General Education Course Proposal & Assessment Plan

For GERC's use only:

Course:	**EDMT 2271**	GERC approved Course?	**APPROVED**	Date:	**10/25/2022**
Objective #:	**3**	GERC approved AssessPlan?	**APPROVED**	Date:	**10/10/2023**
Catalog Year	**2023-24**	UCC approved Course?		Date:	
		Provost approved Course?		Date:	
Course Title:	**Teaching K-8 Mathematics I** **[equivalent to MATH 2257]**				
Department:	**Teaching and Educational Studies**				
College:	**Education**				
GERC Rec'd	**10/12/2022**	Processed Date:	**10/18/2022**	GERC Agenda	**10/25/2022**
UCC Proposal Required?	**Yes**	UCC Proposal Submitted:		UCC Proposal Number	**UCC 2023-24 Proposal #84**
CHANGES Made by Dept? Date:		RESUBMITTED to GERC:		GERC Decision:	

PART A: Signature Page

College and Department: College of Education, Teaching and Educational Studies

Course number and title: EDMT 2271 Teaching K-8 Mathematics II

General Education Objective: 3, Mathematical Ways of Knowing

Is this a new course being proposed to UCC? Yes

Submitter name and email address: Cory Bennett, corybennett@isu.edu

Signatures:

_________________________ _10-12-2022______
Department Chair's Signature Date

_________________________ _10-12-2022
Dean's Signature Date

Official versions of approved assessment plans will reside in the GERC online repository where they will be accessible for view by all ISU faculty and staff, and open to suggestions and comments by originating department chairs and their designees. (Suggest/Comment access can be arranged by contacting gercmail@isu.edu.)

- ***Small changes** to specific instruments or processes within the spirit of the original plan do not require modification of the original plan or GERC approval.*

- ***Significant changes*** *to the assessment schedule, the type of instruments employed, or the selection of learning outcomes addressed* <u>*need to be reviewed by GERC*</u>*. To request this review, departments should use "Suggesting" mode to propose changes in the online document, and indicate on the annual reporting form that changes have been entered.*

PART B: General Information

1. Catalog Description (including credit total)

Investigations of mathematics topics that focus on geometry, measurement, proportional thinking, and statistical reasoning. Emphasis on problem solving, the use of manipulatives and computing technologies, remediation, assessment and resource materials, and optimal pedagogical techniques that help students learn quality mathematics. 3 credits.

2. Provide a brief description of the course including information about format, typical audience, subject matter, texts/resources, and student activities.

As supported by leading organizations in mathematics teaching and learning for K-12 contexts (Association of Mathematics Teacher Educators, 2017; National Council of Teaching Mathematics, 2014) and the research on developing mathematics teachers (i.e. Thames & Ball, 2010), a robust knowledge of the mathematics content being taught, along with appropriate pedagogies to support the learning of mathematics, is foundational to the success of new/early career teachers of mathematics (k-8). This kind of knowledge, the mathematical knowledge for teaching/pedagogical content knowledge (Hill et al., 2008), is also needed to understand the progression of learning for children; teachers need to know how mathematics is connected not only within but between grades (CBMS, 2012). This means courses that prepare elementary and middle school teachers of mathematics should focus on simultaneously developing teacher candidates' content knowledge and the instructional approaches for teaching this content.

This course is designed for students to learn about the teaching and learning of mathematics while also learning fundamental structures of mathematics, how to communicate mathematically, and how to attend to the logic and reasoning of the data and/or mathematics to create meaning to real world contexts. Mathematical topics include 2-D and 3-D geometric relationships including such things as geometric congruence and similarity, proportional reasoning, data analysis and statistical thinking, as well as probability. Pedagogical topics would include modeling and using various representations, leveraging mathematical discourse, using different instructional technologies to support learning, understanding school standards in mathematics, and supporting diverse learners.

