Introduction to STEM 5465
Intermediate / Senior
Wednesdays, 10:30am, Room 2036

Instructor: William Neal
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Course Coordinator: N/A

Course Description:
This course provides an introduction to the nature and value of integrated and multidisciplinary collaborations in Science, Technology, Engineering, and Mathematics (STEM) education. Teacher candidates develop critical perspectives and explore issues in STEM education in terms of policy and practice.

Learning Outcomes:
On the successful completion of the course, students will be expected to:

- Understand how rapid technological development has opened up incredible educational opportunities in all areas of education including STEM education.
- Provide conscientious and effective instruction in STEM education that upholds and models the ethical standards of the teaching profession (Care, Trust, Respect, and Integrity).
- Develop, use, and critically evaluate methodologies and strategies for use in STEM programs.
- Design, use, and critically evaluate teaching, learning, assessment, and evaluation resources for use in STEM education.
- Utilize effective strategies for fostering a safe, positive, and socially just and equitable learning environment in the context of teaching STEM.
• Support students in the use of STEM-related technology in the lab and classroom.

**Course Schedule**

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<tr>
<th>Date</th>
<th>Topic</th>
<th>Assignment Due Dates and Notes</th>
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| Sept. 5 | Course Introduction / Outline / Sakai / Fundamental Principles of STEM Education / STEM, STEAM, STEMM, etc.  
What is STEM education?  
Elements of STEM education – interdisciplinary, student agency, meaningful outcomes, collaboration, connections to wider community | Discuss Group Projects, Individual Projects and Activities                                      |
| Sept. 12| Why?! - A class discussion on the nature and purpose of education and the definition of STEM education.  
Groups discuss plans for their group projects. +  
Groups provide feedback for planning future class sessions. |                                                                                                 |
| Sept. 19| Open Source Software and Hardware  
Discussion of the effect of the technological revolution on the availability of educational resources  
Discussion of the advantages and disadvantages of proprietary technologies and open source technologies  
Preparation for Design activities – download software |                                                                                                 |
| Sept. 26| 3D Design – Blender – Part I – Introduction  
The use of integrative elements in sound curricular design; animation software as an integrative element  
Challenges in the field – ensuring that all students have access to | SEE Activity #1 – students produce lists of open source hardware and software useful in education |
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<tr>
<th>Date</th>
<th>Activity</th>
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<tr>
<td>Oct. 3</td>
<td>3D Design – Blender – Part II – Modelling in Blender</td>
<td>Collaboration to achieve higher level understanding and outcomes</td>
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<td>and, optionally, directly connected to their group projects</td>
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<td>Oct. 17</td>
<td>3D Printing / CAD Programs / Sketchup / Blender</td>
<td>SEE Activity #2 – Student groups produce Blender files that integrate knowledge of computer programming, object animation, art, physics, 3D coordinates, mathematics, etc.</td>
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<td>3D Printing – just another shiny gadget or an opportunity for deep learning?</td>
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<td>Oct. 24</td>
<td>FRC Robotics – Introduction</td>
<td>SEE Activity #3 – Students design and print artistic or engineering-related 3D models</td>
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<td>Worldwide STEM phenomenon with heavy presence in Ontario public schools (among highest in world, per capita)</td>
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<td>Connections to Computer Programming, Physics, Mathematics and Computer Engineering Technology Courses</td>
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<td>Challenges in the field – establishing a STEM Centre</td>
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<td>Challenges in the field – STEM education despite heavy administrative burden</td>
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<td>Oct. 31</td>
<td>FRC Robotics – Robot Design Competition</td>
<td>Rationale of FRC – in typical schools, disciplines are artificially separated, outcomes are time-limited, teachers “fill the students with knowledge,”, application is lacking. FRC was designed to provide a much richer educational experience and to shift the culture of learning such that</td>
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engineers are seen to be as influential and important as celebrities and athletes.

