George Mason University
College of Education and Human Development
Elementary Education Program

ELED 552 6K2 – Mathematics Methods for the Elementary Classroom
3 Credits, Spring 2023
Online: Synchronous and Asynchronous (see calendar)
Synchronous on Tuesday March 7 and each Thursday 5:00 PM - 8:00 PM

Faculty

Name: Dr. Kathleen Matson
Office Location: Thompson 1800
Office Hours: By appointment via Zoom
Office Phone: Please email
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Prerequisites/Corequisites

Admission to the elementary education licensure program.

University Catalog Course Description

Introduces methods for teaching all children topics in arithmetic, geometry, algebra, probability, and statistics in elementary grades. Focuses on using manipulatives and technologies to explore mathematics and solve problems.

Course Overview

In this course, we will begin an inquiry into mathematics teaching and learning that will guide you in your first teaching job and give you the tools that will enable you to continue to inquire and learn as part of your work as a teacher. Class sessions will be interactive and will include a variety of hands-on experiences with concrete and virtual manipulatives appropriate for elementary school mathematics. We will explore:

- The teaching of mathematics, investigating both *what* to teach and *how* to teach it.
- What it means to do mathematics and what it means to understand mathematics through individual, small group, and large group mathematical problem solving.
- Ways to represent understandings of mathematical concepts, communicate reasoning about mathematical ideas, and construct mathematical arguments.
- The ways children might represent mathematical concepts, and look at ways to help children build connections and see relationships among mathematical ideas.
- Characteristics of a classroom environment conducive to mathematical learning by reading and discussing the importance of mathematical tasks, mathematical tools, the roles of teachers and students, and the assessment of mathematical understanding.

In this course, we will take a stance of learning ***for, from,*** and ***in*** practice as follows:

Learning *FOR* Practice (Doing Mathematics): We will build our own *knowledge* of mathematics by closely investigating ideas in number sense and fraction concepts. Additionally, we will engage in several math tasks, extending our knowledge of mathematics and students' thinking, which will provide the foundation for your professional decision-making.

Learning *FROM* Practice (Examining Records of Practice): Records of practice—such as videotapes of lessons taught by yourself or others, students' work, and teachers' professional writing—will allow us to investigate the work of teaching mathematics and improve our own practice.

Learning *IN* Practice (Trying Things Out): Because teaching involves more than just having knowledge, you will be engaged in *enacting* the practices we are investigating as much as possible, so that you are developing the skills and professional decision-making that will make you a successful teacher.

Course Delivery Method

This course will be delivered online using both synchronous and asynchronous formats 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 dates of synchronous online and asynchronous class sessions are listed in the calendar below. The course site will be available on March 6, 2023.

Under no circumstances, may candidates/students participate in online class sessions (either by phone or Internet) while operating motor vehicles. Further, as expected in a face-to-face class meeting, such online participation requires undivided attention to course content and communication.

Technical Requirements

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.
- 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:
  Our course week will begin on Mondays at 12 AM and will end on Sundays at 11:59 PM.
- 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 4 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 should email the instructor to schedule a one-on-one session, including their preferred meeting method and suggested dates/times.

Learner Outcomes or Objectives

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

A. Know what constitutes the essential topics in mathematics of the modern early and intermediate grades school program.
B. Identify and use selected manipulatives and technology such as linking cubes, attribute blocks, geoboards, base-10 blocks, fraction circles, tangrams, calculators, and computers to teach appropriate mathematics content topics in the early and middle grades.
C. Identify and use various instructional strategies and techniques (cooperative and peer group learning, activity centers, laboratories and workshops, teacher-directed presentations, etc.) to teach mathematical content topics appropriate for the early and intermediate grades to all children, including those from non-mainstreamed populations.

