GEORGE MASON UNIVERSITY (GMU)
COLLEGE OF EDUCATION AND HUMAN DEVELOPMENT (CEHD)
ELEMENTARY, LITERACY AND SECONDARY EDUCATION

EDPD502.6R1: Teaching Patterns, Functions, and Algebraic Thinking in Grades K-2

Summer, 2016
June 22 and July 1 at 12:30-3:30
June 24, 28, and 30 at 8:30-11:30
PWCS Independent Hill Complex, Old Admin. Building, Room 203 A&B

Instructor:	*Karen Mirkovich*	**Instructor:**	*Laura Oyhenart*
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Course Description:

This course focuses on deepening teachers' content knowledge, understanding of students' mathematical learning, and instructional strategies for teaching patterns, functions, and algebraic thinking in grades K-2nd. The use of manipulatives, technology, and active learning strategies will be emphasized. The instructors will make connections to lessons reflecting best practices and current research in mathematics.

Course Purpose and Intended Audience:

The primary focus of this course is to increase both the teachers' content knowledge in the area of patterns, functions, and algebraic thinking, and the pedagogical background needed to teach these concepts effectively in an inquiry-based mathematics classroom.

Course Format:

Class meetings will be structured for maximum teacher participation. Each class will include discussions of mathematical topics and readings. The focus of the mathematical content will be based on current research in mathematics. Activities and lessons supporting these concepts will be modeled, practiced, and discussed. After each class, teachers will reflect on their learning through writing reflections, solving mathematical problems, developing assessments and researching technology resources that will provide more rigor to their algebra lessons.

Course Objectives:

- Teachers will increase their own content knowledge of the mathematics they teach at the elementary level.
- Teachers will learn strategies to enhance student understanding of patterns, functions, and algebraic thinking.
- Teachers will integrate technology to expand student understanding.
- Teachers will focus their attention on strategies students use to solve problems.
- Teachers will shift their focus from teacher centered to student centered.

Required and Supplemental Texts and Readings:

Required Texts:
Algebra and the Elementary Classroom; Transforming Thinking and Practice, Maria Blanton. Heinemann, 2011.

Supplemental Readings:

Differentiating in Algebra; Pre-K - Grade 2, Jennifer Taylor-Cox, Heinemann, 2008.

Navigating Through Algebra in Grades K-2, NCTM, 2001.

Lessons for Algebraic Thinking, K-2nd, Rotz & Burns, Math Solutions Publications, 2002.

Selected articles pertaining to early mathematics acquisition and instruction from a variety of sources including: *Teaching Children Mathematics.*

Class Requirements, Performance-Based Assessments, Evaluation Criteria, and Grading Scale:

1. **Attendance and Class Participation**: (10%) Attend and participate in all class sessions. Absences will be reflected in the course grade.
    a. We have much to offer and learn from one another; therefore, active and respectful participation of all class members is crucial to the success of this course. Class discussion and activities cannot be reproduced.
    b. Attendance is very important. Participants in this class must be in attendance and on time for the entire class session in order to contribute to each session. *Missing one class will result in a grade no better than a B. Failure to attend more than one class will result in a grade no better than a C.*
    c. Complete all readings for class discussions and participate in all discussions and activities.
    d. Mathematics problems will be posed during class. Students will need to complete some problems outside of class.

2. **Reflection Based Upon Readings**: (15%) *This reflection will be emailed to the instructors as well as printed out and brought to the <u>third</u> class session.*
    - Read and respond to three reading assignments in a two-page paper.
    - The reflection will include: relevance to the teacher's professional growth and possible changes in student behavior and mathematical growth that might occur if ideas in the readings are implemented.
    - All points in the reflection must be supported informally by references from the readings. Activities are to be explored independently and noted as part of the reflections.
        i. At least two pages (no more than three) double spaced
        ii. Margins should be no wider than 1 inch
        iii. Use Times New Roman 12 point font

3. **Teacher Share Technology Project: (**20%**)** *This technology project will be emailed to both instructors as well as printed out and brought to the fourth class session. Bring enough copies for all class members.*

Create a technology-focused newsletter to help other educators become familiar with a specific on-line source of algebraic information. This newsletter should provide teachers with sources to deepen their own knowledge, practices, and lesson design in the areas of patterns, functions, and algebraic thinking. The focus should be on what *teachers* can get from chosen materials as well as how the materials can help support student development in these areas. Projects will be shared in small groups. A separate project format sheet will be provided by the instructors and projects must follow this format.

