Strategies for the teaching and learning of mathematics in elementary school grades with particular attention to the Ontario Mathematics Curriculum, Grades 1-8. Methodologies and materials specific to selected topics are highlighted with emphasis on contemporary reform mathematics pedagogies, including the integration of computational thinking. 3 hours per week, full year, .75 credit.

Course Description:
Candidates will explore the theoretical and practical theories of mathematics pedagogy and learning with an emphasis on our growing knowledge of how different learners can all achieve success.

Learning Outcomes:
“Effective teaching requires the use of a range of teaching styles and techniques. These variations afford teachers the opportunity to make choices, accommodate change, and meet student needs” (Standards of Practice, p. 3). Rather than transmit information, teachers must transform knowledge so as to make it accessible to others. Children learn in a variety of ways; therefore, teachers must have multiple pedagogical strategies to assist Ontario’s diverse and changing society.

Course-Level Learning Outcomes
Students will demonstrate:

Knowledge
• Knowledge of major mathematical, pedagogical and instructional concepts and strategies.
• A critical understanding of changes in the theories of learning and teaching mathematics, and the application of these changes to the current Ontario curriculum and provincial policy documents.
• The ability to:
  i) critically gather, review, discuss, and reflect on points of view, theory and research on teaching and learning mathematics; and
  ii) select the most appropriate and creative options relevant to a teaching and learning situation.
• A critical understanding of how computational thinking promotes understanding of big ideas in math.

Knowledge of Methodologies
• A solid understanding of major aspects, a range of strategies and varied methods of teaching, assessment and evaluation of learning mathematics; and refine individual points of views and philosophies with regards to learning, teaching, assessing and evaluating of learning.
• The ability to use technology as a teaching tool, and to understand how mathematics-specific technological tools are changing how mathematics is taught.
• The ability to use computer coding as a teaching tool for teaching mathematics concepts and relationships.

Application of Knowledge
• The ability to make critical use of teaching resources, research summaries and policy documents relevant to student leaning of mathematics in Ontario elementary schools.
• The ability to adapt and design lesson and unit plans which enable teachers to create optimal classroom environments in which children of all ability ranges might attain a high level of success.

Communication Skills
• The ability to interact, to communicate, and to collaborate effectively with learners, school staff, members of other professions, learner’s parents/guardians, and the community using language, representations, and reasoning about mathematics learning that is appropriate to the context.
• Skills for organizing and managing various classroom styles including skills for managing learning in groups, and learning with physical and digital tools.

Awareness of Limits of Knowledge
• The ability to recognize, consult, research, reason and solve problems of practice from a range of contexts, including but not limited to the context of diversity among learners.
• An awareness of how teaching and learning of mathematics changes with changes in society and with advances in technology.

Autonomy and Professional Capacity
• Preparedness for teaching mathematics in the junior and intermediate grades in accordance to The Ontario College of Teacher’s “Standards of Practice for the Teaching Profession” and “Ethical Standards for the Teaching Profession.”
• An interest and take an active role in one’s own professional journey in learning to teach mathematics as well as articulate an understanding that one’s own knowledge, abilities, skills, values, beliefs, and attitudes influence their decision making in the profession of teaching.
• An understanding that teaching mathematics in ways that develop learners conceptual understanding and procedural proficiency is an ethical and compassionate act.
• The intellectual independence and curiosity required for continuing professional learning.
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<tr>
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| Knowledge                            | • Knowledge of major mathematical, pedagogical and instructional concepts and strategies.  
• A critical understanding of changes in the theories of learning and teaching mathematics, and the application of these changes to the current Ontario curriculum and provincial policy documents.  
• The ability to:  
  i. critically gather, review, discuss, and reflect on points of view, theory and research on teaching and learning mathematics; and  
  ii. select the most appropriate and creative options relevant to a teaching and learning situation.  
• A critical understanding of how computational thinking promotes understanding of big ideas in math.  
  | Applies | Analyzes | Constructs |
| Knowledge of Methodologies            | • A solid understanding of major aspects, a range of strategies and varied methods of teaching, assessment and evaluation of learning mathematics; and refine individual points of views and philosophies with regards to learning, teaching, assessing and evaluating of learning.  
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• The ability to adapt and design lesson and unit plans which enable teachers to create optimal classroom environments in which children of all ability ranges might attain a high level of success.  
  | Applies | Analyzes | Assesses |
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  | Applies | Analyzes | Explains |
## Autonomy and Professional Capacity