D. Identify and use alternative methods for assessing students' work in mathematics in the early and intermediate grades.
E. Solve problems in the mathematical content areas of logic, number theory, geometry, algebra, probability, and statistics appropriate for adaptation to the early and intermediate grades.
F. Know and explain the learning progression in relation to the standards-based mathematics curriculum, the key elements of the National Council of Teachers of Mathematics Principles and Standards for School Mathematics, and the key elements of the Virginia Standards of Learning for Mathematics.
G. Understand the multiple representations of mathematical concepts and procedures.
H. Understand and use the five processes—reasoning mathematically, solving problems, communicating mathematics effectively, making mathematical connections, and using mathematical representations—at different levels of complexity
I. Explore the contributions of different cultures toward the development of mathematics, and the role of mathematics in culture and society.
J. Understand, possess, and integrate the knowledge, skills, dispositions, and processes needed to support learners' achievement in an interdisciplinary manner in Virginia's Foundation Blocks for Early Learning: Comprehensive Standards for Four-Year-Olds and the Virginia Standards of Learning in English, mathematics, history and social science, science, and computer technology.

Additionally, this course supports the CEHD Core Values of collaboration, ethical leadership, research-based practice, social justice, and innovation. Statements of these goals are at http://cehd.gmu.edu/values/.

Professional Standards
(Interstate Teacher Assessment and Support Consortium (InTASC)

Upon completion of this course, students will have met the following professional standards:

Course Student Outcomes (above)	**INTASC Standard (2013)**
A. Essential math	#4 Content Knowledge
B. Planning and Teaching using manipulatives	#7 Planning for Instruction
C. Instructional Strategies	#8 Instructional Strategies
D. Assessing	#6 Assessment
E. Problem Solving	#5 Application of Content
F. Learner Development and understanding of Learning Progression	#1 Learner Development, #2 Learner Differences

G. Multiple Representations	#4 Content Knowledge, #5 Application of Content
H. Five Processes	#4 Content Knowledge, #5 Application of Content

Required Text

Van De Walle, J., Karp, K. S., & Bay-Williams, J. M. (2018). *Elementary and Middle School Mathematics: Teaching Developmentally.* (10th edition) New York: Pearson(2019:9780134802084)

Course Performance Evaluation

Students are expected to submit all assignments on time in the manner outlined by the instructor (e.g., Blackboard).

Assignments

All assignment details, templates, and rubrics will be available on Blackboard.

- **Course engagement, digital Interactive Notebook (dINB), and Professional Dispositions (45 points)**
  Addresses Learner Outcomes: A, B, C, D, E, F, G, H
  Reading and activity reflections will be done via daily Interactive Notebook entries. During class meetings and asynchronous sessions, students are expected to analyze and reflect on solution strategies, provide differentiated approaches to center activities, and actively engage in class by applying class readings. This work will be collected and kept in a digital interactive notebook shared with the instructor in Google Slides. Professional dispositions are to be displayed at all times while interacting with the instructor and other students.

  Students are expected to contribute to class discussions and activities during synchronous meetings and online as well as genuinely listen and respond to peers as they do the same. The instructor may also call on students in order to maximize classroom opportunities to hear from ALL of the students enrolled in the course. Participation should raise the level of academic discourse, which may include asking questions and encouraging exploration, consideration, and learning. To be active participants in class, you must complete all pre-assigned readings and tasks before the class session for which they are assigned.

  It is expected that you attend all synchronous classes outlined within the syllabus. Absence from class to observe a religious holiday, to serve jury duty, or to participate in required military service, and medical emergencies are exceptions to the above policy. If you need to be absent for any of these reasons, please make arrangements at least 48 hours in advance. In addition, you are

expected to be on time to class each session unless 48 hours advance notice has been provided to the instructor.

This course operates with the assumption that knowledge is socially constructed and the most meaningful learning opportunities are those where you have the opportunity to offer and explore diverse perspectives with peers; therefore, you are expected to contribute to all class and online discussions and activities as well as genuinely listen to peers as they do the same. You are expected to be prepared for each class, which means having completed all assigned readings and tasks for that class prior to the start of class. Your participation includes completion of all synchronous and asynchronous application activities. This includes but is not limited to

- Contributions to whole group and small group discussions
- All digital Interactive NoteBook (dINB) work

Cell phones are for emergency use only and it is expected that you will not use cell phones or computers in class for purposes beyond enhancing your own learning of course content.

Evaluation for dINB - You will complete in-class and between class activities in your online class notebook. The journal tab on Blackboard will contain updates for each class session. **PLEASE NOTE: If you are absent from class, you can earn half the daily points by completing all the between session classwork.

