**College of Education**
**Oregon State University**
**Double Degree Elementary**

**TCE 457 Teaching Elementary Mathematics for Understanding**

**3 credits**

**Class Meetings**: 1600-1850 Wednesdays

**Prerequisites:**

- Provisional Admission (Level II) to Education Double Degree
- This course builds upon the Foundations for Elementary Mathematics Courses (MTH 211, 212 and 390). It is highly recommended that those courses have been completed prior to TCE 457.

**Authorization Levels**
This course is structured to look at the continuum of mathematical development of children from kindergarten through grade 8. Students will work in authorization level groups to discuss various issues related to course content.

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**COURSE DESCRIPTION**
Explores the teaching of mathematics in K-8 classrooms in a manner consistent with state and national standards. Students learn teaching strategies that incorporate the development of mathematical models and mental constructs.

This is a PCTE course in the Double Degree Program for the College of Education at Oregon State University. This class is designed to explore the teaching of elementary mathematics in a manner consistent with NCTM's *Principles and Standards for School Mathematics* and The Common Core State Standards in Mathematics, including the Standards for Mathematical Practice. The student teachers (STs) will learn teaching strategies that incorporate the development of mathematical models and mental constructs. This modeling will utilize visual imagery, technology, and manipulatives whenever possible. The STs will investigate ways to "bridge the gap" between concrete and abstract levels of understanding mathematics. Developmentally appropriate and culturally relevant practices will be incorporated into lessons.

The following instructional themes across the mathematical curriculum will be emphasized: (1) mathematics as problem solving; (2) mathematics as reasoning and proof; (3) mathematics as communication; (4) mathematical connections; (5) mathematical representation, to include the use of technology; and (6) equity in the expectations and instruction of all students.

**REQUIRED TEXTBOOK:**
Van de Walle, J. A., Karp, K.S., & Bay-Williams, J.M. (2013). *Elementary and middle school mathematics: Teaching developmentally* ($8^{th}$ ed.). Boston: Allyn & Bacon.

**STUDENT LEARNNG OUTCOMES:**
The Student Teachers will be able to do the following:

1. Demonstrate the knowledge of national standards and how to use national standards in developing long-term curriculum goals, short-term goals, and daily lessons.
2. Demonstrate knowledge of research-based strategies for the teaching of mathematics to elementary students.
3. Demonstrate the ability to develop curriculum and lessons that meet the needs of diverse learners and are multiculturally sensitive.
4. Implement curriculum plans that maximize student learning incorporating methods and strategies that utilize problem solving and technology.
5. Demonstrate the knowledge of unit and lesson planning in the teaching of mathematics.
6. Plan and design effective learning environments and experiences supported by technology, models, and a variety of materials.
7. Demonstrate knowledge of ways to assess students' understandings of mathematics, including their beliefs.
8. Understand the social, ethical, legal, and human issues surrounding the use of technology.

**Relationship to the Conceptual Framework: Constructivism and Social Justice Perspectives**
This course reinforces the belief that students' experiences, values, and assumptions affect their interpretations and understandings of their own learning. It strives to help the learner construct his/her own knowledge of mathematics. It values the strengths of social learning and encourages a diversity of views and problem-solving alternatives.

This course will also address issues relating to and strategies that encourage equity in the teaching and learning of mathematics. The students will develop a broad social consciousness and critical awareness of conditions in society (of which the classroom is a reflection) that discourage certain populations, especially females and People of Color, from the field of mathematics, limiting career choices and entrance to high paying occupations in the work force. In addition, mathematics can be a discipline of oppression and is often used in this manner to legitimize Eurocentric and other dominant cultural values.

**Link to Conceptual Framework, Knowledge Base, and National and State**
The Professional Teacher and Counselor Education (PTCE) unit Conceptual Framework is based on four foundational or core values that are listed below. To find out more about how the knowledge base relates to the National Council for Accreditation of Teacher Education (NCATE) guidelines, review the Conceptual Framework at the website: http://oregonstate.edu/education/accreditation/

1. Ethics and Professionalism
2. Reflective Practitioner
3. Lifelong Learners
4. Diversity and Equity

With respect to national standards, this course includes application of NCATE content knowledge, professional and pedagogical knowledge and skills, dispositions, and student learning. NCATE Unit Standards: http://www.ncate.org/public/unitStandardsRubrics.asp?ch=4

The Oregon TSPC Standards embedded in this course include the following:

- Standard 1: Plan Instruction that supports student progress in learning and is appropriate for the developmental level.
- Standard 2: Establish a classroom climate conducive to learning.
- Standard 3: Engage students in planned learning activities.
- Standard 4: Evaluate, act upon, and report student progress in learning.