The student demonstrates:

- Preparedness for teaching mathematics in the junior and intermediate grades in accordance to The Ontario College of Teacher’s “Standards of Practice for the Teaching Profession” and “Ethical Standards for the Teaching Profession.”
- An interest and take an active role in one’s own professional journey in learning to teach mathematics as well as articulate an understanding that one’s own knowledge, abilities, skills, values, beliefs, and attitudes influence their decision making in the profession of teaching.
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**Course Content and Activities:**

This course will focus on introducing the teacher candidates to:

- The research and theory of mathematics education
- The mathematics curriculum for the primary and junior grades
- Mathematics pedagogy and classroom practice including teaching through problem solving,
- Computational thinking, and teaching through student work
- The creation of rich mathematics contexts to engage students
- Differentiated instruction and Universal Design for Learning
- Technology to enhance student learning, including computer code
- Resources for lesson planning and professional, life-long learning

<table>
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| 1    | Be a Mathematician!  
      | This class will take place online through OWL. (Labour Day) |
| 2    | Numbers, Numbers, Everywhere! Making Ten |
| 3    | Numbers, Numbers, Everywhere! Counting on Frank |
| 4    | Numbers, Numbers, Everywhere! In-class expectations assignment |
| 5    | Patterns: Linking Research to Practice - Anno’s Magic Seeds |
| 6    | Patterns: Oh, the Possibilities! Fibonacci Sequence |
| 7    | Patterns: Even More Possibilities! Infinity and Beyond |
| 8    | From Simple to Complex: Encouraging questions and finding answers - Collatz Sequence |
| 9    | Giving and Receiving Feedback. Perfecting our lesson plans. |
| 10   | Playing with Art - Learning with Math: Giacometti Sculptures |
| 11   | Performing a math concept - Symmetry |
| 12   | Optimization Problems - The Advantages of Learning Everything at Once. Wolf Gets Hurt, Scruffy’s New Home |
| 13   | Creating Problems with Wide Walls - Playing with Pythagoras |
| 14   | Math Waves - Trigonometry From Grade 4 - 10 |
| 15   | Real Data Practices: Data Visualization, How Left-Handed Are You? |
| 16   | Real Data Practices: Creating Infographics  
      | This class will take place online through OWL. (Family Day) |
Course Materials:

Course readings are available online or will be posted to the class OWL site.

- The Ontario Curriculum, grades 1-8: Mathematics, grade 9 & 10 Mathematics
- A Guide to Effective Instruction in Math K-6: Volumes 1-5
- A Guide to Effective Instruction in Math K-3 and 4-6: (strand specific guides)
- Paying Attention to Algebraic Reasoning
- Paying Attention to Proportional Reasoning
- Paying Attention to Fractions
- Paying Attention to Spatial Reasoning
- Growing Success: Assessment, Evaluation and Reporting (Grades 1-12)

We will be using the following two books which are available as PDFs. You can get both books for $19 at mathsurprise.ca/coding-books/ by using the code uwo2018 (valid until 30/09/2018).

- Gadanidis, G. and Gadanidis, M. (2016). 20 Math Stories. WORLDiscoveries: London, ON. Available at mathsurprise.ca/uwo with access code to be provided

Students may wish to bring a math notebook in which to do the in-class math activities. Everyone is encouraged to bring and use their personal electronic devices. Students may also wish to bring math tools like pencils, compasses, rulers, coloured pencils and the like.

Assignments and Other Course Requirements:

1. Online responses and sharing in our OWL site 1% each up to 10% of final mark. Many opportunities. [Ongoing]

2. Online journal. 10%. [Week 3] 300-500 words suggested.
   a. Reflect on your experiences during the last three weeks of class.
b. Compare and contrast these with your experiences of math as a student.

