



College of Education and Human Development

Early Childhood Education Program  
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**ECED 514: Mathematics and Science for Diverse Young Learners (3:3:0)**  
**Fall 2011**  
**Tuesdays, 7:20-10:00**  
**Innovation Hall 137**

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**Course Description**

Examines ways to foster development of mathematics and science in preschool to third-grade children. Covers construction of math and science lessons and hands-on experiences that address the needs of culturally, linguistically, and ability diverse children.

**Prerequisite:** Admission to the Early Childhood Education program or approval of course instructor.

**Note:** Field experience required.

**Nature of Course Delivery**

The class will have lecture, discussion, group work formats and will require active participation of all students.

**Learner Outcomes**

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

1. Develop an understanding of the changing focus in both curricula and pedagogy at the early childhood level and implications for math and science instruction.
2. Develop strategies to help young children become mathematically and scientifically literate, think critically and creatively, and to see the relationships between mathematics, science, social studies, and language/literacy.
3. Develop the skills necessary to utilize a variety of methods in teaching mathematics and science to young children.
4. Develop insight in selecting, modifying, and presenting instructional activities in mathematics and science.
5. Develop science activities for young children using the scientific process with an emphasis on describing, analyzing, and quantitatively presenting findings.
6. Construct math and science experiences in an environment that promotes equity and responds to cultural, linguistic, and ability diversity.

7. Use state and local curriculum standards for mathematics and science, the standards identified by the National Council of Teachers of Mathematics, and the National Science Education Standards to plan instruction.
8. Describe the role of family and community knowledge, experience, and resources in planning and implementing mathematics and science content in the curriculum.
9. Use a variety of sources for ideas and materials useful in teaching mathematics and science when planning instruction.
10. Integrate mathematics and science objectives into planning and implementing an integrated project.
11. Use authentic assessment strategies to describe young children's understanding of mathematics and science concepts.
12. Reflect on one's own use of inquiry strategies in facilitating children's learning of mathematics and science concepts.

### **Professional Standards**

This concentration complies with the standards for teacher licensure established by the National Association for the Education of Young Children.

### **Required Texts**

Copley, J.V. (2009). *The young child and mathematics* (2<sup>nd</sup> ed.). Washington, DC: National Association for the Education of Young Children.

Harlen, W. (2001). *Primary science: Taking the plunge* (2<sup>nd</sup> ed.). Portsmouth, NH: Heinemann.

National Council of Teachers of Mathematics. (1998). *Curriculum and evaluation standards for school mathematics*. Reston, VA: Author.  
<http://www.nctm.org/standards/content.aspx?id=26798>

National Council of Teachers of Mathematics. (2006). *Curriculum focal points for prekindergarten through grade 8 mathematics*. Reston, VA: Author.  
<http://www.nctm.org/standards/content.aspx?id=270>

National Research Council. (1996). *National Science Education Standards*. Washington, DC: National Academy Press. <http://www.nap.edu/readingroom/books/nses/>

### **Additional Resources**

\*Cross, C., Woods, T., & Schweingruber, H. (2009). *Mathematics learning in early childhood: Paths toward excellence and equity*. Washington, D. C.: National Research Council.

\*Kilpatrick, J., Swafford, J., & Findell, B (ed). (2001). *Adding it up: Helping children learn mathematics*. Washington, D. C.: National Research Council.

Virginia Department of Education. (2009). Revised mathematics standards of learning.  
<http://www.doe.virginia.gov> (Proposed version)

Virginia Department of Education. (2009). Revised mathematics curriculum framework.  
<http://www.doe.virginia.gov> (Proposed version)

Virginia Department of Education. (2010). Revised science standards of learning  
<http://www.doe.virginia.gov> (Proposed version)

\*Available as free downloads under early childhood education at the National Academies Press website: <http://www.nap.edu/topicpage>

## **College of Education and Human Development Expectations and Resources**

### *Student Expectations*

- Students must adhere to the guidelines of the George Mason University Honor Code [See <http://academicintegrity.gmu.edu/honorcode/>].
- Students with disabilities who seek accommodations in a course must be registered with the George Mason University Office of Disability Services (ODS) and inform their instructor, in writing, at the beginning of the semester [See <http://ods.gmu.edu/>].
- Students must follow the university policy for Responsible Use of Computing [See <http://universitypolicy.gmu.edu/1301gen.html>].
- Students are responsible for the content of university communications sent to their George Mason University 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 must follow the university policy stating that all sound emitting devices shall be turned off during class unless otherwise authorized by the instructor.
- Students are expected to exhibit professional behaviors and dispositions at all times.