Learning activities will center on such things as, but not limited to, problem solving, engaging in a community of mathematical learners, and exploring how manipulatives and other representations support mathematical thinking. This course, along with the second course proposal that represents the second part of the content and mathematical progression, focuses on accomplishing these goals as no such course currently exists at ISU.

This course is open to all students as it will help them better understand and consider the role schools play in our community. This course allows community members to learn more about the teaching and learning of mathematics while also learning fundamental structures of mathematics, how to communicate mathematically, and how to attend to the logic and reasoning of the data and/or mathematics to create meaning to real world contexts.

This course would be offered every spring semester and would likely be available face to face and synchronously or through some blended, hyflex modality to allow for greater participation regardless of students' location.

Resources will be updated as needed but may include such things as:
National Council of Teachers of Mathematics resources, https://www.nctm.org/
National Library of Virtual Maniputlatives, http://nlvm.usu.edu/en/nav/vlibrary.html
Math for Elementary Teachers, Custom Edition, Long, DeTemple and Millman. Activities for Elementary Teachers, 6th Edition, Dolan, Williamson and Muri.
Van de Walle, John A; Karp, Karen S.; Bay-Williams, Jennifer M: *Elementary and Middle School Mathematics, Teaching Developmentally* (*10th* ed.). Pearson Ed, 2019.
Youcubed, https://www.youcubed.org/

References

Association of Mathematics Teacher Educators. (2017). *Standards for preparing teachers of mathematics.* AMTE.

Boaler, J. (2015). *What's math got to do with it?: How teachers and parents can transform mathematics learning and inspire success*. Penguin.

Conference board of the mathematical sciences. (2012). *The mathematical education of teachers II.* American Mathematical Society and the Mathematical Association of America.

Hill, H. C., Ball, D. L., & Schilling, S. G. (2008). Unpacking pedagogical content knowledge: Conceptualizing and measuring teachers' topic-specific knowledge of students. *Journal for research in mathematics education*, *39*(4), 372-400.

Martin, D. B. (2018). Mathematics learning and participation as racialized forms of experience: African American parents speak on the struggle for mathematics literacy. In *Urban Parents' Perspectives on Children's Mathematics Learning and Issues of Equity in Mathematics Education* (pp. 197-229). Routledge.

National Council of Teachers of Mathematics. (2014). P*rinciples to action. Ensuring mathematical success for all.* NCTM.

Thames, M. H. & Ball, D. L. (2010). What mathematical knowledge does teaching require? Knowing mathematics in and for teaching. *Teaching Children Mathematics*, *17*(4), 220–225.

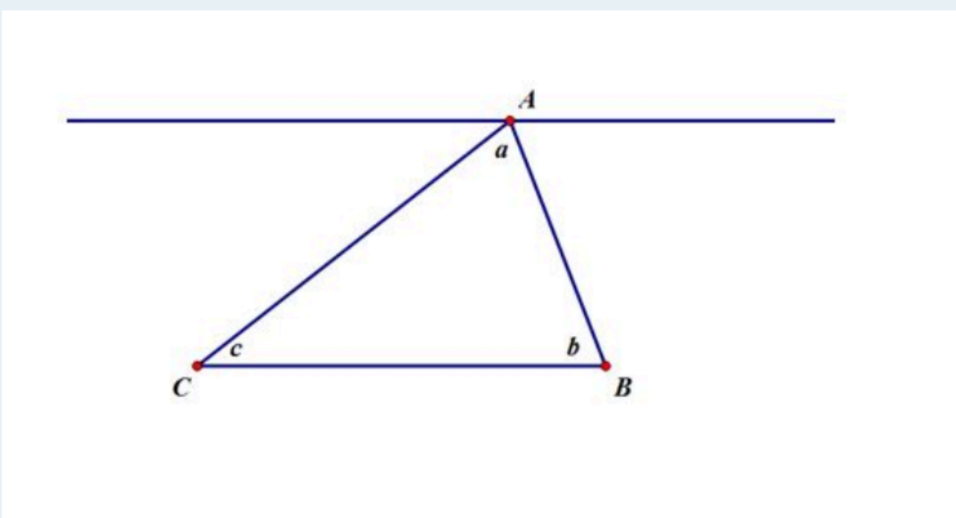
Vukovic, R. K., Roberts, S. O., & Green Wright, L. (2013). From parental involvement to children's mathematical performance: The role of mathematics anxiety. *Early Education & Development*, *24*(4), 446-467.