3. Expectations Continuum. Group, in-class. 10% [Week 4]
   b. Plot the expectations from Making Tens or Counting on Frank from grade 4 - 10 creating a continuum.
   c. What other strands are we addressing as well? Plot those along with your number continuum.
   d. Create a pleasing display of your continua that would appeal to students, parents, teachers.

4. Lesson Design. Group/Individual, in-class and out. 20%. [Weeks 6 - 9]
   a. Groups of 1 - 4. If you know what your placement will be, you might want to work with others with similar placements.
   b. Choose a grade and a strand on which to focus your lesson. You may branch out from these to include other grades as well as integrating other strands if such is practical.
   c. Create a 3-part lesson using the template shared in class or one of your own. Outline what you are going to accomplish in each of the three sections: Getting Started; Working On It; and Consolidation.
   d. You will include Big Ideas, Differentiated Instruction and Accommodations Ideas, Open Questions to Encourage and Extend Learning, and Assessment.
   e. Create any blackline masters or other materials that your students will need.
   f. You will be given some time each class in which to seek and receive feedback while developing your lesson.

5. Concept Map. Group, in-class. 10% [Weeks 10-11]
   b. You will choose from selected big ideas or topics in mathematics and create a concept map which shows all of the ideas that are inherent to your big idea or topic.
   c. As you map these concepts, you may wish to annotate them with the grade they are introduced into the curriculum and all the other grades that they can be found in.
d. You may choose to accomplish your concept map using your favourite mind mapping software, online services like Mindomo (make sure you know how to use it prior to class), or any type of physical media that you can use in class.


“If one is master of one thing and understands one thing well, one has, at the same time, insight into and understanding of many things.”

VINCENT VAN GOGH

Learning in Depth is a program created by Kieran Egan from Simon Fraser University. The idea behind it is that students take one topic and dive deeply into it becoming an expert. This expertise is then shared with the rest of the class. More information about Learning in Depth can be had from their website: http://ierg.ca/LID/ or by reading Egan’s book Learning in Depth available in the Education Library.

The Process


b. You will choose a particular problem of practice or issue in mathematics teaching. January 14th will be our choosing day. We will all choose that one topic that we will dive into learning as much as possible.

c. Working On It Part 1 - search for and read scholarly articles; talk to experts in the field (these connections can be facilitated by your teacher); find and read articles or conversations about your topic in the media. Keep a bibliography of what you have read. Include a one sentence description for each reading so that you can go back easily to find information.

d. Working On It Part 2 - Keep digging as in part 1. Keep adding to your bibliography, and start recording subtopics that your learning has shown you are within your topic. Begin to think about how you are going to share your learning with your classmates. For Jan. 28th, submit a preliminary list of your subtopics, each with a brief summary of what you have learned or what you still need to learn. You will receive feedback to help your learning.

e. Working On It Part 3 - It’s all about the sharing. Consider who your audience will be for your sharing. As a default, you have your classmates as an audience. You may choose a different audience after consultation with your teacher. Think about the purpose of what you are sharing. Choose a format that will help you effectively share your expertise, and
that will be able to be saved by your classmates. If this were an academic paper, it would be no longer than 1500 words.

d. As part of our week 16 class which will take place online due to Family Day, create a visual summary of your learning in an infographic format. Details of how to create great infographics will be discussed in class on week 15.

g. You will be given some time each class in which to seek and receive feedback while digging deeply into your issue.

7. Math “Essay” 15% [Week 18]

This will be an in-class assessment given during the last class on March 4th.

During the course, we will have gone through many different mathematical learning experiences. Two of these experiences will be chosen to be the focus for this assessment, one of which will be chosen by your instructor as the topic for the ‘essay’ on Mar. 4th for you to write about.

You will be provided with one piece of blank paper onto which you will record everything you know about the math experience and how it could be used in a classroom. This does not necessarily have to be done in prose and you may want to give this some thought beforehand. You will not be allowed to bring in any notes or similar materials other than writing or drawing implements.

This process will be modelled and talked about throughout the course.