- Standard 5: Exhibits professional behaviors, ethics, and values

**Knowledge Base: National and State Standards**
National Standards: National Council of Teachers of Mathematics, *Principles and Standards for School Mathematics* (2000)

- Principles: Equity, Curriculum, Teaching, Learning, Assessment, and Technology
- Content: Number and Operations, Algebra, Geometry, Measurement, Data Analysis and Probability
- Process: Problem Solving, Reasoning and Proof, Communication, Connections, Representations
- CCSSM, including the Standards for Mathematical Practice

## COURSE REQUIREMENTS, READINGS, AND ASSIGNMENTS

**Attendance**
Attendance at all class meetings is expected, as the class discussions and group work are essential components in meeting the course objectives. Class will begin and end on time. If missing class is unavoidable, the student should notify the instructor of the absence before class or as soon after class as possible. The student is responsible for information from class and therefore should arrange with a classmate to take notes and collect handouts. Students should expect an alternative assignment from the instructor if they must miss class and be responsible for contacting the instructor for this assignment. Attendance may affect a student's grade if he or she misses more than one class.

**Assignments**
Assignment policy: Grading criteria is listed for each assignment. The students are responsible to read the assignment description to assure their work is complete and meets all the criteria.

**1. Mathography (Outcome: 7)**
***10 Points/Criteria: All required information***
Student Teachers (STs) will write a "mathography" which describes their mathematics background. The purpose of this assignment is for STs to assess and reflect on their own mathematics backgrounds and what they will bring to the mathematics instruction in their classrooms. This paper will include:

- memorable highlights of mathematics experiences from K - college (and beyond, if applicable): **how did your experience influence/affect…**
- feelings about mathematics today
- mathematical strengths and weaknesses today
- attitudes toward mathematics

**2. Readings and Reading Log (Outcomes: 1-8)**
***20 points (4 logs-3points for each log -2points for oral and written class work)***
The assigned readings in the textbooks are an important part of this class. They provide background and strategies for the teaching of elementary mathematics and give you a wealth of useful classroom examples and teaching ideas. ST should read the required chapters prior to class and keep a reading log with questions, insights, and/or notes to themselves. Bring your reading logs to class, as we will spend class time discussing and writing about the readings. You should reflect upon the readings by noting the following for each chapter: 1. Three main ideas; 2. Two math problems need to be worked in each chapter, or, if no math problems are available in a given chapter, 2 practical ideas learned from that chapter that could be used in the classroom; and 3. under "Writing to Learn" at the end of each chapter, write a response to one question you would like to discuss.

**3. Presentation of Mathematical warm-ups (Outcomes: 2,3,6,7)**
***10 points/Criteria: Completed with objectives, extensions, and assessment.***

STs will be asked to lead class in a warm-up activity that they expect to use in their grade level classroom. These warm-ups should be hands on and model best practices. Students will be asked to verbally state objectives, extensions and assessments for warm-ups, as well as provide a written handout/plan to the teacher indicating an objective, materials, assessment, procedure and resource for the idea.

Sign ups for warm ups will be posted on Blackboard, and, once a particular warm up is posted, it is then "off limits" to the rest of the class.

**4. Error Packet (Outcomes: 2,7)**
***5 Points/Criteria: Completed packet***
STs will complete an error packet. This includes a write up of errors and ideas of helping correct errors. The purpose of this assignment is to find patterns of student errors and to think of strategies that will get to the root of the errors and possibly remediate misconceptions.

**5. Female Mathematicians and Mathematicians of Color (Outcome: 3)**
**10** ***Points/Criteria:***
***6 pts: All information posted by due date.***
***4 pts: Responses made to at least four others***

STs will choose a female mathematician or mathematician of color and learn about this person's background and contributions to mathematics by exploring internet sites. They will post some interesting facts about what they learned on the Blackboard site for others to read as well as list the url source. At a minimum, the following information should be addressed: (a) A brief background of your mathematician i.e. historical context, family, education; (b) A photo, if possible; (c) What your mathematician is best known for; (d) Obstacles that had to be overcome by your mathematician; and (e) Comparison of the mathematician's journey to personal experience. Each person must respond to at least four other postings. (Once a mathematician has been posted on Bb, that person is "taken.")