### *Campus Resources*

- The George Mason University Counseling and Psychological Services (CAPS) staff consists of professional counseling and clinical psychologists, social workers, and counselors who offer a wide range of services (e.g., individual and group counseling, workshops and outreach programs) to enhance students' personal experience and academic performance [See <http://caps.gmu.edu/>].
- The George Mason University Writing Center staff provides a variety of resources and services (e.g., tutoring, workshops, writing guides, handbooks) intended to support students as they work to construct and share knowledge through writing [See <http://writingcenter.gmu.edu/>].

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

**Note:** To determine whether the campus is closed due to inclement weather, call 703-993-1000 or go to [www.gmu.edu](http://www.gmu.edu).

## **College of Education and Human Development Core Values**

In the context of an enduring college-level and university-level commitment to teaching, research and service, the College of Education and Human Development also holds the following core values:

### ***Collaboration***

Collaboration is an important human activity that involves shared responsibility in promoting healthy, productive lives and educational success. We commit ourselves to work toward these goals in genuine partnerships with individuals, families, community agencies, schools, businesses, foundations, and other groups at the local, regional, national and international levels.

***Ethical Leadership***

In all professions represented by the college, leadership is an essential component denoting ability and willingness to help lead professional practice to higher levels. We commit ourselves to practice ethical leadership through deliberate and systematic attention to the ethical principles that guide all leaders in a moral society.

***Innovation***

We have a history of creating dynamic, innovative programs and we are dedicated to continue creating innovative approaches in all areas of our work. We commit ourselves to seeking new ways to advance knowledge, solve problems, improve our professional practice and expand on our successes.

***Research-Based Practice***

The best practice in any discipline is based upon sound research and professional judgment. We commit ourselves to basing our instruction, scholarship and policy recommendations on well-established principles that, wherever possible, emerge from research and reflection on its implications for professional practice.

***Social Justice***

Social justice embodies essential principles of equity and access to all opportunities in society, in accordance with democratic principles and respect for all persons and points of view. We commit ourselves to promoting equity, opportunity, and social justice through the college's operations and its missions related to teaching, research, and service.

**Course Requirements****General Requirements**

1. The completion of all readings assigned for the course is assumed. Because the class will be structured around discussion and small group activities, it is imperative that students keep up with the readings and participate in class.
2. Class attendance is important. If, due to an emergency, students will not be in class, they must email or call the instructor and leave a message.
3. The university requires that all pagers and cell phones be turned off before class begins. All in-class usage of electronic devices, which includes telephones, laptops, etc., must have approval of course instructor. Laptops and other electronic devices are to be used for educational and learning purposes only and should not be used during class time to check email, surf the web, or communicate with people outside of the class unless part of the class activity.
4. It is expected that assignments will be turned in on time (by the end of the day) and posted on Blackboard. However, it is recognized that students occasionally have serious problems that prevent work completion. If such a dilemma arises, students should speak to the instructor in a timely fashion.

## Attendance

Attendance in class is important to students' learning; therefore, students are expected to make every effort to attend class sessions. Absences, tardiness, and leaving early may negatively affect course grades. The following policy is from the university course catalog:

Students are expected to attend the class periods of the courses for which they register. In-class participation is important not only to the individual student, but also to the class as a whole. Because class participation may be a factor in grading, instructors may use absence, tardiness, or early departure as de facto evidence of nonparticipation. Students who miss an exam with an acceptable excuse may be penalized according to the individual instructor's grading policy, as stated in the course syllabus.