Participation and Interactive Math Memo RUBRIC

	Unsatisfactory (0 pts per day)	Proficient (3 pts per day)
Classwork: includes work due prior to class session, participation during the session, and reflective and interactive work done after the class session. Applies to both synchronous and asynchronous sessions	The student is absent from class and/or is not prepared for class or between class work is incomplete. Some or all work is missing.	The student is punctual and prepared for class; synchronous and asynchronous work is complete. The student actively participates and supports the members of the learning group and the members of the class. Work is completed in a distinguished way

- **Math Autobiography and Vision Statement (5 points)**
  Write a 1-2 page math autobiography and vision statement addressing the following questions:
  - What was learning math like for you in your early grades? Middle and onwards?
  - What worked and didn't work for you as a math learner?
  - How does your experience shape you as a teacher?
  - What visions of math teaching and learning do you have for your own classroom?

- **Math Routine (10 points)**
  Addresses Learner Outcomes: A, B, C, D, E, F, G, H

With a small group, you will select and plan a Math Routine to teach in your classroom. After leading the routine in your own classroom you will complete a reflection on your experience and your students' responses. The Math Routine will include the essential elements of Math Routine and address a mathematical concept. Use the Math Routine lesson plan template that is provided to add your examples, anticipated student responses, and expected series of questions.

See the assignment description and rubric on Blackboard for more detail.
Math Routine Menu and Number Sense Routines by Grade.

- **Book Chat (15 points)**
  Choose one mathematical content chapter (NOT chapters 1-6) from our textbook as a focus.
  YOUR SELECTION NEEDS TO BE APPROVED BY YOUR INSTRUCTOR.
  Write a brief, double-spaced, 2 page TOTAL (do not exceed) overview using bulleted notes to explain how you might teach this mathematical topic using what you have learned in our textbook.
  - Include the following:
    - How would you connect your topic to previous student knowledge?
    - What are the key ideas for teaching and learning this topic?
    - What instructional activities would you include? Why?
    - What common challenges and misconceptions would you look for?

  See the assignment description and rubric on Blackboard for more detail

- **Problem-Based Lesson with Student Work Analysis (15 points)**
  Addresses Learner Outcomes: A, C, D, E, F, G, H
  You are expected to: 1) select a VDOE rich task and adapt the lesson plan for your classroom; 2) solve the problem yourself using all three representations (concrete, pictorial, abstract); 3) Prepare a *Planning for Mathematical Discourse Chart* that includes anticipated student responses/strategies and questions to assess and advance student work; 4) Implement the rich task in your classroom; 5) Select and sequence student responses for sharing out and make connections between student solutions; 6) complete a Google Slide Deck to summarize and reflect on your lesson.

  Assignment details and rubric can be found in the assignment tab on Blackboard.

- **Mathematical Learning Trajectory: (10 points)**
  Addresses Learner Outcomes: A, B, C, D, F, G
  The assignment will be completed as a Google Slide presentation.
  Choose an SOL standard related to your book chat topic and create a *visual representation* of the developmental learning trajectory for this standard. Provide specific examples to clarify the progression of student understanding of this topic. Select an activity or tasks that would advance a learner along the developmental learning trajectory. Explain why you chose this task or activity.

  Assignment details and rubric can be found in the assignment tab on Blackboard.

Note: Faculty reserve the right to add, alter, or omit any assignment as necessary during the course of the semester. You will always receive advance notice of any modifications. Bookmark this link to access the most current schedule of readings and due dates.

Attendance Policy

Attendance in the course is mandatory. You are held accountable for all information from each class session whether you are present or not. Reasons for any absence must be reported to the instructor in writing. Attendance is tied into your participation grade. If you are not in class, you are not participating.

Tardiness

It is your responsibility to be on time for each class session. Reasons for any absence must be reported to the instructor in writing.

Late Work

Work is due on the announced due date. All late work will incur a penalty of 10 percent for each day late. The only exception to this is for those students with excused absences (see Attendance Policy above).

Given these policies, I also acknowledge this is a fast-paced and condensed course. I care that you have opportunities to succeed. If something arises that threatens your ability to succeed in this course, communicate with me as soon as is reasonably possible.

