Instructor: William Neal  
Email: wneal3@uwo.ca  Telephone: 519-661-2111x88679  
Office: Room 2045

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 the STEM.
* 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.
* Understand the role of STEM and its place in society, including its philosophical and socio-cultural connections, the limitations of STEM, and the connections among science, technology, society, and the environment.
* Understand and discuss the nature of STEM education with reference to a conceptual framework.

Course Content

Assignments
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.
### Course Schedule

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Assignment Due Dates and Notes</th>
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<tbody>
<tr>
<td>Sept. 6</td>
<td>Course Introduction / Outline / Sakai / Fundamental Principles of STEM Education / STEM, STEAM, STEMM, etc. Building a STEM Learning Community</td>
<td>Discuss Group Projects, Individual Projects and Activities</td>
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<tr>
<td>Sept. 13</td>
<td>Open Source Software and Hardware</td>
<td>SEE Activity #1</td>
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<td>Sept. 20</td>
<td>3D Design – Blender – Part I – Introduction</td>
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<tr>
<td>Sept. 27</td>
<td>3D Design – Blender – Part II – Modelling in Blender</td>
<td>SEE Activity #2</td>
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<tr>
<td>Oct. 4</td>
<td>3D Printing / CAD Programs / Sketchup / Blender</td>
<td>SEE Activity #3</td>
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<td>Oct. 18</td>
<td>FRC Robotics – Introduction</td>
<td>Field Trip to visit STEM Centre</td>
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<td>Class to meet at 365 Richmond St. London</td>
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<tr>
<td>Oct. 25</td>
<td>FRC Robotics – Robot Design Competition</td>
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<tr>
<td>Nov. 1</td>
<td>STEM Cheesecake – Part I – Introduction</td>
<td>The Education Revolution? Rough Draft Due</td>
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<tr>
<td>Nov. 8</td>
<td>STEM Cheesecake – Part II – Module Design</td>
<td>SEE Activity #4</td>
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<tr>
<td>Date</td>
<td>Activity</td>
<td>Notes</td>
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<tr>
<td>Jan. 10</td>
<td>STEM Cheesecake – Competition</td>
<td>SEE Activity #5</td>
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<td>Jan. 17</td>
<td>Raspberry Pi - Introduction</td>
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<td>Jan. 24</td>
<td>Raspberry Orchestra – Part I – Introduction</td>
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<tr>
<td>Jan. 31</td>
<td>Raspberry Orchestra – Part II – Performance</td>
<td>SEE Activity #6</td>
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<tr>
<td>Feb. 7</td>
<td>Farbot – Introduction</td>
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<td>Feb. 14</td>
<td>Farbot – Operation</td>
<td>SEE Activity #7</td>
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<tr>
<td>Feb. 21</td>
<td>Group Project Presentations</td>
<td>Group Presentations Due</td>
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<tr>
<td>Feb. 28</td>
<td>Group Project Presentations</td>
<td>The Education Revolution? Final Draft Due</td>
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<tr>
<td>Mar. 7</td>
<td>Reflections</td>
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</tbody>
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**Course Materials**

- Arduino Microcontrollers
- Raspberry Pi
- 3D Printers
- FRC Robots
- Electronics a Kits
**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](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](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.

**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](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: [http://www.edu.uwo.ca/preservice/downloads/Plagiarism%20Policy.pdf](http://www.edu.uwo.ca/preservice/downloads/Plagiarism%20Policy.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](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.

EDUC 5465 Introduction to STEM
Use of Laptops & Notebooks in Class: As a courtesy to members of the class, please put your cell phone on ‘vibrate’ or turn it off during class. Laptops and other electronic devices may be used in a professional manner to facilitate your activities in the course, but out of courtesy to colleagues and the instructor, please do not engage in personal networking and non-course communication during class time – save it for before or after class, or for the break.