## Written Assignments

All written assignments prepared outside of class will be evaluated for content and presentation. The American Psychological Association, Sixth Edition (APA) style will be followed for all written work. All written work unless otherwise noted must be completed on a word processor and should be proofread carefully. (Use spell check!) If students are not confident of their own ability to catch errors, they should have another person proofread their work. When in doubt, they should check the APA manual. Portions of the APA manual appear at the Style Manuals link on the Mason library web guide at <http://library.gmu.edu/resources/edu/>. Students may consult the Writing Center for additional writing support.

Students will do the following:

1. Present ideas in a clear, concise, and organized manner. (Avoid wordiness and redundancy.)
2. Develop points coherently, definitively, and thoroughly.
3. Refer to appropriate authorities, studies, and examples to document where appropriate. (Avoid meaningless generalizations, unwarranted assumptions, and unsupported opinions.)
4. Use correct capitalization, punctuation, spelling, and grammar.

## Grading Criteria

A = 95 – 100

A- = 90 – 94

B+ = 87 – 89

B = 83 – 86

B- = 80 – 82

C = 70 – 79

F = < 70

A+ is possible if work is of exceptional high quality above and beyond that required for the course.

## Grading Policy

All CEHD undergraduate and graduate students are held to the university grading policies as described in the Academic Policies section of the current catalog, which can be accessed at <http://catalog.gmu.edu>. Those students enrolled in a CEHD Licensure Graduate Certificate program, however, must earn a B- or better in all licensure coursework. A degree-seeking graduate student will be dismissed after accumulating grades of F in two courses or 9 credits of unsatisfactory grades (C or F) in graduate courses. A 3.0 grade point average is required for completion of the graduate degree.

### Specific Course Assignments

Assignments	Due Dates	Points
Participation (Individual/group/preparation)	<i>Ongoing</i>	15
Group Topic Presentations	<i>Various</i>	35
Informal Assessment Video Analysis	<i>October 18</i>	25
Teaching Observation Analysis	<i>November 22</i>	25
<b>TOTAL</b>		<b>100</b>

### Assignments

#### Attendance and Participation (15 points)

Because active participation and engagement are imperative for optimal learning, preparation for and participation in class activities will be evaluated based on the following criteria:

- Students attend class, arrive on time, and stay for the entire class period.
- Students complete readings and prepare for class activities prior to class as is evidenced by their ability to discuss and write about the concepts presented and examined in the texts as well as participate fully in related activities.
- Students are actively involved in in-class learning experiences as is evidenced by (1) participating in all activities, (2) engaging in small and large group discussions, (3) completing written work related to the activities, and (4) supporting the participation and learning of classmates.
- Students show evidence of critical reflective thinking through in-class discussions, activities, and written reflections.

#### Group Topic Presentations (35 points)

- Students will choose presentation groups based on a topic of interest listed on the class schedule on the syllabus. All members will participate in gathering information, preparing materials, and presenting. Some class time will be provided to work in groups.
- Students will select an appropriate article or chapter to provide to the class at least a week before the presentation that provides foundational information related to the topic.
- Groups will prepare and present an informative and interactive 25–30 minute presentation on their math or science topic with all group members participating equally.
- The presentation will include:
  - An overview of the topic to include the key ideas or content and the importance of the topic to students' mathematical or scientific learning supported by class readings and additional resources

- A research-based developmental sequence or learning trajectory for pre-kindergarten-3<sup>rd</sup> grade students specific to the topic
- A list of state and national content standards related to the topic
- Lesson ideas or learning activities for teaching the topic including the modeling of at least 1 learning activity with all appropriate materials during the presentation
- Strategies for instruction in the topic for a range of learners
- A list of at least 10 resources related to teaching the topic that could include children's literature, websites, manipulatives or materials, or other teacher resources
- A handout that includes all of the above and references used to develop the presentation

### **Informal Assessment Video Analysis (25 points)**

Students will choose one video clip on Blackboard to analyze.

In a bulleted list or in paragraphs, students will answer in detail the following questions:

- List and provide evidence for four skills/ knowledge the child has mastered.
- List and provide evidence for three skills/ knowledge the child is developing.
- List and provide evidence for two skills/ knowledge that are emergent for the child or which might reasonably be expected to develop next.
- Develop and list five learning objectives for what the student could next be expected to become familiar with, learn, or master.
- Provide short descriptions for three whole or small group learning experiences or lessons based on the learning objectives to further the child's learning in the topic or content area.
- Describe and provide evidence for how the teachers' lessons could be adapted to better meet the individual needs of the learner based on his or her current skills, knowledge, and interests.