3. Describe how the proposed course helps students to achieve each of the **defined student learning outcomes** for this objective (please see Appendix below). Provide specific examples of course content and student activities for each of the gen ed learning outcomes that the course intends to address. Demonstrate rigor appropriate to a general education course.

i) Read, interpret, and communicate mathematical concepts.

One way this would be accomplished would be engaging in small group projects or problem solving activities as this helps develop reasoning and sense making through communication. An example of this would be to understand how different measures of center (central tendency) might be used to understand what is going on in the mathematics and how different measures of center might be better to describe certain scenarios or contexts. Or, by attending to the mathematical relationships within plane figures (see example below) students can better describe and explain key concepts that begin within elementary grades (i.e. “all triangles have 180 degrees for the sum of their interior angles”).

Use the triangle below to prove that the sum of the interior angles of a triangle is 180^{o}. Explain why your mathematics is correct.



In essence, by engaging in mathematical discourse that accentuates the differences in the mathematics, along with how K-8 students might interpret this information, students can better understand the nuances in the concepts and how to approach teaching this.

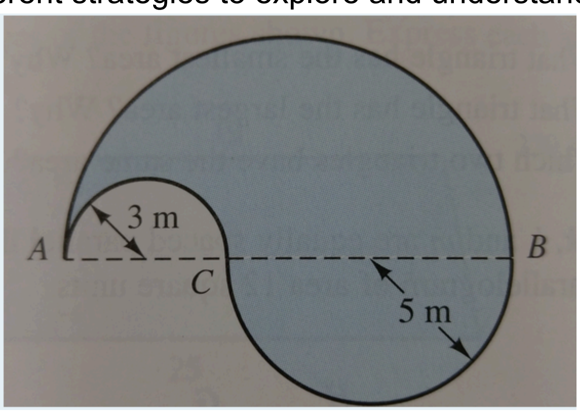
(ii) Represent and interpret information/data.
Using varied representations is central to learning and doing mathematics. As such, this course will include discussions on how different representations support mathematical knowledge, especially since a major focus is on data and statistics. An example might include interpreting a data set like the one listed in the question below which asks them to use different Measures of Central Tendency (MCT) and the Mean Absolute Deviation (MAD) describe the scenario.

Here are the class scores from a recent exam. Describe this data mathematically using at least two different MCTs, the MAD, and the range. Then, provide an explanation of what your calculations tells us; that is, what is your interpretation of this data

79	78	79	65	95	77	49
91	63	58	78	96	74	68
71	86	91	94	79	69	86
62	78	77	88	67	78	84
69	53	79	75	64	89	77

(iii) Select, execute and explain appropriate strategies/procedures when solving mathematical problems.

Problem solving is both a means of learning mathematics and the medium in which mathematics lives; it is simultaneously a process and an outcome. As such, problem solving activities will be central to this course as learning how to think and behave as a student mathematician develop a repertoire of strategies to approach and explain mathematics. An example might be something like question below that allow for different strategies to explore and understand the mathematics:



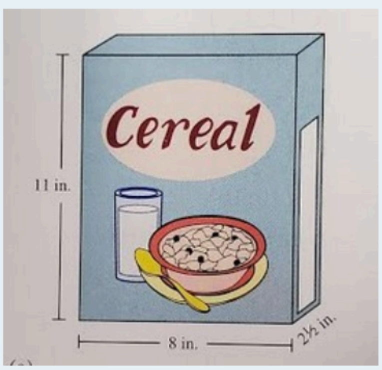
(iv) Apply quantitative reasoning to draw and support appropriate conclusions.
Given the emphasis on doing and communicating mathematics as well as developing mathematical knowledge for teaching, this course relies heavily on applying mathematical reasoning to make appropriate conclusions about learning within a school context. As an example, students will be given tools and representations of

mathematical ideas that might be explored in elementary grades and be asked to consider the mathematics involved within the representation.

