Computational Thinking in Mathematics and Science Education (Intermediate/Senior) 5467 (001), 0.5

*Blended Learning Course (four hours per week face-to-face and online)
Monday On-Site 10:30-12:30, Room 1054, and Online (asynchronous)

Instructor: Lisa Anne Floyd
Email: lpennaru@uwo.ca

Course Coordinator: George Gadanidis
Email: ggadanid@uwo.ca

Course Description:

A critical introduction to the role of computer coding and digital making as ways of teaching mathematics and science concepts and relationships. The history, current trends, future possibilities of computational thinking in mathematics and science education are situated within the broader context of mathematics, science, and technology education.

Learning Outcomes:

By the end of this course, students will be able to:

- Explore, share, and reflect on the mathematical and scientific learning through computational thinking tasks (both coding and unplugged)
- Describe how computational thinking may be used to develop mathematics and science concepts while fostering innovation, creativity and criticality
- Describe the affordances and challenges of teaching mathematics and science with computational thinking including the areas of planning, implementation, and assessment
- Explore, share, and reflect on coding environments for computational thinking in mathematics and science education
- Build connections between curriculum expectations, both within a specific grade/course as well as across grades/courses to create a more connected and relevant mathematics and/or science program for themselves, their students, and their colleagues
• Review, discuss reflect on, and critically evaluate theory and research on computational thinking in mathematics and science education
• Identify opportunities to use computational thinking to develop deeper, more connected understandings within mathematics and/or science programs
• Identify opportunities to connect research to practice to support teacher professional practice decisions
• Discuss and reflect on theoretical research concerning the use of computational thinking in mathematics and science education
• Communicate with education stakeholders, with specificity and clarity, the affordances and issues of implementing computational thinking in mathematics and science education
• Recognize how changing perspectives (e.g., environmental; stewardship), current research from fields outside of mathematics (e.g., cognitive science), and technology may generate a need for change in areas of mathematics education
• Respect and address culturally responsive and culturally instructive pedagogies (i.e., culturally responsive making)
• Assume and plan for diversity in student prior knowledge, experiences abilities in relation to course content (i.e., consider ways to address gender gap in many of the STEM areas)
• Demonstrate initiative, responsibility, accountability, thoughtful decision-making, reflective practice, ethical behaviour, academic integrity, and responsible conduct of research that is in compliance with policy and procedural guidelines.

**Course Content:**

**Topics include:**
*Coding in mathematics (geometry, patterns, probability, linear relations), Coding in science, Effective use of digital tangibles, Exploring sensors, STEM across the curriculum*

**Platforms and Digital Devices that will be explored:** *Scratch, Python, Sphero, Arduino, Makey Makey, micro:bit, electronic stickers, other online coding platforms and applications*

**Organization of Course Content:**

Two hours per week face-to-face, two hours per week online.

Please post questions about the course in the main forum within OWL.

Teacher candidates will be in smaller groupings for online discussions.

*Alternative readings, activities may be assigned by instructor based on student interests, discussions*
Note - Detailed instructions and a list of online activities will be provided each week via OWL. All readings/videos will be made available via OWL by your instructor.

<table>
<thead>
<tr>
<th>WEEK</th>
<th>IN-CLASS (Monday s (10:30-12:30) 1054</th>
<th>ONLINE **Readings/Videos/Activities</th>
<th>Forum/Mindmap/Reflection</th>
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<tbody>
<tr>
<td>Date</td>
<td>Activity</td>
<td>Read:</td>
<td>Notes:</td>
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<td>Electricity overview (posted in OWL)</td>
<td>OR <strong>Mindmap</strong> (your choice of software – Mindomo recommended) on a selection of one or more readings/activities so far and/or summarize forum discussion for selected topic.</td>
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<tr>
<td>Date</td>
<td>Topic</td>
<td>Read</td>
<td>Assignment</td>
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<td><em>Explore: TinkerCad</em> (<a href="https://www.tinkercad.com/circuits">https://www.tinkercad.com/circuits</a>) – Virtual Arduino environment</td>
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<td>Date</td>
<td>Activity</td>
<td>Resource/Task</td>
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<td>Explore: Online resources – <a href="http://researchideas.ca/wmt/c2b1.html">http://researchideas.ca/wmt/c2b1.html</a></td>
<td>Reflection: Select one of own posts from online discussion and/or one of a classmates’ post – expand, reflect.</td>
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<td>Final Assignment Due</td>
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**Course Materials:**

Suggested materials, including digital devices will be *recommended* throughout the course. All readings will be available online.

**Assignments and Other Course Requirements:**

*If you wish to propose alternate assignments, please discuss with your instructor*

**A - ONLINE DISCUSSIONS (20 %)**

*Please see detailed Expectations in OWL*

Students will participate in a variety of weekly online tutorials/activities and will engage in open discussions within small groups online.

Ongoing discussions (weeks 1-3) – 10 %

Ongoing discussions (weeks 5-7) – 10 %

*Students will complete self-assessment based on a scale*

**B – REFLECTIONS/MINDMAPS (30 %)**

*Please see detailed Expectations in OWL*

Mindmap or Reflection (week 4) – 15 %

Mindmap or Reflection (week 8) – 15 %
Reflection:
Select one of own posts from online discussion and/or one of a classmates’ post – expand, reflect.

OR

Mindmap:
Create a mindmap (your choice of software – Mindomo recommended) on a selection of one or more readings/activities so far and/or summarize forum discussion for selected topic.

C – COMPUTATIONAL THINKING TASK for teaching Math/Science/STEM (50 %)
Due Date (on or before): November 8th, 2017
*Opportunity to receive peer feedback during week 8 on OWL Forum

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. Please
contact your instructor if you require an extension on an assignment.

**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](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](https://www.edu.uwo.ca/teacher-education/docs/policies/WEB_PlagiarismPolicy.pdf)

**Plagiarism-Checking:**
- 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](http://www.turnitin.com)).
- 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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**Western SUPPORT SERVICES**

**FINANCIAL ASSISTANCE:** Registrarial Services ([http://www.registrar.uwo.ca](http://www.registrar.uwo.ca))

**WRITING SUPPORT:** Student Development Centre ([http://www.sdc.uwo.ca/](http://www.sdc.uwo.ca/))

**LEARNING SKILLS SUPPORT:** Student Development Centre ([http://www.sdc.uwo.ca/](http://www.sdc.uwo.ca/))

**INTERNATIONAL STUDENTS:** Student Development Centre ([http://www.sdc.uwo.ca/](http://www.sdc.uwo.ca/))

**ABORIGINAL STUDENTS:** Student Development Centre ([http://www.sdc.uwo.ca/](http://www.sdc.uwo.ca/))

**STUDENTS with DISABILITIES:** Student Development Centre ([http://www.sdc.uwo.ca/](http://www.sdc.uwo.ca/))

**SOCIAL & CULTURAL ISSUES:** University Students’ Council ([http://westernusc.ca/services/](http://westernusc.ca/services/)).

**EMOTIONAL or MENTAL DISTRESS:** [http://www.uwo.ca/uwocom/mentalhealth/](http://www.uwo.ca/uwocom/mentalhealth/)