Students will note which video clip was used.

**Due October 18**

### **Teaching Observation Analysis (25 points)**

Students will observe **one** math lesson *or* science lesson (can be interdisciplinary), at his or her internship site or field experience site. Based on the observation, students will prepare a paper using the attached template (**Attachment 1**). The focus is on describing, analyzing, and reflecting upon the instructional content and strategies the teacher uses to teach math or science. The paper should provide specific linkages to course readings.

**Due November 22**

### Tentative Class Schedule

<b>Date</b>	<b>Topics Addressed</b>	<b>Readings</b>	<b>Assignment Due</b>
<i>August 30</i>	Cognitive aspects of math and science Meaningful math and science learning	Welcome to ECED 514!	
<i>September 6</i>	Constructivist environments to support math/science learning Mathematics and science content knowledge for teaching and learning	Copley, Chapter 1 Harlen, Chapter 1	
<i>September 13</i>	Introduction to mathematics and science content standards, including the Virginia Standards of Learning Sequential nature of mathematics	Copley, Chapter 2 National and State Math and Science Learning Standards	
<i>September 20</i>	Focus on math instruction to develop the five processes of mathematical understanding—reasoning mathematically, solving problems, communicating mathematics effectively, making mathematics connections, and using mathematical representations of different levels of complexity	Copley, Chapters 3 & 4	
<i>September 27</i>	Authentic math and science assessment—addressing the needs of diverse learners	Harlen, Chapters 2 & 9	
<i>October 4</i>	Inquiry-based approach to teaching science Questioning techniques	Harlen, Chapter 3 Operations and Computation reading	Operations and Computation Presentation
<i>October 18</i>	The language of math and science	Copley, Chapter 6 Physical science reading	Physical Science Presentation <b>Informal Assessment</b> <b>Video Analysis</b>
<i>October 25</i>	Focus on math and science instruction for diverse young children	Harlen, Chapter 4 Place value reading	Place Value Presentation
<i>November 1</i>	Multiple mechanisms for representing mathematical concepts and procedures Contributions of different cultures to the history and development of mathematics and science	Copley, Chapter 7 Life science reading	Life Science Presentation
<i>November 8</i>	The role of science in explaining and predicting events and phenomena Developing the skills of data analysis, measurement, observation,	Harlen, Chapter 6 Fractions reading	Fractions Presentation



	prediction, and experimentation		
<i>November 15</i>	Technology in early childhood math and science Resources and references for young children and math and science	Copley, Chapter 5 Earth and space science reading	Earth and Space Science Presentation
<i>November 22</i>	Creating safe environments for children's research and experimentation Using community resources to enhance math and science instruction	Harlen, Chapter 7 Money reading	Money Presentation <b>Teaching Observation Analysis</b>
<i>November 29</i>	Math and science across the disciplines	Harlen, Chapter 8 Copley, Chapter 8	
<i>December 6</i>	Self-reflections on filling the role of math and science teacher for diverse young learners Course wrap-up	Copley, Chapter 9 Harlen, Chapter 5	