4. **Teacher Created Assessment:** (15%) *This assessment will be emailed to both instructors as well as printed out and brought to the fifth class session.*

Create an open-ended, problem-based assessment which will be used to assess the student knowledge of the specific algebraic objectives. The assessment will be designed as part of a lesson provided by the class instructors. Assessments will be shared in small groups.

5. **Teacher Created Rubric:** (15%) *This assignment will be emailed to both instructors as well as printed out and brought to the fifth class session.*

Create a rubric that aligns specifically and directly with the teacher created assessment listed above. (Assignment # 4). The rubric will provide a scoring tool for this assessment and will be designed as part of the lesson assigned by the class instructors. Included with the rubric will be a short written plan detailing the next steps in instruction for those students that achieve mastery and those that do not. Rubrics and next steps will be shared in small groups.

6. **Final Course Reflection:** (25%) *This reflection will be emailed to both instructors no later than 5 p.m. on the Friday after the last class (July 3).*

Complete a three-page course reflection describing what you have learned from this course and how your instruction will be impacted in the future. Compare and contrast how you were previously teaching patterns, functions, and algebraic thinking concepts to how you will teach them now. Include at least one concrete way you plan to incorporate these ideas into your instruction. Your reflection should also include how you will apply one of the technology ideas learned from a teacher share project. *This paper will take the place of an end-of-class exam.*

Formula for Grading:

**University graduate courses expect a minimum commitment of two hours of out of class work for each hour spent in class.*

Expectations for all assignments are as follows:

- All work shows evidence of thinking, understanding, and reflective thought.
- All work should be in final form and must reflect graduate level standards.
- All work is due on the assigned class date by the start of the class session or as described in the syllabus.
- All work should be emailed to **both** instructors and a paper copy should be turned in at class time.
- Late work will not receive full credit.

A (90% - 100%)	**C** (70% - 79%)
B (80% – 89%)	**F** (below 70%)

Late Assignments:

- Late assignments will only be accepted the class session following the one where the assignment was due.
- Late assignments will not receive full credit and will be penalized by at least one complete grade.
- Final assignments must be turned in to an instructor by 5 p.m. on Friday, July 4th.
- In case of a class cancellation due to inclement weather or any other unscheduled event, all assignment due dates will be moved forward one class period.

COLLEGE OF EDUCATION AND HUMAN DEVELOPMENT STATEMENT OF EXPECTATIONS:

The Graduate School of Education (GSE) expects that all students abide by the following:

Students are expected to exhibit professional behavior and dispositions. See gse.gmu.edu for a listing of these dispositions.

Students must follow the guidelines of the University Honor Code. See http://www.gmu.edu/catalog/apolicies/#TOC_H12 for the full honor code.

Students must agree to abide by the university policy for Responsible Use of Computing. See http://mail.gmu.edu and click on Responsible Use of Computing at the bottom of the screen.

Students with disabilities who seek accommodations in a course must be registered with the GMU Disability Resource Center (DRC) and inform the instructor, in writing, at the beginning of the semester. See www.gmu.edu/student/drc or call 703-993-2474 to access the DRC.

