GEORGE MASON UNIVERSITY
COLLEGE OF EDUCATION AND HUMAN DEVELOPMENT
GRADUATE SCHOOL OF EDUCATION
ADVANCED STUDIES IN TEACHING AND LEARNING PROGRAM

EDCI 663 DL1 - Research in Science Teaching
CRN 21675
3 credits, Spring 2022
January 24 – May 18
Online

Professor: Nancy Holincheck, Ph.D.   **E-mail**: nholinch@gmu.edu
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Office Hours: By appointment. Online via Skype or Collaborate by appointment.

Prerequisite:
Admission to the ASTL Program.

> **For Spring 2022 be sure to view the Syllabus Addendum:**
> **Safe Return To Campus Guidance For Students Enrolled In**
> **CEHD Courses**

Course Description:
This three-credit graduate course for experienced science and mathematics teachers investigates the research and methodology involved in teaching and learning biological, chemical, physical, and earth sciences from kindergarten through grade twelve.

Course Delivery Methods:
This course will be delivered online using a mostly asynchronous format via 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 one week before the semester begins, on or by January 17, 2022.

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 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.

Expectations
- Course Week: Because asynchronous courses do not have a "fixed" meeting day, our week will start on Tuesday, and finish on Monday.

- 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 at least 2 times per week.
- 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. Students 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 ensure accessibility must be registered with George Mason University Disability Services.

Learning Outcomes:
As a result of EDCI 663, students will be able to:
- Connect past, present, and future movements in science education reform to research and practice;
- Identify types of research and understand their strengths and weaknesses;
- Examine initiatives taken to strengthen science teaching through research;
- Follow new developments in science research;
- Evaluate the validity of claims in current science teaching research in order to translate the results of research into classroom activities and practice;
- Build a repertoire of research-based science teaching and assessment strategies by reading, writing, observing, participating in, reflecting on, and discussing research on the teaching of science;
- Create activities for students that reflect research in effective science teaching and follow the national, state, and local standards;
- Develop strategies to help students to become scientifically literate, think critically and creatively, and create conceptions of the scientific enterprise, otherwise known as the nature of science; and
- Be fluent in recent research findings that are widely accepted to advise colleagues in their classroom practice.

Relationship to Program Goals and Professional Organizations:
This course is part of a three-course sequence for experienced science teachers within the science and STEM education degree concentrations in Mason's Advanced Studies in Teaching and Learning M.Ed. program. The course follows the recommendations of the *Next Generation Science Standards (NGSS)*, the *National Science Education Standards, Benchmarks for Science Literacy,* and *Standards of Learning for Virginia Public Schools.* Additionally, it focuses on implementing the expectations for teaching and learning outlined by the National Council for Accreditation of Teacher Education (NCATE), the National Board of Professional Teaching Standards (NBPTS), and the Interstate School Leaders Licensure Consortium (ISSLC). Students in this course will become familiar with the communities of science education researchers and be able to access information from published findings to implement in class. EDCI 663 expands the teachers' knowledge and skills in research-based assessment and instruction.

These position statements indicate that the core knowledge expectations in science education include:
● Vary their teaching actions, strategies, and methods to promote the development of multiple student skills and levels of understanding.
● Successfully promote the learning of science by students with different abilities, needs, interests, and backgrounds.
● Successfully organize and engage students in collaborative learning using different student group learning strategies.
● Successfully use technological tools, including but not limited to computer technology, to access resources, collect and process data, and facilitate the learning of science.
● Understand and build effectively upon the prior beliefs, knowledge, experiences, and interests of students.
● Create and maintain a psychologically and socially safe and supportive learning environment.

Additionally, this course was designed with a vision for accomplished teaching, as indicated by NBPTS Science Standards for Early Adolescence
(http://www.nbpts.org/userfiles/File/ea_science_standards.pdf) and Adolescence and Young Adulthood
(http://www.nbpts.org/userfiles/File/aya_science_standards.pdf) the Five Core Propositions of the National Board for Professional Science Teaching:
● Proposition 1: Teachers are Committed to Students and Their Learning
● Proposition 2: Teachers Know the Subjects They Teach and How to Teach Those Subjects to Students
● Proposition 3: Teachers are Responsible for Managing and Monitoring Student Learning.
● Proposition 4: Teachers Think Systematically about Their Practice and Learn from Experience.
● Proposition 5: Teachers are Members of Learning Communities.