<table>
<thead>
<tr>
<th>SUPPORT SERVICES</th>
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<tbody>
<tr>
<td><strong>A variety of support services are available at Western.</strong></td>
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<tr>
<td><strong>If you need advice or assistance, do not hesitate to get in touch with any of these services.</strong></td>
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<tr>
<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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<tr>
<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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<tr>
<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>INTERNATIONAL STUDENTS:</strong> Student Development Centre <a href="http://www.sdc.uwo.ca/">http://www.sdc.uwo.ca/</a></td>
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<td><strong>ABORIGINAL STUDENTS:</strong> Student Development Centre <a href="http://www.sdc.uwo.ca/">http://www.sdc.uwo.ca/</a></td>
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<tr>
<td><strong>STUDENTS with DISABILITIES:</strong> Student Development Centre <a href="http://www.sdc.uwo.ca/">http://www.sdc.uwo.ca/</a></td>
</tr>
<tr>
<td><strong>SOCIAL &amp; CULTURAL ISSUES:</strong> University Students’ Council <a href="http://westernusc.ca/services/">http://westernusc.ca/services/</a></td>
</tr>
<tr>
<td><strong>EMOTIONAL or MENTAL DISTRESS:</strong> Students who are in emotional or mental distress should refer to Mental Health @ Western <a href="http://www.uwo.ca/uwocom/mentalhealth/">http://www.uwo.ca/uwocom/mentalhealth/</a> for a complete list of options about how to obtain help.</td>
</tr>
<tr>
<td><strong>B.Ed./Dip.Ed. PROGRAM ISSUES:</strong> <a href="mailto:zuber@uwo.ca">zuber@uwo.ca</a>, Teacher Education Office, room 1131</td>
</tr>
<tr>
<td><strong>NEED HELP but not sure what to do:</strong> <a href="mailto:zuber@uwo.ca">zuber@uwo.ca</a>, Teacher Education Office, room 1131</td>
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</table>
**Additional Information:**

**About the Course:**

The Introduction to STEM course is based on a conceptual framework that was formulated through numerous years of experience in STEM-related educational activities both inside and outside of the classroom. It is designed such that students will build on their understanding of the importance of STEM education through structured class discussions, an individual project and a hands-on project that will enable teacher candidates to link their experience to educational theory and to thereby further develop their understanding of teaching and learning.

**About the Instructor:** William Neal has been teaching at international secondary schools since 1996. Since then he has been heavily involved in STEM-related projects as a teacher of mathematics, science and computers courses. Projects undertaken by William's students include code in the classroom, a Rubens tube, automated RC vehicles, a Thin Client computer network, DIY 3D printers, research at the London Health Sciences Centre, international service trips and an FRC robotics team. William is currently serving as the Director of STEM at London International Academy.

**Teaching Outline:**

Multiple teaching and learning strategies have been included in the course to ensure that teacher candidates have ample opportunity to demonstrate their understanding of the material.

*Talks / Lectures.* Talks and lectures are designed to be brief and to introduce the activities of the course.

*Group Work.* Group activities make up a significant portion of the course. Students will work in teams throughout the course to complete the SEE activities and their group projects.

*Group Discussions.* Students deepen their understanding of course material through structured discussions based on the elements of a conceptual framework of STEM education.

*Technology Demonstrations.* Many technological connections are made in STEM education. During these activities, specific technology will be demonstrated.
Hands on Activities. These activities follow the technology demonstrations, enabling teacher candidates to further develop their skills through direct interaction with the technologies.

Assignment Guidelines:

(please see attached assignments document)

References and Suggested Readings:

The following list of resources and readings is presented as a starting point for students preparing their individual and group projects.

Introduction


STEM Learning Communities


**Education Revolution?**


**Specific Programs and Technologies**


**Coding in the Classroom and Spreadsheets**


Lesson and Unit Planning


Teaching and Learning Laboratory (TLL), and Singapore University of Technology and Design (SUTD) . *RES.TLL-004 STEM Concept Videos.* Fall 2013. Massachusetts Institute of Technology: MIT OpenCourseWare, https://ocw.mit.edu. License: Creative Commons BY-NC-SA.

Project-Based Learning