When replying to a discussion thread, please keep these criteria in mind:

| **Criteria** | **Description** |
|---|---|
| Relevance | Posted response is specific to the concepts discussed in the original message. |
| Extend the Discussion | Response extends the discussion by introducing a new idea or adding to the idea introduced in the original message. |
| Tone | Response is positive and professional. |

Some guidelines for posting:
1. When introducing a new mathematician, be sure to start by clicking "Add New Thread."
2. The subject line is important. When starting a new thread, make sure to create a subject line that includes the information as illustrated in the following example:
   Ex: Sophie Germain (1776-1831) by Karen Higgins
3. When replying to a thread, leave the "re:" portion of the subject line, but feel free to edit the subject line to express how you are extending the conversation.
4. Feel free to reply to more people than required in the assignment.

**6.Observation of and Reflection on a Math Lesson (Outcomes: 1, 2, 5,7)**
***10 Points/Criteria:***

***5 pts. Observation completed in a thoughtful manner***
***5 pts. Reflection completed in a thoughtful manner***

Plan to observe and reflect on a mathematics lesson at the elementary level with a focus on conceptual and procedural knowledge. Use the handout provided in class as a guideline for this assignment.

**7. Mathematics Mini Unit (Outcomes: 1-8)**
***37 Points/Criteria: See scoring guide below***
The students will develop a mathematics unit of instruction on a topic appropriate for a particular grade level. The finished mini unit must have the following elements:

1) **Unit rationale** that discusses relevance to the unit's goals and objectives. Why is the unit appropriate? How will the topic help meet benchmarks and how is it interesting and relevant to the students? Why is it important to study this area of math?
2) **Unit learning targets/goals** that incorporate the "key mathematical ideas" to be understood by the students using the Oregon's Standards and NCTM Principle and Standards. Specific standards should be listed here.
3) An **annotated list of resources** that includes (at a minimum) three on-line websites, two journal articles, and at least one piece of children's literature. Other resources might include textbooks or teacher resource books. **These resources should include both background information related to the mathematics of the lesson and activities.**
4) **Five lessons** related to each other and presented in a sequential order that support the attainment of the unit goals and key mathematical ideas. There must be **at least one lesson for each of the following: use of models, use of technology by students, problem solving, small group or cooperative work, and the use of children's literature.** The unit may also include related art, science, and/or writing lessons.
5) **Each lesson** plan in the unit must include**: a) a learning objective (related to unit goals), b) list of materials/preparation for lesson, c) the beginning/launch (bringing students into the lesson, building of understanding, posing questions, giving directions, setting expectations), d) the activity (what the students will be doing), e) adaptations for varying students' needs, and f) the conclusion (sharing of work/solutions/leaning, discussion of ideas, and/or presentations of findings by students, summary of what was learned). It will also include g) how the students' learning will be assessed.**
6) **Assessment strategies** that focus on student learning and are tied to your topic's learning goals and objectives. This should include the following: (a) the beginning of a pre/post assessment with a minimum of three sample questions; (b) two other assessment strategies, which include at least one formative strategy (to be used during the unit to inform your teaching of the unit); and (c) a justification for why you chose the strategies from (d) and how you will use the information to inform your teaching and/or report to parents/students.
7) You should write **a reflection** discussing what you learned a) about the unit topic, b) about planning and teaching mathematics to children, and c) about this process of writing a unit.
8) Completed mini-units will be posted on Blackboard for others in the class to review and utilize.