Required Texts:
● Dana, N. F., & Yendol-Hoppey, D. (2019). *The reflective educator's guide to classroom research: Learning to teach and teaching to learn through practitioner inquiry.* Corwin.
[Note that this is also a required text for ASTL's EDUC 613 and EDUC 606 courses.]
● No additional texts are required for this class. Readings will include peer-reviewed articles and book chapters available from the Mason library.

Course Performance Evaluation:
Students are expected to submit all assignments on time via Blackboard. High quality work is expected on all assignments and in class. Attendance at all class meetings for the entire class is a course expectation. All assignments must be completed to receive a passing grade for the course. Assignments are either due at the beginning of class or by midnight on the day they are due — please consult the

Class Schedule for due dates & times. Graded assignments that are late will receive a ten percent grade reduction (one full letter grade lower). In the event a class is missed, the student will develop with the approval of the instructor an additional assignment that relates to the work being missed.

Assignments:
The assignments are organized according to the themes of the class.

Theme	Subtopics	Assignments
Understanding what came before	Historical and current research literature Reform initiatives in science education	Research in Science Teaching Dialectical Notebook
Being research consumers	Types of educational research Finding journals Reading research articles Critiquing research articles	Research Article Critique Literature Review & Action Research Proposal
Actively translating research to practice	Identifying relevant recommendations from empirical research, including qualitative, quantitative, and Action Research projects	Literature Review & Action Research Proposal
Preparing to study your own teaching	Planning Classroom Research	Literature Review & Action Research Proposal Presentation: Journal Entry 1, Journal 2, Literature

1) **Research in Science Teaching Dialectical Notebook Responses**
   Each student will be provided a Google Slide deck in which to maintain their Digital Interactive Notebook (DINb). Follow the directions provided in the DINb and in Module 1.

2) **Discussion & critique of science education research article**
   A valuable skill for an innovative teacher is to be able to access and discern information from the latest science 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 empirical science education research article from the *Journal of Research in Science Teaching*, *Science Education,* or the *International Journal of Science Education*.
      (An empirical study reports on research the authors conducted. Abstracts of empirical studies generally address participants, the study conducted, and major findings.)
   B. Critique the article using the *Rubric for Article Critique* and the *Guide for Analyzing a Research Article* found at the end of this syllabus.
   C. Lead a class discussion during a synchronous class meeting about your research article. As you prepare for the discussion be sure to consider questions you will use to engage your peers.

3) **Lesson revision** – Choose an activity (or series of activities) from your classroom. You will make adaptations to the activity(ies) to incorporate research-based recommendations into your teaching and pilot the changes in your classroom. This assignment has four parts:
   A. Discuss the original activity.
   B. Discuss the changes made and how they align with research recommendations.
   C. Pilot the revised activit(y/ies) in your class.

D. Share your experiences with the class in a flipgrid video (5 minutes or less) and respond to your classmates' narratives.

4) **Literature Review & Action Research Proposal Presentation– asking questions about your classroom, using literature to advise your actions, and systematically planning for data collection**
By the end of this class, you will have a great deal of information about how educational research is conducted and reported. An important part of translating research to practice is for teachers to not only read about research, but conduct action research projects in their own classrooms. You will first review literature related to a topic in which you are interested, and then create an action research proposal presentation. Note that you are NOT expected to implement the action research project this semester.

For this assignment, you will complete the following assignments:
A. **Journal Entry 1: Action Research Problem Statement**
Identify a problem in an educational setting that you would like to explore. Use references to support your discussion - some non-peer-reviewed literature can be used, but
B. **Journal Entry 2: Action Research Discussion of Research Questions**
Develop and refine one or more research questions that would guide this project.
C. **Journal Entry 3: Action Research Literature Review Table**
Explore the literature on this topic (10 or more articles) and complete the literature review table & synthesis for at least 10 of these articles
D. **Final Presentation: Presentation of proposed research**
Using your knowledge of methodologies, design a study that would collect data to answer the research questions. Create a presentation to share an overview of the literature, your research questions, and proposed research design
E. **Final Reflection on Action Research Proposal**

5) **Participation & Professionalism**
Class participation and professionalism applies to multiple aspects of engagement in our course content, including: the in-class experiences, article critique discussions, peer evaluations of student work, and examination of science education literature. As this is an online course, it is critical that all students stay actively involved in the course modules. This part of your grade also includes quality participation in class discussions (live and/or in the Digital Interactive Notebook) and professionalism in all communication with your professor and your peers.

