The article should be empirical research from either the *Journal of STEM Education* or *International Journal of STEM Education.* (Articles from other journals may be acceptable, but must be pre-approved by your instructor.)

B. Write a 2-3 page analysis of the article, using the rubric and the guide for analyzing a research article. This assignment should use APA style headings, references, and in-text citations.

3. **Student-centered Teaching & Learning in STEM: PBL/MEA/Maker Try-it Reflection (15%)**

Throughout the semester you will learn about student-centered teaching for STEM, with some focus on PBL, MEAs, and Maker Activities. Each student will identify an MEA, STEM PBL resource, Maker Activity, or other new STEM activity from online resources linked in class and implement the resource (or some part of the resource) in their own classroom. Effective teaching requires that you learn, apply that professional learning, assess its effects, and use that evaluation to drive further instruction. Each student will write a try-it reflection, which should use APA style references and in-text citations:

1) Describe what you did and why (tie this to our readings/class discussions and to your students),
2) What happened (how you assessed student learning and the findings),
3) Challenges or questions you have about what you did, and
4) Your next steps—will you use this again, how might you change it?

4. **Integrated STEM Lesson Plan and Video (15%)**

A major goal of this course is to enable students to incorporate integrated STEM instruction into their classes in an explicit and reflective way. To reach this goal, students will create a new or modify an existing lesson with explicit, reflective integrated STEM. Students will then prepare a short video (approximately 5 minutes) in which they introduce the lesson or activity, present the objectives and assessment of the lesson, and discuss the ways they incorporate STEM and STEM design principles in their classes. The video can be an edited video of the teacher actually teaching in a K-12 classroom, or it can be recorded by the teacher outside of a classroom. Videos and lesson should be submitted by the designated due date in the class schedule. These will be incorporated into the class modules for class discussion. Students should sure to view the "Accomplished" column of the rubric to identify how the video and lesson plan will be assessed.

5. **Classroom Practices for STEM Equity: Research and Policy Literature Review (25%)**

Issues of equity and access are persistent problems in STEM education and many STEM career fields. Drawing on course readings and supplementing with additional research and policy literature, students will write a 3-5 page research and policy review on a STEM equity issue of their choice. Although the problem should be situated within the global or national context, the main focus of this assignment should be on addressing the problem at a local level, with recommendations for STEM teaching practices that can be implemented in teacher's own schools and grade level(s). APA Style headings, references, and in-text citations must be used throughout this document. The recommended sections of this assignment are:

a) **Introduction:** Identify the problem and situate it within the global or national context. Provide a (brief) historical perspective on the issue.
b) **Problem Statement:** Explicitly state the problem with a goal in mind—this may be broad or very specific (e.g. How to increase access to STEM for students in under-represented groups; How to increase enrollment of girls in A.P. Physics at XX High School). Provides references to literature and/or data that demonstrates why this is a problem and a realistic goal.
c) **Literature Review:** Review research and policy literature for recommendations for school and classroom practices. These are likely to include research on the impact of district and school policies, as well as research on formal and informal STEM instructional practices. The literature should be discussed academically and reviewed thematically; use of sub-headings are strongly recommend.
**d) Recommendations & Expected Outcomes:** This section should focus on specific recommendations for the student's specific teaching context. Recommendations should be made for policies and practices at multiple levels (e.g. Classroom, School, District), and may be organized in paragraphs or as a bulleted list. (Note that if this section is presented in a bulleted list format, academic language and complete sentences must be used.) Expected outcomes for each recommendation should be clearly stated.
**e) Reflection & STEM Advocacy Orientation:** Which recommendations will you prioritize in your own teaching context? Why do you consider them to be realistic and achievable? What are some

potential barriers to implementation? How has reviewing STEM education policy literature this semester (especially for this assignment) influenced your thinking about STEM education? How will the literature impact your practices in the classroom and/or as a teacher leader? How will you advocate for STEM education and equity in STEM in your current and future roles? [Note: you should be realistic and honest in your discussion of STEM Advocacy, but do not underestimate the power that a teacher has to serve as an advocate within their own classroom – and beyond.]