The major assignments of this course are intended to be of a most practical nature – they’re what we do as teachers every day.

Be sure to use the course rubric to help plan, monitor, and self-assess as you complete each assignment.

All assignments will be explained and discussed in class but may also be found in Assignment Outlines in the Syllabus section in OWL.

Policy Statements:

Accessibility: The University of Western Ontario is committed to recognizing the dignity and independence of all students and seeks to ensure that persons with disabilities have genuine, open and unhindered access to academic services. Please contact the course instructor if you require course materials in an alternative format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for
information about requesting academic accommodation, or go to the following website:
http://www.edu.uwo.ca/teacher-education/docs/policies/Accessibility_Western.pdf

ATTENDANCE: The B.Ed. program is an intense and demanding programs of professional preparation. You are expected to demonstrate high levels of both academic and professional integrity. Such integrity is demonstrated in part by your commitment to and attendance at all classes, workshops, tutorials, and practicum activities. Read more about the Faculty's attendance policy on-line at http://www.edu.uwo.ca/teacher-education/docs/Attendance%20Policy%202016.pdf.

EXCUSED ABSENCES: If you are ill, require compassionate leave, or must miss classes for religious observance, your absence is excused; you will not be penalized but you are responsible for work missed.

UNEXCUSED ABSENCES: Any absence that is not a result of illness, bereavement, or religious observance is an unexcused absence. Three unexcused absences will result in you being referred to the Associate Dean and placed on academic probation. Any further unexcused absence will result in failure of the course and withdrawal from the program.

Language Proficiency: In accordance with regulations established by the Senate of the University, you must demonstrate the ability to write clearly and correctly. Work which lacks proficiency in the language of instruction is unacceptable for academic credit, and will either be failed or, at the discretion of the instructor, returned to you for revision to an acceptable level.

Late Penalties: Normally, the only acceptable reasons for late or missed assignments are illness (which you must report to the Teacher Education Office) or extreme compassionate circumstances. Unexcused late assignments will be penalized at a rate of _____% per day, and will not be accepted more than _____ days after the due date unless prior arrangements have been made with the instructor.

Academic Offences: Scholastic offences are taken very seriously in this professional Faculty. You are, after all, going to be a teacher. Read about what constitutes a Scholastic Offence at the following Web site: http://www.edu.uwo.ca/teacher-education/docs/policies/WEB_ScholasticDiscipline.pdf

Plagiarism: Plagiarism means presenting someone else’s words or ideas as your own. The concept applies to all assignments, including lesson and unit plans, laboratory reports, diagrams, and computer projects. For further information, consult your instructors, the Associate Dean’s Office, and current style manuals. Advice about plagiarism and how to avoid it can also be found here: https://www.edu.uwo.ca/teacher-education/docs/policies/WEB_PlagiarismPolicy.pdf

Plagiarism-Checking:

a. All required papers may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (http://www.turnitin.com).

b. Computer-marked multiple-choice tests and/or exams may be subject to submission for similarity review by software that will check for unusual coincidences in answer patterns that may indicate cheating.
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<th>Western SUPPORT SERVICES</th>
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<td><strong>FINANCIAL ASSISTANCE:</strong> Registrarial Services (<a href="http://www.registrar.uwo.ca">http://www.registrar.uwo.ca</a>)</td>
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<td><strong>WRITING SUPPORT:</strong> Student Development Centre (<a href="http://www.sdc.uwo.ca/">http://www.sdc.uwo.ca/</a>)</td>
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<td><strong>LEARNING SKILLS SUPPORT:</strong> Student Development Centre (<a href="http://www.sdc.uwo.ca/">http://www.sdc.uwo.ca/</a>)</td>
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<td><strong>SOCIAL &amp; CULTURAL ISSUES:</strong> University Students’ Council (<a href="http://westernusc.ca/services/">http://westernusc.ca/services/</a>)</td>
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<td><strong>EMOTIONAL or MENTAL DISTRESS:</strong> <a href="http://www.uwo.ca/uwocom/mentalhealth/">http://www.uwo.ca/uwocom/mentalhealth/</a></td>
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