Points for Assignments:

Research in Science Teaching Dialectical Responses in Digital interactive Notebook	20 points
Discussion & critique of science education research article	10 points
Lesson revision –	15 points
Action research literature review & proposal *Journal 1: (5 points)* *Journal 2: (5 points)* *Journal 3: (15 points)* *Presentation: (10 points)*	35 points
Participation & Professionalism	20 points
TOTAL	**100 points**

Grading Scale:
A = 93-100%
A- = 90-92%
B+ = 88-89%
B = 80-87%
C = 70-79%
F = Below 70%

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

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 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 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 https://its.gmu.edu/knowledge-base/blackboard-instructional-technology-support-for-students/.
- For information on student support resources on campus, see https://ctfe.gmu.edu/teaching/student-support-resources-on-campus

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.

For additional information on the College of Education and Human Development, please visit our website https://cehd.gmu.edu/students/.

EDCI 663 Research in Science Teaching Class Schedule: Spring 2022
Syllabus & schedule are subject to change.
Instructor will notify students regarding changes via email and Blackboard Announcements.

Date	Topics	What is due
Weeks 1 & 2 Jan 24-Jan 30 Jan 31-Feb 6	● Types of education research ● Finding relevant research articles	**Complete Module 1: see due dates in module** **Read:** ● Kim article ● Vincent-Ruz & Schunn article ● Milton-Brkich et al. article.
Weeks 3 & 4 Feb 7-Feb 13 Feb 14-Feb 20	To include maybe: ● Critiquing research articles ● Developing research questions ● Revising lessons to incorporate best practices	**Complete Module 2: see due dates in module** **Read:** ● Research article posted in module ● Dana & Yendol-Hoppey pp 3-15 **AND** ● Choose one action research study from articles provided **Due In week 4:** ==Synchronous Class Meeting in Week 4: Day/Time TBD== ==Due by February 20: Journal Entry 1:== **Action Research Problem Statement**
Weeks 5 & 6 Feb 21-Feb 27 Feb 28-Mar 6	Qualitative based methodologies: Data collection & analysis methods *Workshop RQs in week 5 DinB*	**Complete Module 3: see due dates in module** **Read:** ● Dana & Yendol-Hoppey ch. 3 ● Readings posted in module 3 ==Due by March 6: Journal Entry 2:== Action Research Discussion of Research Questions
Weeks 7 & 8 Mar 7-Mar 13 Mar 14-Mar 20	Quantitative based methodologies: Data collection & analysis methods Mason Spring Break: Week 8	**Complete Module 4: see due dates in module** **Read:** ● TWO research articles shared by classmates by end of week 6 ● Other reading posted in module 4 ==Synchronous Class Meeting in Week 7:== ==Two students lead critical article discussion==
Weeks 9 & 10 Mar 21-Mar 27 Mar 28-Apr 3	Planning a mixed methods study	**Complete Module 5: see due dates in module** **Read:** ● TWO research articles shared by classmates by end of week 8 ● Other reading posted in module 5

		Synchronous Class Meeting in Week 9: **Two students lead critical article discussion**
Weeks 11 & 12 Apr 4-Apr 10 Apr 11-Apr 17	Reviewing literature *Local public school Spring Breaks: Week 11 or 12*	**Complete Module 6: see due dates in module** **Read:** **Complete Module 6** **Due by April 17: Journal Entry 3:** Action Research Literature Review Table
Weeks 13 & 14 Apr 18-Apr 24 Apr 25-May 1	Research to practice: Education policy & science education reform	**Complete Module 7: see due dates in module** **Read:** ● Readings posted in module 7 **Due by April 18 (end of week 13): Lesson Revision (Post video to flipgrid by end of week 13, review & respond to peers by end of week 14)**
Weeks 15 & 16 May 2-May 8 May 9-May 15	Final presentations Complete student evaluations of teaching	**Complete Module 8: Teaching Evals & Final Presentation** **Synchronous Class Meeting in Week 15** **Due in week 15: Action Research Proposal Presentations**

Holistic Rubric for Assignment #2: Discussion & critique of science education research article (10 points) *(Also see Guide for Analyzing a Research Article on the following page)*

- Article focuses on a relevant issue in Science Education. Article is submitted to peers by (at least) one week before discussion in class

- In-class discussion: Student discussant should *lead* discussion around each of the following topics
    - Salient points of article
    - Strengths & weaknesses of article
    - How the article relates to his/her own teaching
    - How the article relates to classmates' teaching
    - Potential avenues for future research (teacher/action research OR traditional research)

Holistic Rubric for Assignment #3: Lesson Revision (10 points)
Flip-grid video should explicitly address the following points:

- What the original activity (or activities) looked like (3 points)
    - Explain why you wanted to make changes to the original activity

- What changes you made and why you made those changes (3 points)
    - How the changes align with research-based recommendations.