**General Requirements**

A. Please note that this online course is **NOT self-paced;** it consists of *weekly modules* that progress sequentially through the semester. You will be expected to complete one learning module each week. It is critical that each student complete all readings and activities on a weekly basis so that learning is adequately scaffolded and that students develop rapport with the content and their colleagues. Class 'attendance' is both important and **required**. *If, due to an emergency, you will not be participating in course activities on time, please contact your instructor prior to due dates or time. Please note that learners with more than two 'absences' risk a letter grade drop or can lose course credit.*

B. All assignments are due no later than **11:59 PM EST** of the date indicated in each week's assignments published in the **COURSE SCHEDULE AND TOPICS** section of this Syllabus. Due dates are also posted on our Bb course site.
    a. **Grades for assignments date-stamped in Blackboard after the due date will be reduced by 10%, unless prior approval from instructor has been granted. Late submissions are not acceptable after the course end date without prior arrangements.**
    b. Assignments earning less than a passing grade may be rewritten and resubmitted so that the assignment is satisfactorily completed. In fact, because mastery learning is our program's goal, we may ask (or *require)* you to redo an assignment that is far below expectations. Our goal for all learners is mastery, so we thank you, in advance, for making *genuine learning* your goal.

C. Please adhere to the assignment submission instructions listed in this Syllabus**.** Only assignments submitted as indicated will be graded; incorrect submissions may result in a grade of zero for those assignments.
    a. All assignments should be submitted in Word and should have the filename format as follows: Last name-Assignment Title. *Please do not upload written assignments in PDF format*. Other editable formats are acceptable (i.e., .doc, .docx, .rtf, .ppt, .pptx, .xlsx, .xlsx). If there are supporting documents for assignments, they may be submitted in PDF format.

D. *Please Note: All written work* should be carefully edited for standard grammar and punctuation, as well as clarity of thought. All submitted work should be prepared through word processing and reflect APA style (6th edition), as well as be double- spaced, with 1" margins, and 12-point font (Times New Roman, Calibri, or Arial).

**Instructor Role**

- Your professor will read online discussion forums regularly; however, their active role as faculty is to support the discussion development and not so much to "enter into each one" so that the dialogue is authentic among participants engaging in this community of practice. Please note that during this time, your professor will be noting the quality and extent of your participation.

**Student Expectations**

- Students are also requested to adhere, to the extent possible, to a 24-hour turn-around time for emails.
- Students are expected to visit our Blackboard site *at least three* times during the week: thus, once at the beginning of each week, once in the middle of the week, and then again at the end to read any new posts and replies. Please note that you can subscribe to forums/threads to be notified when new posts are added; access the posted directions in Blackboard for doing this.

- Students are expected to read all posted/emailed Course Announcements. These contain important information from your instructor. In addition to being sent by email, these will be available in the Course Announcements link in Blackboard.
- It is also expected that you will monitor your participation so that you remain timely and responsive and are able to complete all tasks on-time, without reminder. Successful students in an online learning environment are proactive, self-regulated, and manage their time well. You should expect to spend 12-15 hours a week on this 3-credit course, including reading, engagement in other content, reflection, and posting. This commitment is commensurate with the commitment expected for F2F classes, which also includes preparation, class time, and assignments.
- Questions are welcome, and your professor is available to respond to individual class members as needs might arise.

**Grading**

At George Mason University course work is measured in terms of quantity and quality. A credit normally represents one hour per week of lecture or recitation or not fewer than two hours per week of laboratory work throughout a semester. The number of credits is a measure of quantity. The grade is a measure of quality. The university-wide system for grading graduate courses is as follows:

| Grade | Grading | Grade Points | Interpretation |
|---|---|---|---|
| A | 94-100 | 4.0 | Represents mastery of the subject through effort beyond basic requirements |
| A- | 90-93 | 3.67 | |
| B+ | 88-89 | 3.33 | Reflects an understanding of and the ability to apply theories and principles at a basic level |
| B | 80-87 | 3.0 | |
| C | 70-79 | 2.0 | Denotes an unacceptable level of understanding and application of the basic elements of the course |
| F | < 69 | 0 | |

**See the University Catalog for details:** http://catalog.gmu.edu/policies/academic/grading/

**Professional Dispositions**

See https://cehd.gmu.edu/students/polices-procedures/

**Honor Code & Integrity of Work**

Students must adhere to the guidelines of the Mason Honor Code (seehttps://catalog.gmu.edu/policies/honor-code-system/). The principle of academic integrity is taken very seriously, and violations are treated as such.