Grading

Course Assignment Weighting

Assignment	Due Date	Points
Daily participation and digital Interactive NoteBook (dINB) 3 points per session	Ongoing	45
Math Autobiography and Vision Statement	March 7	5
Math Routine	March 28	10
Book Chat	April 4	15
Mathematical Learning Trajectory	April 11	10
Problem-Based Lesson with Student Work Analysis	April 25	15
Total		**100**

Policies for Grading

The mathematics education courses in GMU's Elementary Education Program integrate pedagogy and mathematics content appropriate for the elementary school grades. For students to earn a grade of A in the

course, they must demonstrate excellence in *both* the pedagogical knowledge and the content knowledge of the mathematics appropriate at their level of teaching. Thus, the grading in the course is structured to help evaluate student excellence in both areas. Problem sets and assessment work focuses primarily on ascertaining student excellence in handling mathematics content appropriate for the elementary grades, and represents 50% of students' grades. Pedagogical knowledge is ascertained primarily from readings, assignments and participation in the course, and represents 50% of students' grades. Therefore, students who demonstrate excellence in both pedagogical knowledge and content knowledge receive grades of A.

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**	**4.00**	**Represents mastery of the subject through effort beyond basic requirements**
A-	**90-93**	**3.67**	
B+	**85-89**	**3.33**	**Reflects an understanding of and the ability to apply theories and principles at a basic level**
B	**80-84**	**3.00**	
C*	**70-79**	**2.00**	**Denotes an unacceptable level of understanding and application of the basic elements of the course**
F*	**<69**	**0.00**	

* Note: "C" is not satisfactory for a licensure course

"F" does not meet the requirements of the School of Education.

Professional Dispositions

Students are expected to exhibit professional behaviors and dispositions at all times.
(See Elementary Education Program Handbook).

Class Schedule

These topics and activities are subject to change to be responsive to the pace of the course. This is a projected sequence of due dates and planned readings. An *Always Current* course schedule can be accessed through the Blackboard course site.

	Active Learning and Discussion Emphasis	**Readings Due**	**Assignments Due**

Tue March 7 5:00-8:00 PM **SYNCHRONOUS** *Session 1*	Welcome! Intro to Math Methods Knowing and Doing Mathematics How Do Children Learn Mathematics?	Ch 2: pp. 13–28 Note: ***Try*** tasks 1-4 before reading on	Math Autobiography and Vision Statement Daily Interactive Notebook (DiNB) (in class)
Thur March 9 5:00-8:00 PM **SYNCHRONOUS** *Session 2*	Introduction to the Standards NCTM Mathematical Teaching Practices	Ch 1: pp 4-8 *SKIM* VDOE Standards of Learning for Mathematics (Focus on your grade) Watch Video: Brain Evidence Read: Transforming Math Learning	Daily Interactive Notebook (DiNB)
Tue March 14 **ASYNCHRONOUS** *Session 3*	Development of Grade Level Mathematical Concepts and Procedures	Mental Math Routine Video Math Topic Book Chat Chapter	Daily Interactive Notebook (DiNB) Select your Math Routine
Thur March 16 **ASYNCHRONOUS** *Session 4*	Development of Grade Level Mathematical Concepts and Procedures	Watch EdPuzzle: Strength-Based Mathematics Instruction Math Topic Book Chat Chapter (continued)	Daily Interactive Notebook (DiNB)
Tue March 21 **ASYNCHRONOUS** *Session 5*	Teaching Through Problem Solving	Ch 3: pp 30-42 Early Number and Counting Video (7 min.)	Daily Interactive Notebook (DiNB)
Thur March 23 5:00-8:00 PM **SYNCHRONOUS** *Session 6*	High Cognitive Demand Tasks Thinking Through a Lesson Protocol	Smith et al, Thinking Through a Lesson Protocol Ch 3: 48-53 Article on 5 Practices	Daily Interactive Notebook (DiNB)
Tue March 28 **ASYNCHRONOUS** *Session 7*	Creating Assessments	Chapter 5 p. 83-94 Kling and Bay-Williams (2014) Assessing Basic Fact Fluency	Daily Interactive Notebook (DiNB) Math Routine Slides and Reflection