- Implementation of changed activity in your classroom (4 points)
    - What worked well? What could be improved in the future?
    - Will you continue using this activity, make changes to it, or revert to what you did before? Why?
    - This is your opportunity to be reflective and demonstrate thoughtfulness.
    - Examples of student work or student comments/feedback would strengthen this section

Guide for Analyzing a Research Article

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?

EDCI 663: Research in Science Teaching
Action Research Proposal Presentation Guidelines

Literature Review & Action Research Proposal - asking questions about your classroom, using literature to advise your actions and systematically organizing data collection
By the end of this class, you will have a great deal of information about how educational research is conducted and reported. An important part of translating research to practice is for teachers to not only read about research, but conduct action research projects in their own classrooms. For this assignment, you will:

A. **Journal Entry 1: Problem Statement**
Identify a problem in an educational setting that you would like to explore. Use references to support your discussion - some non-peer-reviewed literature can be used, but

B. **Journal Entry 2: Discussion of Research Questions**
Develop and refine one or more research questions that would guide this project.

C. **Journal Entry 3: Literature Review Table**
Explore the literature on this topic (10 or more articles) and complete the literature review table & synthesis for at least 10 of these articles.
A literature review template will be provided on Blackboard.

D. **Final Presentation: Presentation of proposed research**
Using your knowledge of methodologies, design a study that would collect data to answer the research questions. Create a presentation to share an overview of the literature, your research questions, and proposed research design

Recommended Structure of Final Proposal Presentation:
● Introduction & Literature Review
  – Problem Statement: Introduce topic & significance
  – Statement of purpose and research questions.
  – Literature Review: This section should present the themes you identified in the literature. You should not review studies in "book report style" – instead seek to discuss the themes and recommendations that you identified as being common across studies.
  – At least 6-8 references (articles and/or books) should be referenced. References should be synthesized, not summarized.
● Research Method
  – Research design & connection to research purpose
  – Participants (describe students in class, including relevant demographic characteristics)
  – Measures/Data Collection Plan
  – Intervention (if applicable: include your control/alternate treatment)
  – Data Collection Procedures (all data you will collect should be described & procedures for collection stated clearly)
  – Ethical considerations
  – Proposed preliminary data analysis (how will you know if "it" worked?)
● APA Style References
  – Include your APA style references on slides at the end of your presentation.

EDCI 663: Research in Science Teaching
Action Research Proposal Presentation Rubric

	No evidence	Beginning	Developing	Accomplished
Problem Statement: The problem or conflict is genuine and of importance to the teacher researcher. The problem is clearly related to science instruction and student learning in science. The problem is explicitly stated and discussed in terms of classroom impact.				
Research Question: The research question and purpose are clear and concise, stated in "answer-able" terms (in ways that can be addressed by teacher research). Research question follows logically from the problem statement.				
Literature Review: Literature review provides enough background to orient the reader to the current state of knowledge. At least six research studies are used to support the literature review. Literature review synthesizes literature by connecting the studies together (using common themes) and connects the literature back to the importance of the topic. Literature is not presented in book report style.				
Research Method: Connection between the purpose and the research design is explained. Participants, data collection plan, and procedures are explained in enough detail that it is clear what will be done and when. If relevant, measures are shared and discussed. Ethical considerations (including impact on student & researcher biases) are discussed. The plan discusses potential analysis techniques for the type of data collected and the nature of the research questions. *(Note that this must be addressed in the presentation using text AND discussion. Do not attempt to put all of these details in your slides.)*				
Writing, Mechanics & APA: Slides are not overly wordy. Text is appropriately academic, avoiding idioms and colloquialisms. Citations are used appropriately, but direct quotes are used rarely. Uses correct citations based on APA 7th edition and has few or no spelling or grammatical errors. References are provided at the end of the presentation in APA style.				
Total				**/30**