***Violations of the Honor Code*** include:

1. Copying a paper or part of a paper from another student (current or past);
2. Reusing work that you have already submitted for another class (unless express permission has been granted by your current professor **before** you submit the work);
3. Copying the words of an author from a textbook or any printed source (including the Internet) or closely paraphrasing without providing a citation to credit the author. For examples of what should be cited, please refer to: https://owl.english.purdue.edu/owl/resource/589/02/

**Late Work Policy**

At the graduate level all work is expected to be of high quality and submitted on the dates due. *Work submitted late will be reduced one letter grade for every day of delay, unless prior arrangements have been explicitly made.* Because we live in uncertain times, if you have any extraordinary circumstances (think flood, earthquake, evacuation) that prevent you from submitting your work in a timely manner, it is your responsibility to contact the instructor as soon as possible after the circumstances occur and make

arrangements to complete your work. *It is up to the discretion of the instructor to approve the late/makeup work.*

**Course Withdrawal with Dean Approval**
Graduate and non-degree students may request a withdrawal from classes after the drop deadline for non-academic reasons. Such requests are only considered under exceptional circumstances. Students must provide verifiable, third-party documentation with the request. For questions about documentation, contact the CEHD Office of Student and Academic Affairs at **cehdsaa@gmu.edu**. *Students should contact an academic advisor* in APTDIE to withdraw after the deadline, and there is no guarantee that such withdrawals will be permitted.

**Online Participation/Attendance Policy**
Students are expected to participate in **all** online discussions. Not participating in an online discussion module will be reflected with a zero for the week and considered a class absence. Students are expected to attend all of the required synchronous class meetings via Blackboard Collaborate (see Class Schedule). The instructor will work with students to identify a time that works for students, and students are expected to attend these sessions. Students' Participation and Professionalism grade is related to student participation in online work, including online discussions and synchronous class meetings.

**Incomplete (IN)**
This grade may be given to students who are in good standing, but who may be unable to complete scheduled course work for a cause beyond reasonable control. The student must then complete all the requirements by the end of the ninth week of the next semester, not including summer term, and the instructor must turn in the final grade by the end of the 9th week. Unless an explicit written extension is filed with the Registrar's Office by the faculty deadline, the grade of IN is changed by the registrar to an F (Mason catalog). Faculty may grant an incomplete with a contract developed by the student with a reasonable time to complete the course at the discretion of the faculty member. The faculty member does not need to allow up to the following semester for the student to complete the course. A copy of the contract will be kept on file in the APTDIE office.

**Tentative Class Schedule**

| Date | Theme/Class Topic | Readings/Assignments due for class date |
|---|---|---|
| **Module 1: Wks 1 & 2 8/27-9/2 9/3-9/8** | **Current STEM Policy Context & STEM Integration** | **READ:** Weld chapter1 |
| **Week 3: 9/10-9/16** | **STEM Communities** *+PBL, MEAs & Maker Spaces* Blackboard Collaborate open office hours this week | **READ:** Weld chapters 2 & 3 |
| **Week 4: 9/17-9/23** | **Successful STEM Schools** | **READ:** NRC Report on Successful K-12 STEM education ***DUE to Blackboard by 11:59 pm on 9/23:*** *STEM Education Research Article Analysis* |
| **Week 5: 9/24-9/30** | **STEM Assessment** | **READ:** Weld chapter 6 AND chapter on Blackboard from: Jolly, A. (2016). *STEM by Design: Strategies and Activities for Grades 4-8*. London: Routledge. |
| **Week 6: 10/1-10/7** | **Current Initiatives in STEM** Blackboard Collaborate open office hours this week | **READ:** Weld chapter 5 ***DUE to Blackboard by 11:59 pm on 10/7:*** *Student-centered Teaching & Learning in STEM: PBL/MEA/Maker Try-it Reflection* |
| **Week 7: 10/8-10/14** | **Issues of Equity and Access in STEM** | **READ:** Myers & Berkowicz chapters 3, 4, 5 ***Journal entry due this week: Equity and Access in STEM*** |
| **Week 8: 10/15-10/21** | **Leadership for STEM Advocacy** | **READ:** Myers & Berkowicz chapters 6 & 7 ***DUE to Blackboard by 11:59 pm on 10/21:*** *Integrated STEM Lesson Plan and Video due by Monday night, 11:59 pm* |
| **Week 9: 10/21-10/28** | **Effecting Change as a STEM Leader** Blackboard Collaborate open office hours this week | **READ:** Myers & Berkowicz chapter 8 |
| **Week 10: 10/29-11/4** | **Shifting to an Integrated STEM-centered Curriculum** | **READ:** Myers & Berkowicz chapter 9 ***Journal Entry due this week: Literature chart for Research & Policy Literature Review*** |
| **Week 11: 11/5-11/11** | **STEM Teacher Professional Learning** | **READ:** Weld chapter 8 AND Myers & Berkowicz chapter 10 |
| **Week 12: 11/12-11/18** | **Addressing Barriers to STEM Integration** Blackboard Collaborate open office hours this week | **READ:** Myers & Berkowicz chapter 11 & 12 ***SUBMIT TO CFG on Blackboard:*** *DRAFT of Classroom Practices for STEM Equity: Research and Policy Literature Review* |
| **Week 13 11/19-11/25** | **Future of STEM Education** | **READ:** Weld chapter 9 AND Myers & Berkowicz chapter 13 ***SUBMIT TO CFG on Blackboard:*** *Provide feedback to your CFG this week on their Draft* |
| **Week 14 11/26-12/2** | *Thanksgiving Week* | *Work on Reflection for Research and Policy Literature Review due in Week 15* |
| **Week 15: 12/3-12/9** | **Pulling it All Together** Course Evaluations | ***Due to Blackboard by 11:59 pm on Monday 12/9:*** ***Classroom Practices for STEM Equity: Research and Policy Literature Review*** |