| MINI UNIT SCORING GUIDE: 37 Total Points Possible | | |
|---|---|---|
| *Element* | *Criteria* | *Points* |
| Unit rationale & learning goals | Related to key mathematical ideas from NCTM Principles and Standards and the Common Core State Standards in Mathematics | 2-rationale<br>3-learn. goals |
| List of resources | Includes at least 3 websites, 2 journal articles, and children's literature; plus it includes background on topic (mathematics) and activities | 4 |
| Lessons | Includes all types of lessons listed in assignment (At the top of each lesson, please indicate the type(s) of lesson.) | 5 |
| Organization | Includes 1) title page with name of unit, grade level, and your name; 2) unit rationale; 3) learning goals; 4) sequenced lessons; 5) assessment strategies; and 6) the annotated list of resources. | 2 |
| Lesson Plans | All required elements (a-g) listed in assignment are included and demonstrate a well thought out learning activity | 14 |
| Assessment Strategies | All required elements (a-d) carefully thought out. | 4 |
| Reflection | All three questions are thoughtfully addressed with personal connections and examples given | 3 |

**Grading scale**

Grades in the Class will be computed as follows:

95 -- 100 points A
90 – 94.5 points A-
84 – 89.5 points B+
80 – 83.5 points B

Any student who needs an "Incomplete" at the end of the term must confer with the Instructor prior to the last class meeting and arrange a completion schedule. This may be done over email.

**Link to Statement of Expectations for Student Conduct:**
**http://oregonstate.edu/studentconduct/regulations/index.php**

**Statement Regarding Students with Disabilities**

Accommodations are collaborative efforts between students, faculty and Disability Access Services (DAS). Students with accommodations approved through DAS are responsible for contacting the faculty member in charge of the course prior to or during the first week of the term to discuss accommodations. Students who believe they are eligible for accommodations but who have not yet obtained approval through DAS should contact DAS immediately at 541-737-4098.

**Bibliography and Additional Resources:**

Andrini, B. (1998). *Cooperative learning & mathematics, K-8*. San Clemente, CA: Kagan.

Ashlock, R. B. (2002). *Error patterns in computation* (8th ed.). Upper Saddle River, NJ: Pearson.

Boaler, J., & Humphreys, C. (2005). *Connecting mathematical ideas: Middle school video cases to support teaching and learning*. Portsmouth, NH: Heinemann.

Braddon, K. l., Hall, N. J., & Talor, D. (1993). *Math through children's literature: Making the NCTM standards come alive*. Englewood, CO: Teacher Ideas

Press.
Burns, M. (2000). *About teaching mathematics: A k-8 resource*. Sausalito, CA: Math Solutions Publications.
Cohen, E. (1994). *Designing groupwork: Strategies for the heterogeneous classroom*. New York: Teachers College Press.
Fosnot, C. T., & Dolk, M. (2001). *Young mathematicians at work: Constructing multiplication and division*. Portsmouth, NH: Heinemann, www.heinemann.com.
Fosnot, C. T., & Dolk, M. (2001). *Young mathematicians at work: Constructing number sense, addition and subtraction*. Portsmouth, NH: Heinemann.
Fosnot, C. T., & Dolk, M. (2002). *Young mathematicians at work: Constructing fractions, decimals, and percents*. Portsmouth, NH: Heinemann, www.heinemann.com.
Gawronski, J. D. (2005). *Mathematics assessment sampler, Grades 3 -5*. Reston, VA: National Council of Teachers of Mathematics, www.nctm.org
Hankes, J. E., & Fast, G. R. (Eds.). (2002). *Changing the faces of mathematics: Perspectives on IndigenousPpeople of North America*. Reston, VA: National Council of Teachers of Mathematics.
Hiebert, J., Carpenter, T. P., Fennema, E., Fuson, K. C., Wearne, D., Murray, H., et al. (1997). *Making sense: Teaching and learning mathematics with understanding*. Portsmouth, NH: Heinemann.
Higgins, K. M., Price-Stone, D., & McFadden, S. (1997). *Math Warm Ups*. New York: Dale Seymour Publications, 1 800 321-3106.
Kagan, S. (1994). *Cooperative groupwork*. San Clemente, CA: Kagan.
Kamii, C. (1985). *Young children reinvent arithmetic*. New York: Teachers College Press.
Lester Jr., F. K. (Ed.). (2003). *Teaching mathematics through problem solving: Pre-kindergarten-grade 6*. Reston, VA: National Council of Teachers of Mathematics.
McDonald, J. P., Mohr, N., Dichter, A., & McDonald, E. C. (2007). *The power of protocols: An educator's guide to better practice* (2nd ed.). New York: Teacher's College Press.
Morrow, L. J. (Ed.). (1998). *The teaching and learning of algorithms in school mathematics*. Reston, VA: National Council of Teachers of Mathematics.
NCTM (Ed.). (2002). *Changing the faces of mathematics: Perspectives on Latinos*. Reston, VA: National Council of Teachers of Mathematicss.
O'Connell, S. (2007). *Introduction to problem solving: Strategies for the elementary math classroom* (2nd ed.). Portsmouth, NH: Heinemann, www.heinemann.com.
Perl, T. (1978). *Math Equals: Biographies of women mathematicians and related activities*. Reading, MA: Addison-Wesley.
Warren, R. L., & M., T. (1994). *The scientist within you7: Experiments and biographies of distinguished women in science*. Eugene, OR: ACI Publishing.
Warren, R. L., & Thompson, M. (1994). *The scientist within you* (Vol. 2). Eugene, OR: ACI Publishing.