The following “building” is made up of 12 blocks. Including the bottom, what is the total surface area?

Another example uses more real world contexts and thus leverages the mathematics to explore and answer the question understudy.

Below is an image of a cereal box. Determine if a box can be made with a rectangular piece of cardboard that is 21 inches by 15 inches?



PART C: General Education Course Assessment Plan *[11/2: ready for GERC’s review]*

1. When will each targeted learning outcome of the objective be assessed?

   Student learning outcomes are assessed informally and formally throughout the semester on a rotating basis. One learning outcome will be assessed each semester, based on when they are offered (i.e. fall, spring or summer) with all four learning outcomes being assessed over the course of four years. Informally, learning outcomes will be assessed through class discussions, weekly assignments, and other performance assessments such as problem solving projects.

2. What direct and indirect instruments will be used? Describe the type of materials that will be collected, as well as any procedures involved in selecting a representative sample of student work for review and/or retention. (Materials should be retained according to procedures outlined by Academic Affairs.)

Direct instruments: Quizzes and exams will be the primary/direct instruments used and student work samples, which will be randomly selected and which will represent 10% of total number of students in the class, will be collected and analyzed. Please see Appendix C for specific examples of the assessment questions that would be typical within quizzes and exams. Also, Appendix A indicates which instruments align with each outcome of Objective 3. Indirect instruments will include course syllabi from all instructors.

3. Explain how assessment instruments will be used to evaluate achievement of each of the general education learning outcomes. Include **specific examples** of exam questions, writing prompts, or project descriptions that could yield student work demonstrating **each outcome**, and describe the process, criteria, and/or rubrics that would be used to assess the achievement of each learning outcome with those instruments. (Examples are provided on GERC's web page.)

Performance samples will be collected randomly using accepted sampling techniques from student quizzes and exams to allow the committee to determine if the assessment instruments are accurately measuring student performance on the stated objectives. See Appendix C for sample questions and Appendix B for the rubric used to determine adequate minimum achievement.

4. What threshold of performance do you define as adequate achievement of a learning outcome, and what quantitative results will ultimately be tabulated?

A score in the Meets category of the rubric provided (See Appendix B) or higher will be considered the minimum threshold for adequate achievement for learning outcomes. Student scores on quizzes and exams will be the quantitative results to determine levels of adequate achievement.

5. What is the process within the department for reviewing and interpreting those results and translating findings into curriculum changes or refinements to the assessment process?

As part of the review process for each objective, the assessment instruments will be presented to the program review committee for review and discussion. The program review committee will consist of mathematics education faculty and the department chair of Teaching and Educational Studies within the College of Education. This group will review results and will recommend changes to instruments, questions, or methods for analyzing data as necessary.

6. Additional comments or clarifications.

Appendix: General Education Learning Outcomes

Appendix A
Learning Outcome Assessment Instruments

General Education Learning Outcomes	Assignments through which students will demonstrate the General Education Learning Outcome
Read, interpret, and communicate mathematical concepts.	• Quiz 1 – Geometric Figures (angles, lines, segments) • Quiz 2 – Measurement systems, deriving formulas, Pythagorean Theorem • Quiz 3 – Transformations, rigid motions, congruence • Quiz 4 – Measures of Central Tendency, probability • Final Exam
Represent and interpret information/data	• Quiz 3 – Transformations, rigid motions, congruence • Quiz 4 – Measures of Central Tendency, probability • Final Exam
Select, execute and explain appropriate strategies/procedures when solving mathematical problems.	• Quiz 1 – Geometric Figures (angles, lines, segments) • Quiz 2 – Measurement systems, deriving formulas, Pythagorean Theorem • Quiz 4 – Measures of Central Tendency, probability • Final Exam
Apply quantitative reasoning to draw and support appropriate conclusions.	• Quiz 2 – Measurement systems, deriving formulas, Pythagorean Theorem • Quiz 3 – Transformations, rigid motions, congruence • Quiz 4 – Measures of Central Tendency, probability • Final Exam