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

**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/ ).

- 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*

- Questions or concerns regarding use of Blackboard should be directed to http://coursessupport.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, please visit our website https://cehd.gmu.edu/students/ .**

## Guide for Analyzing a Research Article

*Use to complete STEM Education Research Article Analysis*

Key Characteristics of a Research Article

1. What was the purpose of the study?
2. What was (were) the research question(s)?
3. What were the topics of the literature review?
4. What type of research was conducted?
5. What type of sampling was used?
6. How were the data collected?
7. How were the validity and reliability of the data assessed?
8. What descriptive and/or inferential analyses were used?
9. What conclusions did the researchers report?

Quantitative Research

1. Is the study experimental or non-experimental?
2. Were the participants assigned at random to treatment conditions?
3. If it is non-experimental, was the researcher attempting to examine cause-and-effect issues? If yes, did he or she use the causal-comparative method?
4. What types of measures were used? Did the authors give enough information to make a decision on validity and reliability on the instruments?
5. Did the instruments align with the research questions?
6. How was the sample of participants obtained?
7. What are the demographics of the sample?
8. Were there statistical differences in the results?
9. Did the researcher critique his or her own work in the limitations section?

Qualitative Research

1. Was the study conducted by an individual or research team?
2. Was the initial analysis conducted independently by more than one researcher?
3. Were outside experts consulted for peer review?
4. Did the researchers participate in member checking?
5. How were the participants obtained?
6. What are the demographics of the participants?
7. Do the researchers explain their methods of analysis

**Participation and Professionalism Rubric**

| | Evolving | Competent | Accomplished |
|---|---|---|---|
| **Overall Participation & Professionalism** | Very few tasks are completed on time AND/OR completed tasks do not demonstrate thoughtful consideration of the content. Collaborate session, if scheduled, may not have been attended. Communication with peers and instruction may be disrespectful or inappropriate. | Most tasks for all weeks are completed on time and demonstrate thoughtfulness. Collaborate sessions, if scheduled, were attended and student somewhat engaged with peers and instructor. Communication with peers and instruction is usually respectful and appropriate. | All tasks for all weeks are completed on time and demonstrate thoughtfulness. Collaborate sessions, if scheduled, were attended and student actively engaged with peers and instructor. Communication with peers and instruction is always respectful and appropriate. |
| **Discussion Quality** | Discussion posts and most replies are limited; Readings are not at all integrated to support posts; Some to no posts utilize and demonstrate learners' prior and/or new knowledge; Replies do not go beyond superficial responses; Replies may not build on others' responses to create connected threads. | Most discussion posts and most replies are one *hearty* paragraph to three paragraphs; Readings are somewhat integrated to support posts; Most but not all posts utilize and demonstrate learners' prior and/or new knowledge; Replies typically go beyond superficial responses; Most replies build on others' responses to create connected threads; Questions may be posed for further thought and discussion; Some questions from peers may be addressed (there is some evidence that you went back to read discussion replies) | All discussion posts and all replies are one *hearty* paragraph to three paragraphs; Readings and weekly content are integrated to support thoughtful posts (*and explicitly referenced*); Posts utilize and demonstrate learners' prior *and* new knowledge; All replies go beyond superficial responses; Replies build on others' responses to create connected threads; As appropriate, questions are posed for further thought and discussion; Questions from peers are addressed (there is evidence that you went back to read discussion replies). |
| **CFG Engagement** | Rarely or never participates in Critical Friends Group work. Feedback is not meaningful, detailed, and constructive. Discounts critical friends' perspectives and questions. | Mostly participates in critical friend(s) group work; meets almost all CFG deadlines; provides meaningful, detailed, and constructive feedback OR consistently participates in critical friends groups on time but feedback is not meaningful, detailed, and constructive; there is no evidence that critical friend perspectives have been considered. | Consistent participation in critical friend(s) work; meets all CFG deadlines; Quality work/questions provided to critical friends for discussion; Thoughtfully considers all perspectives raised by critical friends; Meaningful, detailed, and constructive feedback provided to critical friends. |