Thur March 31 5:00-8:00 PM **SYNCHRONOUS** *Session 8*	Planning in the Problem-Based Classroom	Ch 4: pp 55-69 Split it up! Unpacking the Equipartitioning Learning Trajectory.	Daily Interactive Notebook (DiNB)
Tue April 4 **ASYNCHRONOUS** *Session 9*	Teaching Mathematics Equitably to ALL Children	Chapter 6 pp. 104-114	Daily Interactive Notebook (DiNB) Book Chat Overview
Thur April 6 5:00-8:00 PM **SYNCHRONOUS** *Session 10*	Differentiating Instruction	Ch 4: 69-74 Never Say Anything a Kid Can Say Warning Signs! Avoid taking over children's thinking.	Daily Interactive Notebook (DiNB)
Tue April 11 **ASYNCHRONOUS** *Session 11*	Teaching Mathematics Equitably to ALL Children	Chapter 6 pp. 114-124	Daily Interactive Notebook (DiNB) Mathematical Learning Trajectory
Thur April 13 5:00-8:00 PM **SYNCHRONOUS** *Session 12*	Developing Basic Fact Fluency	Chapter 9: pp. 184-189; pp. 205-210 Ch 3: 45-48	Daily Interactive Notebook (DiNB)
Tue April 18 **ASYNCHRONOUS** *Session 13*	Developing Algebraic Thinking	Ch 13 - selected pages	Daily Interactive Notebook (DiNB)
Thur April 20 5:00-8:00 PM **SYNCHRONOUS** *Session 14*	Developing Measurement Concepts	Chapter 18: pp. 461-486; (selection of pp. 469-498)	Daily Interactive Notebook (DiNB)
Tue April 25 **ASYNCHRONOUS** *Session 15*	Catch-up		Problem-Based Lesson with Student Work Analysis

Thur April 27 5:00-8:00 PM **SYNCHRONOUS** *Session 16*	Course Reflection		Project Share Symposium

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

University Libraries https://library.gmu.edu

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

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

As a faculty member, I am designated as a "Responsible Employee," and must report all disclosures of sexual assault, 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 from Mason's Title IX Coordinator by calling 703-993-8730, or emailing titleix@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 http://cehd.gmu.edu/.

Support for submission of assignments to VIA should be directed to **viahelp@gmu.edu** or **https://cehd.gmu.edu/aero/assessments**. Questions or concerns regarding use of Blackboard should be directed to **https://its.gmu.edu/knowledge-base/blackboard-instructional-technology-support-for-students/**

Emergency Procedures

You are encouraged to sign up for emergency alerts by visiting the website https://alert.gmu.edu. There are emergency posters in each classroom explaining what to do in the event of crises. Crisis in Education App at: https://itunes.apple.com/us/app/in-case-of-crisis-education/id476578079?mt=8

Course Materials and Student Privacy

- All course materials posted to Blackboard or other course sites are private; by federal law, any materials that identify specific students (via their name, voice, or image) must not be shared with anyone not enrolled in this class.
- Video recordings of class meetings that include audio or visual information from other students are private and must not be shared.
- Live video conference meetings (e.g. Collaborate or Zoom) that include audio or visual information from other students must be viewed privately and not shared with others in your household.
- Some/all of your CEHD synchronous class meetings may be recorded by your instructor to provide necessary information for students in this class. Recordings will be stored on Blackboard (or another secure site) and will only be accessible to students taking this course during this semester.

NCTM Process Standards Virginia Standards for Learning (for students)

Mathematical Process Goals for Students

The content of the mathematics standards is intended to support the following five process goals for students: becoming mathematical problem solvers, communicating mathematically, reasoning mathematically, making mathematical connections, and using mathematical representations to model and interpret practical situations. Practical situations include real-world problems and problems that model real-world situations.

Mathematical Problem Solving

Students will apply mathematical concepts and skills and the relationships among them to solve problem situations of varying complexities. Students also will recognize and create problems from real-world data and situations within and outside mathematics and then apply appropriate strategies to determine acceptable solutions. To accomplish this goal, students will need to develop a repertoire of skills and strategies for solving a variety of problem types. A major goal of the mathematics program is to help students apply mathematics concepts and skills to become mathematical problem solvers.

