Math 603 Research & Practice – Geometry

Catalog description: In this course we explore: geometry, measurement, and probability at the Middle Childhood/Early Adolescence level as defined in the *Common Core State Standards for Mathematics*; best practices and methodologies for teaching this content; and relevant research in teaching and learning mathematics. A fifteen-hour practicum is required. (Prerequisite: Math 602 with a grade of C or above.)

Student will demonstrate each of the following capacities.

Regarding professional standards:

- For each of the six Wisconsin Guiding Principles for Teaching and Learning, give a research-based justification of the significance of the principle and several scenarios illustrating effective practice of the principle in action in a mathematics classroom.
- For any given activity, lesson, or collection of lessons, identify and justify, in accordance with *Common Core State Standards for Mathematics*, all domains and specific standards addressed.
- For any given activity, lesson, or collection of lessons, identify and analyze ways in which learners can be supported in developing proficiency with the Standards for Mathematical Practice as stated in *Common Core State Standards for Mathematics*.
- State each of the six NCTM Principles and the ten content and process Standards.

Regarding mathematics education research:

- Articulate an understanding of what research tells us about the current state of children's mathematical knowledge in the United States.
- Be able to discuss the implications of various learning theories for the design of mathematics instruction.
- Relate the work of major theorists (e.g. Piaget, Vygotsky, Bruner, van Hiele) to mathematics curriculum and classroom practice.

Regarding pedagogical practice:

- Articulate basic structure of a lesson plan and explore a specific type (Review-Teach-Practice, Investigate/Problem-Based, or Direct Instruction)
- Articulate learning objectives using the language of Bloom's taxonomy.
- Articulate the van Hiele level of understanding supported by a given learning activity and recommend subsequent activities designed to move the learner to the next level.
- Construct (original or based on materials explored within the course) classroom activities around a variety of different types of goals: concept introduction, exploration, reinforcement and generalization.
- Design problems that assess a given geometric concept.
- Identify topics that exhibit the interconnectedness of algebra and geometry.

Within geometric concepts:

- Describe two- and three-dimensional geometric objects by: naming them; comparing, sorting and classifying; drawing and constructing physical models to specifications; identifying properties (such as isosceles, parallel sides, or rotational symmetry).
- Identify three-dimensional shapes from two-dimensional perspectives and draw two dimensional sketches of three-dimensional objects that suggest depth perspective accurately.
- Compare objects and components of objects for qualities such as adjacent, interior, parallel, and perpendicular; and, in the case of two-dimensional objects only, region of intersection.
- Identify symmetry, congruence, and similarity through use of physical materials and motion geometry (slides, flips, and turns). Use appropriate tools to perform common transformations on two-dimensional figures and describe and analyze the effects of such transformations. Use transformations to develop patterns.
- Solve problems using geometric objects and spatial reasoning to visualize, represent, and solve. This may include use of transformations.
- Locate and represent objects on a rectangular coordinate system.
- Evaluate others reasoning and solutions for correctness.
- Recommend ways that teachers may anticipate and work to prevent common geometric misconceptions. Recommend ways that teachers may address such misconceptions, once they have occurred.

Within measurement concepts:

- Describe measurable attributes such as length, liquid capacity, time, weight, temperature, volume, angle size; and use appropriate tools and units to measure them.

- Use arbitrary and standard units (metric and US Customary) to describe quantities; convert units within a system (*e.g.*, miles to inches); convert units between systems (*e.g.*, meters to inches). Demonstrate understanding that direct measurement produces approximate, not exact results and use smaller units to determine more precise results.
- Identify and describe attributes in situations where they are not easily measurable; such as distance or area of an irregular figure.
- Determine measurements indirectly using each of the following: estimation, conversion of units, ratio and proportion (*e.g.*, similarity and scaling), geometric relationships and properties for angle size (*e.g.*, sum of angles in a triangle), Pythagorean relationship.
- Evaluate the reasonableness of an obtained measurement.
- Recommend ways that teachers may anticipate and work to prevent common misconceptions regarding measurement. Recommend ways that teachers may address such misconceptions, once they have occurred.

Within statistics concepts:

- Describe the nature of the attribute under investigation, including how it was measured and its units of measurement. Summarize distributions by displaying numerical data in plots on a number line, including dot plots, histograms, and box plots.
- Give quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation).
- Use data from a random sample to draw inferences about a population with an unknown characteristic of interest.
- Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations.
- Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities.
- Use equations and graphs of lines to model linear relationships between two quantitative variables. Informally fit a straight line to a scatterplot, and informally assess the model fit by judging the closeness of the data points to the line. Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.

Within probability concepts:

- Demonstrate understanding that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring.
- Approximate the probability of a chance event by collecting data, observing long-run relative frequency, and predicting the approximate relative frequency given the probability.
- Develop a uniform probability model by assigning equal probability to all outcomes, and use the model to determine probabilities of events.
- Develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process.
- Represent sample spaces for compound events using methods such as organized lists, tables and tree diagrams; and find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.

Approved: April 2014