**STEM Education Research Article Analysis Rubric**

| | **No Evidence** | **Beginning** (Limited evidence) | **Developing** (Clear evidence) | **Accomplished** (Clear, convincing and substantial evidence) |
|---|---|---|---|---|
| **Description** | Description is unclear with no inclusion of key points (0 points) | Reference for article may be missing from beginning of article. Describes the article briefly (0.5 points) | Reference for article is provided at beginning of article. Describes the article accurately with little synthesis (1 point) | Reference for article provided in APA style at beginning of article. Describes and synthesizes the key points accurately and concisely (2 points) |
| **Analysis, Application and Interpretation** | Section does not address strengths and weaknesses of article; does not include supporting sources (0 points) | Section includes interpretation by addressing only strengths of the article, does not compare and contrast points from articles to related readings; includes one supporting sources from related readings (1-2 points) | Section includes interpretation by addressing strengths and weaknesses of the article, compares and contrasts points from articles to related readings; includes two supporting sources from related readings (3-4 points) | Includes analysis, application, an interpretation by addressing strengths and weaknesses of the article, tells why points are strengths or weaknesses; compares and contrasts points from articles to related readings; includes three or more supporting sources from related readings (5-6 points) |
| **Reflection** | Describes general thoughts about article (0 points) | Includes only a short reflective statement or does not make personal connections to the article (1 points) | Includes reflective statement with connections to classroom practice; needs to delve more deeply into the application to the classroom or personal connections to the article. (2-3 points) | Includes a strong reflective statement that connects journal article to the teacher's own classroom practice and clear statement of personal connections to the article. (4-5 points) |
| APA References & Clarity of Writing (Mechanics) | Contains many grammatical errors or error patterns. No evidence of APA style references. (0 points) | Lacks in grammatical or stylistic form OR contains many errors or error patterns. References lack some compliance with correct APA 6$^{th}$ style (0.5 points) | Grammatically and stylistically well written, but contains some errors or error patterns. References are in APA style but contain some minor errors. (1 point) | Grammatically and stylistically well written with few errors or error patterns. Reference list & in-text citations are in APA style (6$^{th}$ edition. (2 points) |