Mathematical Communication

Students will communicate thinking and reasoning using the language of mathematics, including specialized vocabulary and symbolic notation, to express mathematical ideas with precision. Representing, discussing, justifying, conjecturing, reading, writing, presenting, and listening to mathematics will help students to clarify their thinking and deepen their understanding of the mathematics being studied. Mathematical communication becomes visible where learning involves participation in mathematical discussions.

Mathematical Reasoning

Students will recognize reasoning and proof as fundamental aspects of mathematics. Students will learn and apply inductive and deductive reasoning skills to make, test, and evaluate mathematical statements and to justify steps in mathematical procedures. Students will use logical reasoning to analyze an argument and to determine whether conclusions are valid. In addition, students will use number sense to apply proportional and spatial reasoning and to reason from a variety of representations.

Mathematical Connections

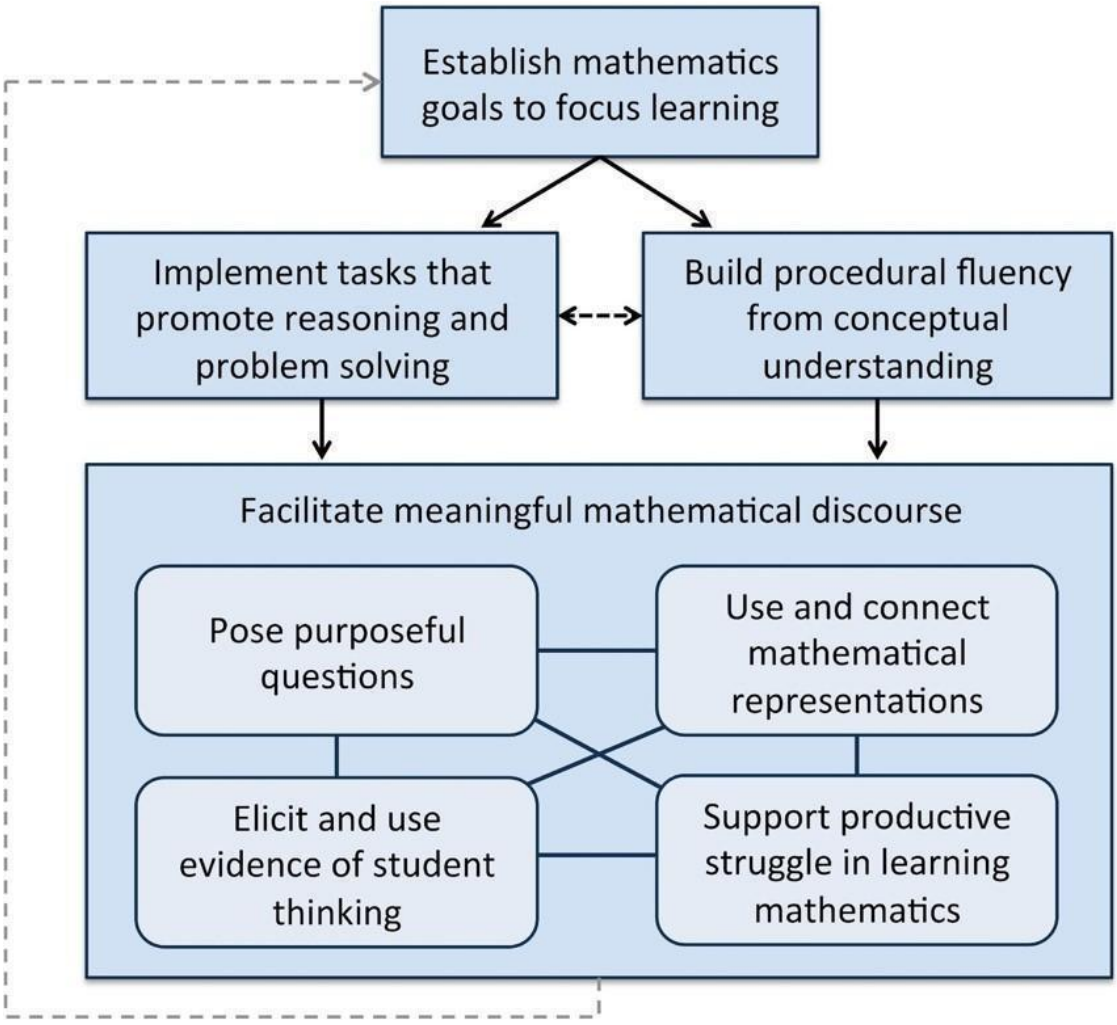
Students will build upon prior knowledge to relate concepts and procedures from different topics within mathematics and see mathematics as an integrated field of study. Through the practical application of content and process skills, students will make connections among different areas of mathematics and between mathematics and other disciplines, and to real-world contexts. Science and mathematics teachers and curriculum writers are encouraged to develop mathematics and science curricula that support, apply, and reinforce each other.