Appendix B

Course Assessment Rubric

	Exceeds End-of-Course Expectations	Meets End-of-Course Expectations	Entry-Level Expectations
1. Read, interpret, and communicate mathematical concepts.	Demonstrates ability to extend course concepts to new contexts. Demonstrates the ability to interpret and apply abstractions. Understands and correctly utilizes appropriate mathematical language in new contexts.	Demonstrates ability to read, interpret, and communicate the course concepts. Understands the use of abstractions related to course material. Understands and correctly utilizes appropriate mathematical language.	Demonstrates understanding of concepts relating to appropriate pre-requisite material.
2. Represent and interpret information/data.	Appropriately represents data or information graphically and/or functionally. Draw valid conclusions from analysis. Predict consequences, trends, or patterns.	Appropriately represents data or information graphically and/or functionally. Draw valid conclusions from analysis.	Demonstrates a general understanding of graphs and/or tables.
3. Select, execute and explain appropriate strategies/procedures when solving mathematical problems.	Student can select the appropriate strategy in a generalized problem. Process is internalized. Student can justify why the process is used.	Student can select appropriate strategy. Process is performed correctly without assistance. Student can write down steps.	Student can follow an argument as to which strategy is chosen. Process is performed correctly with assistance. Student can follow steps.

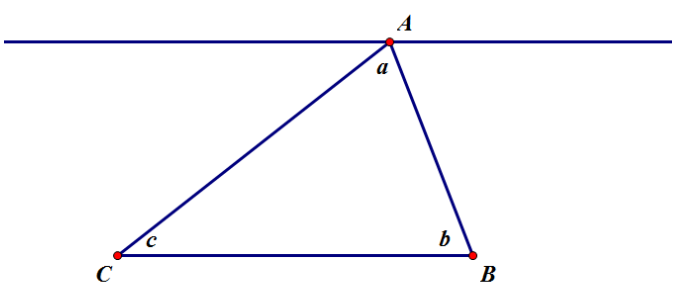
4. Apply quantitative reasoning to draw appropriate conclusions and support them.	Uses appropriate methods to check the solution and recognize that it is reasonable. Demonstrates that the conclusion correctly addresses the initial problem. Explains the problem, process and conclusions to others. Recognize the limitations of the methods and the conclusions. Recognize patterns within a problem that can be applied to other situations.	Uses appropriate methods to check the solution and recognize that it is reasonable. Demonstrates that the conclusion correctly addresses the initial problem. Explains the problem, process and conclusions to others.	Uses appropriate methods to check the solution and recognize that it is reasonable.

Appendix C

Sample Assessment Items

Example for Learning Outcome 1, 3 and 4

1. Use the triangle below to prove that the sum of the interior angles of a triangle is 180º. Explain why your mathematics is correct.