**Integrated STEM Lesson Plan and Video Rubric**

| | Evolving | Competent | Accomplished |
|---|---|---|---|
| **Lesson Plan: Objectives & STEM Integration** | Lesson plan objectives may not be stated and/or may not include standards alignment. STEM Integration is lacking, lesson plan may focus on only one area of STEM. | Lesson plan objectives are stated and plan includes alignment to standards. Integration of multiple STEM content areas is evident, but is not meaningfully synthesized. | Lesson plan objectives are clearly stated; includes alignment to math and science standards (VA SOLs or Common Core/NGSS). Integration of STEM is clearly evident and provides meaningful use of multiple STEM content areas in a synthesized manner. |
| **Lesson Plan: STEM Instruction & Assessment** | Instructional methods may not be relevant or may be teacher-centered. Student STEM skills are not stated, and assessment practices may not be clearly connected to the lesson objectives. | Instructional methods are described, but may not be appropriately used, or not clearly connected to stated student STEM skills. Lesson plan provides adequate opportunities for student-centered development of STEM skills. STEM Assessment practices are evident but do not clearly connect to the STEM skills identified in the lesson. | Relevant STEM instructional methods are clearly described and appropriately used in the lesson, with a focus on student-centered practices to develop clearly stated student STEM skills. Collaboration is a component of the lesson. STEM Assessment practices are relevant and assess students' STEM skills developed in the lesson. |
| **Video** | Video does not sufficiently explain or introduce the lesson, and materials or activities may not be evident. STEM integration may be missing from the video. Video may be too long or too short. | Video is close to the appropriate length (3-7 minutes), and introduces the lesson so that peers and the instructor understand the purpose of the lesson. Objectives may not be stated clearly, or materials may not be presented or explained. STEM integration is evident within the video, but the purpose may not be made clear. Presenter may not be engaging. | Video is appropriate length (4-6 minutes) and provides peers and the instructor an overview of the lesson, materials, and intended outcomes. Lesson objectives are clearly stated and intended outcomes are stated and/or evident from the lesson activities. How and why the lesson integrates STEM is made clear. Presenter is dynamic and engaging in the video. |

**Classroom Practices for STEM Equity: Research and Policy Literature Review Rubric**

| | **Beginning**<br>(Limited evidence) | **Developing**<br>(Clear evidence) | **Accomplished**<br>(Clear, convincing and substantial evidence) |
|---|---|---|---|
| **Introduction**<br>*2 points* | STEM issue is not situated within global or national context. Historical perspective is not provided. | STEM issue is adequately situated within global or national context, an adequate historical perspective on issue is provided. | Thoroughly identifies a relevant equity issue in STEM and clearly situates it within the global or national context. Provide a brief but useful historical perspective on issue. |
| **Problem Statement**<br>*2 points* | Problem statement may not include a goal or is not a STEM equity problem. | STEM equity problem is stated with a goal in mind. Literature is used to adequately discuss the problem and goal. | Explicitly states the STEM equity problem with a goal in mind—which may be broad or very specific. Provides reference to literature and/or data that demonstrates why this is a problem and a realistic goal. |
| **Literature Review**<br>*6 points* | Literature is discussed in "book report" fashion, without organization around themes or synthesis. Discussion may focus on methods rather than findings. | Adequately discusses research and policy literature for recommendations for school and classroom practices. Literature may lack synthesis or discussion of themes from literature may not be clear. | Thoroughly discusses research and policy literature related to recommendations for school and classroom practices, organized thematically and synthesized for an academic discussion. |
| **Recommendations & Expected Outcomes**<br>*3 points* | Recommendations are not relevant or not literature based. Recommendations may not be broken down into different levels of practice. Expected outcomes may be vague or not clearly connected to the problem/goal stated in the problem statement. | Recommendations are clearly made for multiple levels of practice, but may lack clear connection to literature (e.g. no citations). Expected outcomes are stated, but may not be clearly connected to the problem/goal stated in the Problem Statement. | Specific recommendations are made for the student's specific teaching context. Relevant recommendations are provided for different levels of practice (e.g. classroom, school, district), and expected outcomes are clearly stated for each recommendation. Literature is cited for each recommendation. Recommendations and outcomes are relevant for the problem/goal stated in the problem statement. |
| **Reflection & Advocacy Orientation**<br>*5 points* | Reflection may not discuss STEM education issues and may not address issues of STEM access and equity; fails to adequately connect to course literature. Advocacy orientation is unrealistic for stated current and future roles in education. | Reflection address issues of access and/or equity in STEM Education, and makes adequate connections to course literature. Discussion of advocacy orientation is not meaningful for stated current and future roles in education. | Evidence of thoughtful reflection on STEM Education issues, with additional focus on issues of access and equity. Makes clear and thoughtful connections to how course literature has influenced their thinking, with relevant citations. Discusses advocacy orientation with realistic and meaningful perspectives on the student's stated current and future roles in education. |
| **Style & Mechanics**<br>*2 points* | Lacks in grammatical or stylistic form OR contains many errors or error patterns. References are not in APA style. | Grammatically and stylistically well written, but contains some errors or error patterns. References are in APA style but contain some minor errors. | Grammatically and stylistically well written with few errors or error patterns. Headings, reference list & in-text citations are in APA style. A minimum of 8 references are included, at least 4 of which were not assigned readings. |