Mathematical Representations

Students will represent and describe mathematical ideas, generalizations, and relationships using a variety of methods. Students will understand that representations of mathematical ideas are an essential part of learning, doing, and communicating mathematics. Students should make connections among different representations – physical, visual, symbolic, verbal, and contextual – and recognize that representation is both a process and a product.

National Council of Teachers of Mathematics - 8 Teaching Practices (for teachers)

See Appendix B, page 635 of textbook



Mathematics Teaching Practices: Supporting Equitable Mathematics Teaching

EQUITABLE TEACHING PRACTICES VDOE SOL Institutes, 2018	
Mathematics Teaching Practices (NCTM)	Equitable Teaching
1. **Establish mathematics goals to focus learning.** Effective teaching of mathematics establishes clear goals for the mathematics that students are learning, situates goals within learning progressions, and uses the goals to guide instructional decisions.	● Establish learning progressions that build students' mathematical understanding, increase their confidence, and support their mathematical identities as doers of mathematics. ● Establish high expectations to ensure that each and every student has the opportunity to meet the mathematical goals. ● Establish classroom norms for participation that position each and every student as a competent mathematics thinker. ● Establish classroom environments that promote learning mathematics as just, equitable, and inclusive.
2. **Implement tasks that promote reasoning and problem solving.** Effective teaching of mathematics engages students in solving and discussing tasks that promote mathematical reasoning and problem solving and allow multiple entry points and varied solution strategies.	● Engage students in tasks that provide multiple pathways for success and that require reasoning, problem solving, and modeling, thus enhancing each student's mathematical identity and sense of agency. ● Engage students in tasks that are culturally relevant. ● Engage students in tasks that allow them to draw on their funds of knowledge (i.e., the resources that students bring to the classroom, including their home, cultural, and language experiences).
3. **Build procedural fluency from conceptual understanding.** Effective teaching of mathematics builds fluency with procedures on a foundation of conceptual understanding so that students, over time, become skillful in using procedures flexibly as they solve contextual and mathematical problems.	● Connect conceptual understanding with procedural fluency to help students make sense of mathematics and develop a positive disposition toward mathematics. ● Connect conceptual understanding with procedural fluency to reduce mathematical anxiety and position students as mathematical knowers and doers. ● Connect conceptual understanding with procedural fluency to provide students with a wider range of options for entering a task and building mathematical meaning.

EQUITABLE TEACHING PRACTICES

VDOE SOL Institutes, 2018

Mathematics Teaching Practices (NCTM)	Equitable Teaching
4. **Facilitate meaningful mathematical discourse.** Effective teaching of mathematics facilitates discourse among students to build shared understanding of mathematical ideas by analyzing and comparing student approaches and arguments.	● Use discourse to elicit students' ideas and strategies and create space for students to interact with peers to value multiple contributions and diminish hierarchical status among students (i.e., perceptions of differences in smartness and ability to participate). ● Use discourse to attend to ways in which students position one another as capable or not capable of doing mathematics. ● Make discourse an expected and natural part of mathematical thinking and reasoning, providing students with the space and confidence to ask questions that enhance their own mathematical learning. ● Use discourse as a means to disrupt structures and language that marginalize students.
5. **Pose purposeful questions.** Effective teaching of mathematics uses purposeful questions to assess and advance students' reasoning and sense making about important mathematical ideas and relationships.	● Pose purposeful questions, then listen to, and understand students' thinking to signal to students that their thinking is valued and makes sense. ● Pose purposeful questions to assign competence to students. Verbally mark students' ideas as interesting or identify an important aspect of students' strategies to position them as competent. ● Be mindful of the fact that the questions that a teacher asks a student and how the teacher follows up on the student's response can support the student's development of a positive mathematical identity and sense of agency as a thinker and doer of mathematics.
6. **Use and connect mathematical representations.** Effective teaching of mathematics engages students in making connections among mathematical representations to deepen understanding of mathematical concepts and procedures and to use as tools for problem solving.	● Use multiple representations so that students draw on multiple resources of knowledge to position them as competent. ● Use multiple representations to draw on knowledge and experiences related to the resources that students bring to mathematics (culture, contexts, and experiences). ● Use multiple representations to promote the creation and discussion of unique mathematical representations to position students as mathematically competent.