**Websites**

National Council of Teachers of Mathematics: www.nctm.org
Illuminations: www.illuminations.nctm.org
The Math Forum: Internet Mathematics Library: http://mathforum.org/library
The National Library for Virtual Manipulatives (NLVM): http://matti.usu.edu/nlvm/nav/vlibrary.html
Arcytech: http://arcytech.org/java
Math Archives: K-12 Internet Sites: http://archives.math.utk.edu/k12.html
Oregon Council of Teachers of Mathematics (OCTM): http://www.octm.org
Oregon Department of Education (ODE): www.ode.state.or.us

NCTM has two journals, published monthly, which are excellent sources for K-8 teachers: Teaching Children Mathematics and Mathematics Teaching in the Middle School. There is information about these journals and about NCTM on the internet at: www.nctm.org

The Oregon Council of Teachers of Mathematics also publishes a journal: The Oregon Mathematics Teacher (TOMT). This is a wonderful source of activities written by and for Oregon teachers. Information about this organization is on the internet at: www.octm.org

Note: This is just a beginning list of many excellent resources on mathematics. Be sure to keep your own list and add the useful resources you find.

**CLASS SCHEDULE AND DUE DATES (Tentative!!)**

| Class | Topics | To be read/done ahead | Bring to class |
|---|---|---|---|
| Week 1 | Why change<br>Doing mathematics as adult learners<br>Content vs. process<br>Problem centered<br>Differentiated Instruction | Future readings are from the Van de Walle textbook(7th Edition). | *Assignment #1: Mathography will be written in class. |
| Week 2 | Standards<br>Constructivism<br>Number Sense | Chapters 1, 2, 8, 9, 10 | Assignment #2:<br>Reading Logs #1(5)<br>"3-2-1" for each chapter |
| Week 3 | Continue with Number Sense and Place Value | Chapters 11, 12, 13 | *Assignment #3: Warm Ups start(10)<br>* Assignment #5: Post Mathematician's name on Bb |
| Week 4 | Lesson planning<br>Problem solving<br>Managing Classroom Instruction | Chapters 3, 4<br><br>Have classroom visitation arranged | *Assignment #4:<br>Error Packet(5)<br>*Assignment #3: warm ups continue<br>*Assignment #2:<br>Reading Logs #2(5) |
| Week 5 | Measurement<br>Geometry | Chapters 19, 20 | *Assignment #3: warm ups continue<br>*Topic for mini-unit |
| Week 6 | Assessment<br>Error patterns<br>Mathematical Discourse | Chapter5 | *Assignment #3: warm ups continue<br>* Assignment #5: Post information on mathematician |
| Week 7 | Equity<br>Technology | Chapters 12, 13 | *Assignment #2: Reading Logs #3(5)<br>*Assignment #3: warm ups end<br>*One lesson plan |
| Week 8 | Developing Fractions Decimals and percents<br>Proportional reasoning | Chapters 15, 16, 17, 18<br>(no 3-2-1 on chapter 18) | * Assignment #5: Responses to peers' mathematicians' posting due<br>*Assignment #6: Observations due |
| Week 9 | Algebraic Thinking & Logical Reasoning | Chapters 14, 23<br>(no 3-2-1 on chapter 23) | Reading Logs #4(5) |
| Week 10 | Probability<br>Data Analysis | | *Assignment #2:<br>Mini-Unit(37) |