### Group Topic Presentation Evaluation Rubric

	<b>Exceeds Expectation</b>	<b>Meets Expectations</b>	<b>Does Not Meet Expectations</b>	<b>Points and Comments</b>
<b>Related Article</b> <i>2 points</i>	An appropriate and relevant article is provided for students with several links to the article during the presentation	An appropriate and relevant article is provided for students with links to the article during the presentation	The article is either not appropriate or relevant to the topic and/or there aren't any links to the article during the presentation	
<b>Topic Overview</b> <i>3 points</i>	A detailed description of the math or science topic that is supported by references to class or other readings	Description of the math or science topic that is supported by references to class or other readings	Limited or no description of the math or science topic and/or that is not supported by references to readings	
<b>Developmental sequence</b> <i>5 points</i>	A thorough, research supported description of the stages of knowledge acquisition related to the topic	A research supported description of the stages of knowledge acquisition related to the topic	A lack of description of the stages of knowledge acquisition or inaccurate or not research supported description	
<b>Learning Standards</b> <i>2 points</i>	Complete listing of all state and national standards related to the topic	List of state and national standards related to the topic	Incomplete list of state and national standards related to the topic	
<b>Learning Activities</b> <i>5 points</i>	Detailed listing and explanation (at least 5) of learning activities to master the essential concepts related to the topic	Listing and explanation of learning activities (at least 5) to master the essential concepts related to the topic	Incomplete listing and explanation of learning activities that will not help students to master the essential concepts related to the topic	
<b>Strategies for instruction</b> <i>5 points</i>	Comprehensive instructions for how to teach about the topic for a range of learners	Instructions for how to teach about the topic for a range of learners	Limited or no instructions for how to teach the topic without focusing on a range of learners	
<b>Resources</b> <i>5 points</i>	A variety of carefully selected materials (at least 10) and resources to facilitate instruction related to the topic	Resources (at least 10) to facilitate instruction related to the topic	Limited or no materials and resources and/or materials that do not facilitate instruction related to the topic.	
<b>Visual aids and Modeling</b> <i>3 points</i>	The use of visual aids and effective modeling during the presentation facilitates the clarity and value of the presentation	There is use of visual aids and modeling that somewhat facilitate the clarity and value of the presentation	Limited or ineffective use of visual aids and modeling during the presentation	
<b>Class Handout</b> <i>2 points</i>	The class handout provides a useful and concise overview of the presentation for colleagues with appropriate references	The class handout provides an overview of the presentation for colleagues with appropriate references	There is no handout to accompany the presentation and / or the handout has no references	
<b>Presentation</b> <i>3 points</i>	The presentation is very engaging and informative. All group members participate equally	The presentation is engaging and informative. All group members participate equally	The presentation is not engaging and or informative and/or all group members do not participate equally	
<b>Total Points</b>				<b>/ 35</b>

### Informal Assessment Video Analysis Evaluation Rubric

	<b>Exceeds Expectation</b>	<b>Meets Expectations</b>	<b>Does Not Meet Expectations</b>	<b>Points and Comments</b>
<b>Mastered Skills</b> <i>3 points</i>	Four mastered skills listed with detailed evidence	Four mastered skills listed with some evidence	Fewer than four mastered skills listed and/ or absence of evidence	
<b>Developing Skills</b> <i>3 points</i>	Three developing skills listed with detailed evidence	Three developing skills listed with some evidence	Fewer than three developing skills listed and/ or absence of evidence	
<b>Emergent Skills</b> <i>2 points</i>	Two emergent skills listed with detailed evidence	Two emergent skills listed with some evidence	Fewer than two emergent skills listed and/ or absence of evidence	
<b>Learning Objectives</b> <i>3 points</i>	Five measurable and specific learning objectives listed with clear links to the analysis of the student's knowledge and skills	Five measurable and learning objectives listed with some links to the analysis of the student's knowledge and skills	Fewer than five learning objectives and/or a lack of links to the analysis, not specific or not measurable	
<b>Lessons / Learning Activities</b> <i>5 points</i>	Detailed and complete descriptions of three lessons or learning experiences with clear links to the analysis	Complete descriptions of three lessons or learning experiences with links to the analysis	Fewer than three lessons and / or lack of detail without links to the analysis	
<b>Adaptations</b> <i>5 points</i>	Detailed and complete description of adaptations the teacher can provide to best meet the learning needs of the student based on his or her skills, knowledge, and interests	Complete description of adaptations the teacher can provide to best meet the learning needs of the student based on his or her skills, knowledge, and interests	Incomplete description of adaptations and/or adaptations are not based on the needs of the student and his or her skills, knowledge, and interests	
<b>Links to Course Readings</b> <i>5 points</i>	Strong evidence of incorporating at least two course readings to support the analysis	Evidence of incorporating at least two course readings to support the analysis	Limited or ineffective incorporation of course readings	
<b>Total Points</b>				<b>/ 25</b>