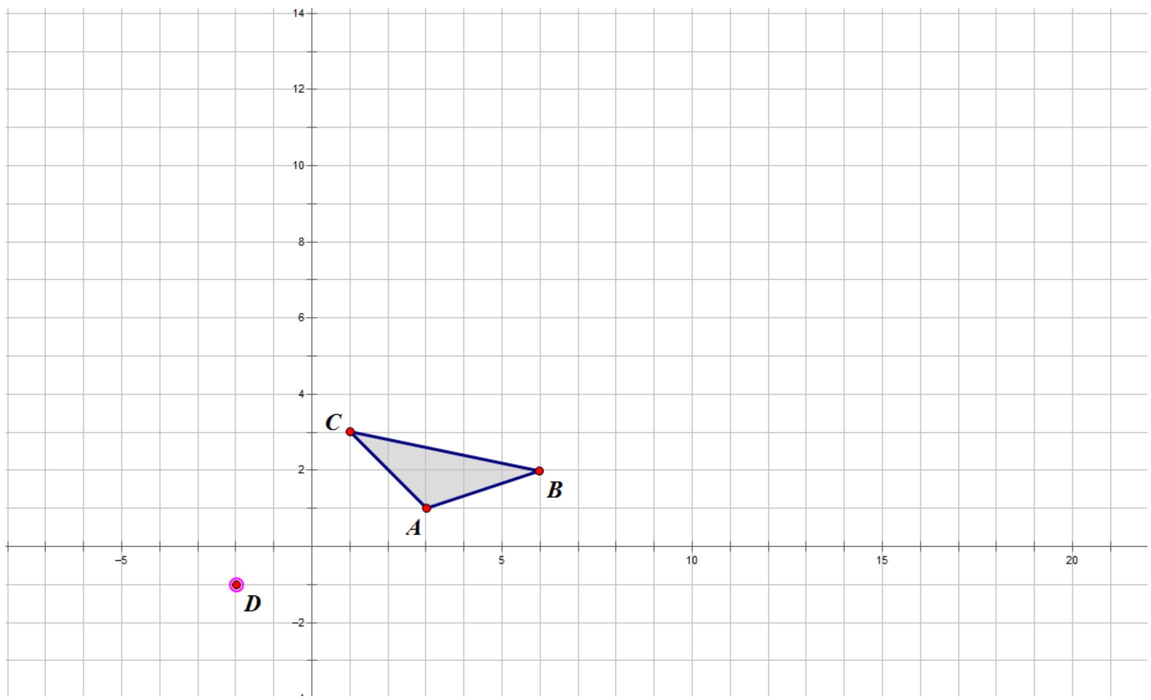


Example for Learning Outcome 1

2. Given the pentagon below, what are the angle measure of x?

Example for Learning Outcome 2 and 4

3. Dilate triangle *ABC* with a scale factor of 2, with point D as the Center of dilation. Then determine the area of the dilated triangle (the image).



Example for Learning Outcome 1, 2, 3, and 4

4. The following table shows the heights in feet of the 8 tallest buildings in St. Louis, Missouri and in Los Angeles, California. Use at least two different measures of central tendency, the range, and the mean absolute deviation to describe this data set and to support your interpretations.

Los Angeles	St. Louis
858	593
750	588
735	540

699	434
625	420
620	398
578	392
571	375

Example for Learning Outcome 4

5. For which transformations will parallel lines remain parallel? (circle all correct answers)?

A. Translation B. Reflection C. Rotation D. Dilation

Example for Learning Outcome 4

6. For which transformations will the orientation of a triangle change? (circle all correct answers)?

A. Translation B. Reflection C. Rotation D. Dilation

Example for Learning Outcome 4

7. For which transformations will distances between points change? (circle all correct answers)?

A. Translation B. Reflection C. Rotation D. Dilation

Example for Learning Outcome 4

8. For which transformations will angle measures remain the same? (circle all correct answers)?

A. Translation B. Reflection C. Rotation D. Dilation

Example for Learning Outcome 1, 2, 3, and 4

9. Your friend says “you have a better chance of getting three heads in a row when you flip a coin than rolling two dice and getting a sum greater than 9.” Prove if your friend is correct or incorrect.

Example for Learning Outcome 1, 2, and 3

10. A rectangular container (Container A), as shown on the left, is full of water. Some of the water is then poured into the container on the right (Container B), which is a cylinder. Now, the height of the water in both containers is the same. What is the height of the water in each of the two containers?