Effective strategies: support activities with adequate background knowledge, train youth to be aware of group dynamics, plan carefully, call on the support of others

Challenges in the field – Initiating and sustaining an FRC program – administrative, logistical and organizational considerations

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<tr>
<td>Nov. 7</td>
<td>Coding in the Classroom</td>
<td>Use of spreadsheets for various simulations and activities</td>
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<td>Brief introduction to Python – connecting computer code to topics in any subject.</td>
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<td>Python Anaconda – mathematics and science libraries</td>
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<td>Students prepare outlines for lesson activities using coding in the classroom</td>
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<td>Jan. 9</td>
<td>Coding in the classroom II</td>
<td>Teams of students present outlines for lesson activities using coding in the classroom (10 minute presentations)</td>
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<td>Jan. 16</td>
<td>Raspberry Pi – Introduction</td>
<td>The Raspberry Pi is a staple of STEM activities. Linux, its operating system, is a natural fit for STEM activities – robust, flexible, powerful and...free! (Free and Open Source that is)</td>
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<td>Jan. 23</td>
<td>Raspberry Orchestra – Part I</td>
<td>Introduction - Students learn music through computer coding and computer coding through music – Sonic Pi Live Coding Software</td>
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<tr>
<td>Date</td>
<td>Activity Description</td>
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| Jan. 30| Raspberry Orchestra – Part II – Live Coding Performance  
Student groups put their music, coding and coordination skills to the test with live performances!                                                                                                       | SEE Activity #6 –  
Groups perform a musical number using live coding                  |
| Feb. 6 | Farbot – Introduction  
An open-ended STEM activity with connections to technology, agriculture, social studies and the environment                                                                                                   |                                                                     |
| Feb. 13| Farbot – Operation  
Students operate the Farbot remotely using a web connection. They program a sequence of moves and observe them with the Farbot camera.                                                                         | SEE Activity #7 –  
Students program the Farbot and operate it remotely through a web connection |
| Feb. 20| Group Project Presentations                                                                                                                                                                                           | Group Presentations Due                                               |
| Feb. 27| Group Project Presentations                                                                                                                                                                                           | The Education Revolution?  Final Draft Due                           |
| Mar. 6 | Reflections – Based on the activities in the course, reflect on various aspects of STEM education listed below, in their groups and through a whole class discussion  
- What is STEM education?  
- Challenges in the field  
- Effective STEM strategies  
- Evaluation of course materials  
- Rationale behind STEM education programs  
- STEM and STSE (linked to Farbot, Theremin, FRC Robotics, 3D printing, SEE activities) |                                                                     |
Course Materials:

Most required course materials are available online.

Assignments and Other Course Requirements:

The course assignments are designed to support the candidates' growth and development as STEM educators. These are opportunities for the participants to appreciate the nature of STEM education, to further develop their interdisciplinary skill base and to contemplate their future roles in STEM education.

STEM GROUP PROJECT – 35%
Teacher candidates select a topic of interest, research and implement a STEM project in collaboration with the course instructor, using the basic technological elements for STEM education and assessment and evaluation tools developed in the course.

THE STEM EDUCATION EXPERIENCE (SEE) – 35%
Students engage in a series of activities used in secondary school STEM programs, gaining experience and insight in preparation for their STEM careers.

THE EDUCATION REVOLUTION? – 30%
Teacher candidates explore recent trends that concern technological advances and their effect on STEM education. Candidates may choose from a wide variety of topics and present their findings as an essay, website, journal, computer program, model, video or presentation.

CONTRIBUTIONS TO LEARNING COMMUNITY (embedded in all of the above activities)
Throughout the course, emphasis is placed on how well each candidate contributes to the learning of others. Candidates are expected to demonstrate participation through careful preparation, critical analysis, and thoughtful commentary on the material being discussed in each class. Each individual bears the responsibility of making a significant contribution to the learning of others. Success in this component of the course also reflects appropriate attendance and punctuality.
**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. Late assignments will not be accepted for re-submission further to feedback.

**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:**

1. 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.

**Western SUPPORT SERVICES**

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

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

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

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

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

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

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

EMOTIONAL or MENTAL DISTRESS: http://www.uwo.ca/uwocom/mentalhealth/