### Teaching Observation Analysis Evaluation Rubric

	<b>Exceeds Expectation</b>	<b>Meets Expectations</b>	<b>Does Not Meet Expectations</b>	<b>Points and Comments</b>
<b>Description of Lesson Content</b> <i>3 points</i>	Complete and detailed list of what occurred during the lesson including the subject area and grade level, standards utilized, concept(s) and/or process skills being taught, description of the activity, learning objectives, and relevant vocabulary	Complete list of what occurred during the lesson including the subject area and grade level, standards utilized, concept(s) and/or process skills being taught, description of the activity, learning objectives, and relevant vocabulary	Incomplete description of the lesson content that does not include all of the required information and/or uses inadequate detail	
<b>Description of Instructional Strategies</b> <i>3 points</i>	Complete and detailed list of the instructional strategies used, adaptations provided, links to family/community knowledge or children's interests, management procedures, assessments, questions asked by the teacher, and questions asked by the children	List of the instructional strategies used, adaptations provided, links to family/community knowledge or children's interests, management procedures, assessments, questions asked by the teacher, and questions asked by the children	Incomplete description of the instructional strategies used	
<b>Analysis of Teacher's Use of Specific Instructional Strategies</b> <i>6 points</i>	Detailed and complete analysis of the effectiveness of the teacher's use of instructional strategies related to vocabulary, adaptations, management, assessment, and questioning supported by evidence and course readings	Analysis of the use of the effectiveness of the teacher's use of instructional strategies related to vocabulary, adaptations, management, assessment, and questioning supported by evidence and course readings	Limited or incomplete analysis of the teacher's use of specific instructional strategies without or with limited support from evidence and course readings	
<b>Analysis of Overall Effectiveness</b> <i>4 points</i>	Comprehensive analysis of the effectiveness of the instructional strategies and those that were most and least effective supported by evidence and course readings	Analysis of the effectiveness of the instructional strategies and those that were most and least effective supported by evidence and course readings	Limited or incomplete analysis of the effectiveness of the instructional strategies, no discussion of the least and most effective strategies, and/or lack of support from evidence and course readings	
<b>Analysis of Changes to the Lesson</b> <i>4 points</i>	Thorough analysis of the needed changes to the lesson with detailed supports for why those changes are needed and would be beneficial for the students	Analysis of the needed changes to the lesson with detailed supports for why those changes are needed and would be beneficial for the students	Limited analysis of the needed changes to the lesson without supports or with limited supports for why those changes would be needed and/or beneficial for the students	
<b>Reflection</b> <i>5 points</i>	A thoughtful and complete reflection on the implications of the observation and analysis for future practice that meaningfully incorporates course readings	A complete reflection on the implications of the observation and analysis for future practice that meaningfully incorporates course readings	A limited or incomplete reflection on the implications of the observation and analysis and/or that does not incorporate course readings	
<b>Total Points</b>				<b>/ 25</b>

## **Attachment 1: Teaching Observation Analysis**

### **Description** (List or provide brief descriptions)

- Subject Area and Grade Level
- Standards Utilized (POS, SOL, or National Standards)
- Concept(s) and/or Process Skills Being Taught
- Brief Description of Activity
- Objectives (Individual and/or Group)
- Relevant Vocabulary
- Instructional Strategies Used
- Adaptations Provided for Groups of Students or Individual Students
- Links to Family/Community Knowledge or Children's Interests
- Management Procedures
- Assessments
- Questions Asked by the Teacher
- Questions Asked by the Children

### **Analysis** (Address each question with supports from the observation and course readings)

- Evaluate the effectiveness of the teachers' use of strategies
  - To help students understand relevant vocabulary
  - To meet the learning needs of groups of students or individual students
  - To link to students' knowledge, interests, and backgrounds
  - To manage the students during the learning activity
  - To assess students' learning during the lesson
  - To use questions and address students' questions to promote student learning
- Overall, how effective and engaging was the lesson? Which instructional strategies were the most and least effective? Why?
- What changes would you make to the lesson and why?

### **Reflection**

- Describe the implications of the observation and analysis for your future math or science instruction