EQUITABLE TEACHING PRACTICES

VDOE SOL Institutes, 2018

Mathematics Teaching Practices (NCTM)	Equitable Teaching
7. **Elicit and use evidence of student thinking.** Effective teaching of mathematics uses evidence of student thinking to assess progress toward mathematical understanding and to adjust instruction continually in ways that support and extend learning.	● Elicit student thinking and make use of it during a lesson to send positive messages about students' mathematical identities. ● Make student thinking public, and then choose to elevate a student to a more prominent position in the discussion by identifying his or her idea as worth exploring, to cultivate a positive mathematical identity. ● Promote a classroom culture in which mistakes and errors are viewed as important reasoning opportunities, to encourage a wider range of students to engage in mathematical discussions with their peers and the teacher.
8. **Support productive struggle in learning mathematics.** Effective teaching of mathematics consistently provides students, individually and collectively, with opportunities and supports to engage in productive struggle as they grapple with mathematical ideas and relationships.	● Allow time for students to engage with mathematical ideas to support perseverance and identity development. ● Hold high expectations, while offering just enough support and scaffolding to facilitate student progress on challenging work, to communicate caring and confidence in students.

Equity-Based Practices for Teaching Mathematics

Going deep with mathematics.
Developing a deep understanding of mathematics is a major goal of equity-based mathematics teaching practices (Aguirre 2009; Gutstein 2006). Lessons include high cognitive demand tasks that support and strengthen student development of the strands of mathematical proficiency, including conceptual understanding, procedural fluency, and problem solving and reasoning (National Governors Association Center for Best Practices and Council of Chief State School Officers 2010; National Research Council 2001a; Stein et al. 2000).

Leveraging multiple mathematical competencies.
Recognizing and positioning students' various mathematical backgrounds and competencies is a key equity-based practice (Featherstone et al. 2011; Horn 2012; Turner et al. 2012) All students have different mathematical strengths that can serve as resources for learning and teaching mathematics.

Affirming mathematics learners' identities.
A positive, productive mathematics learner identity contributes to the mathematical learning of a child (Berry 2008; Boaler 2002; Martin 2000, 2009; Stinson 2008). Instruction that values multiple mathematical contributions, provides mul6ple entry points and promotes student participation in various ways (teams, groups, and so on) can aid the development of a student's mathematical learning identity.

Challenging spaces of marginality.
Traditionally, mathematics learning has been an independent and isolating experience with a focus on lecture and seatwork. Further, students who do not perform well in this traditional classroom setting are often marginalized, ignored, or positioned as "dumb" (Boaler 2002; Jackson 2009). Practices that embrace student competencies, diminish status, and value multiple mathematical contributions as essential to cultivate (Aguirre et al. 2012; Featherstone et al. 2011; Horn 2012).

Drawing on multiple resources of knowledge.
Equity-based teaching depends on the capacity to recognize and intentionally tap students' knowledge and experiences-mathematical, cultural, linguistic, peer, family, and community-as resources for mathematics teaching and learning. Drawing on this knowledge and experience includes helping students bridge everyday experiences to learn mathematics, capitalizing on linguistic resources to support mathematics learning, recognizing family or community mathematical practices to support mathematics learning, and finding ways to help students learn and use mathematics to solve authentic problems that affect their lives (Aguirre 2009; Aguirre et al. 2012; Civil 2007; Brenner and Moschkovich 2002; Gutiérrez 2002; Gutstein 2006; Moschkovich 1999; Simic-Mueller, Turner, and Varley 2009; Staats 2009; Turner et al. 2012; Turner and Strawhun 2007).