Teaching Patterns, Functions, and Algebraic Thinking in Grades K-2

Class	Date	Topic	Readings/Assignments** **<u>**due for the following class</u>**
1	6/22/16 **12:30- 3:30**	**<u>Course Overview:</u>** ▪ Review of syllabus ▪ Explanation of assignments and due dates **<u>Lesson Focus:</u>** ▪ Repeating Patterns ▪ Growth patterns ▪ Describing change **<u>Other:</u>** Course registration form	**Readings:** Text: *Algebra and the Elementary Classroom, (*Blanton) Chapter 1 Article: *Algebra in the Early Years? Yes!* (Taylor-Cox) **Mathematics Problem**: Create a new *Table Problem* using either a hexagon or a triangle, OR describe the toothpick problems in two different ways.
2	6/24/16 **8:30- 11:30**	**<u>Lesson Focus:</u>** ▪ Functional vs. recursive thinking ▪ Functions and change over time ▪ Modeling algebraic expressions	**Readings:** Text: *Algebra and the Elementary Classroom* (Blanton), Chapter 6, pp. 93-105. Article: *An Algebraic-Habits-of-Mind Perspective on Elementary School* (TCM) **Mathematics Problem:** Go to <u>http://mathclips.ca/index.html?cluster=4</u> and choose "Linear Growing Patterns". Do module 2.1 and then create your own *pictorial representation.* Build the first 4 stages. Then use the *pattern rule* to determine stage 10, 25, and 75. **Paper:** Reflection based on readings and in-class tasks
3	6/28/16 **8:30- 11:30**	**<u>Lesson Focus:</u>** ▪ Attributes ▪ Rules and generalizations ▪ Properties	**Readings:** Article: *Mathematical Conversations to Transform Algebra Class (with Blanton question sheet)* Article: *Is it a Pattern?* (TCM) **Mathematics Problems**: *Operating with Odd and Even Numbers*, problem #1 *(handout) or Attributes Classification of Shapes - Level 6.* **Project:** Teacher Share Technology project (bring a class set of copies to class for distribution)

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<td>4</td>
<td>6/30/16

8:30-
11:30</td>
<td><u>Lesson Focus</u>:

▪ Algebraic thinking and representations
▪ Equality, equivalence, and constant difference
▪ Tools for developing equivalency

<u>Collaborative Learning:</u>

Share teacher technology projects</td>
<td>Readings:

Article: Children's Understanding of Equality: A Foundation for Algebra (TCM)

Article: Using Technology to Balance Algebraic Explorations (TCM)

Mathematics Problem: Using Your (Number) Sense of Balance (TCM)—problem #1 (handout)

Lesson Project: Teacher created assessment and rubric</td>
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<td>5</td>
<td>7/01/16

12:30-
3:30</td>
<td><u>Lesson Focus:</u>

▪ Variables
▪ Algebra Mats
▪ Final thoughts

<u>Collaborative Learning:</u>

Share lesson plans and assessments/rubrics

<u>Class evaluations</u></td>
<td>Final Course Reflection due by 5 p.m. on Monday, July 4.

Send an electronic copy to both instructors.</td>
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<td>N/A</td>
<td>7/04/16</td>
<td colspan="2">All assignments are due to <u>both</u> instructors by 5 p.m. Final feedback and grades from instructors will be delivered by email. Official GMU grades may not be posted to transcripts until the end of the summer. <u>Please refer to the instruction sheet provided at the first class.</u> Instructors cannot access transcripts or GMU records.</td>
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ASSIGNMENT RUBRIC

CRITERIA:	**No Evidence** **F**	**Beginning** **C**	**Developing** **B**	**Accomplished** **A**
Depth of reflection by the teacher regarding their professional growth in algebraic thinking.	No evidence of reflections on professional growth regarding algebraic thinking.	Minimal evidence of reflections on professional growth regarding algebraic thinking.	Some evidence of reflections on professional growth regarding algebraic thinking.	Significant evidence of reflections on professional growth regarding algebraic thinking.
Depth of reflection on possible changes in student algebraic thinking.	No evidence of reflective thought about changes in student algebraic thinking.	Minimal evidence of reflective thought about changes in student algebraic thinking.	Some evidence of reflective thought about changes in student algebraic thinking.	Significant evidence of reflective thought about changes in student algebraic thinking.
Depth of knowledge of effective instructional strategies for algebraic thinking.	No evidence of effective instructional strategies.	Minimal evidence of effective instructional strategies.	Some evidence of effective instructional strategies.	Significant evidence of effective instructional strategies.
Depth of pedagogical shift towards student-centered vs. teacher-centered instruction of algebraic problem solving.	No evidence of pedagogical shift towards student-centered algebraic problem solving.	Minimal evidence of pedagogical shift towards student-centered algebraic problem solving.	Some evidence of pedagogical shift towards student-centered algebraic problem solving.	Significant evidence of pedagogical shift towards student-centered algebraic problem solving.