Western Education

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# EDUC 5465

## Introduction to STEM Education

## Instructors:


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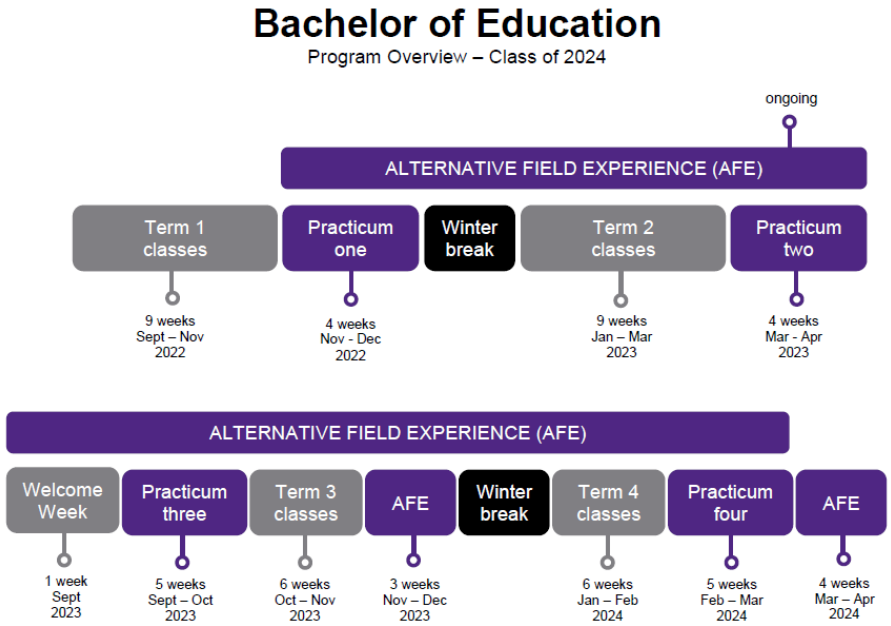
## Schedule:

**Section 001:** Tues 10:30AM-12:30PM,
Room: 2036

## Program Context:

This is a **IS Curriculum Course** taken by Teacher Candidates during **Year 1, Full Year** of the Bachelor of Education.



# Introduction to STEM Education (EDUC 5465)

**Course Description:**

An introduction to the nature and value of integrated and multi-disciplinary collaborations in Science, Technology, Engineering and Mathematics education. Teacher Candidates develop critical perspectives and explore issues in STEM education in terms of policy and practice. 2 hours per week, full year, .5 credit.

This course provides an introduction to the nature and value of integrated and multi-disciplinary collaborations in intermediate/senior Science, Technology, Engineering, and Mathematics (STEM) education. Topics addressed, but not limited to, will include: STEM in the Ontario Science Curriculum, the nature and structure of STEM, embedding STEM, STEM pedagogy, the STEM learning environment, STEM curriculum planning, STEM assessment and evaluation, equity and inclusiveness in STEM and STEM activities.

**Course Materials:**

There is no textbook required for this course. Any readings required will be selected based on the needs of each class. These readings will be posted on our OWL class site no less than two weeks in advance of the required class and there will be no more than two readings required per class. This strategy has been adopted to provide an alternative method of building our course together as we come to understand the histories, experiences and knowledges that you bring to the course.

**Course Credits:** 0.5

## Number of Weeks: 18

## **Week 1:** Introduction to STEM

Introduction and general overview of the course.

STEM and STSE differences and connections are introduced.

The value and nature of embedded STEM and separate STEM courses is explored.

Connecting STEM courses to Ontario Intermediate/Senior Science Ministry Curriculum and learning outcomes is explored.

### Learning Activities

| Type | Name | Description |
|---|---|---|
| **Discussion** | Week 1 Discussion | Outlining why STEM is a unique and enriching learning opportunity. Connecting STEM to the Ontario Intermediate/Senior Science Ministry Curriculum and STSE. Class participation, discussions, and ad-hoc reflection exercises. |
| **Reading** | Week 1 Materials & Readings | The Value of STEM Education Articles. The Ontario Intermediate/Senior Science Curriculum. |

## **Week 2:** The Nature of STEM and Establishing STEM

Proper identification of how potential Ontario Intermediate/Senior Ministry Curriculum plays an essential role in establishing STEM.

Developing STEM is rooted in the framework of STSE.

Exploration of the framework of STEM education to create effective learning environments in embedded and interdisciplinary STEM.

### Learning Activities

| Type | Name | Description |
|---|---|---|
| **Discussion** | Week 2 Discussion | Exploration of essential STEM aspects and connections to the Ontario Intermediate/Senior Ministry Curriculum and STSE. Class participation, discussions, and ad-hoc reflection exercises. |

| Learning Activities | | |
|---|---|---|
| **Type** | **Name** | **Description** |
| **Reading** | Week 2 Materials & Readings | STEM Framework Articles. |

## **Week 3:** The STEM Framework and Approach

Many perceived challenges of STEM education interfere with proper implementation.

The key framework components of STEM drive success.

A problem-based approach is pivotal for successful STEM education.

| Learning Activities | | |
|---|---|---|
| **Type** | **Name** | **Description** |
| **Discussion** | Week 3 Discussion | Identification and strategies to manage the perceived challenges of developing STEM education. Analysis of the key framework components of STEM education. Class participation, discussions, and ad-hoc reflection exercises. |
| **Reading** | Week 3 Materials & Readings | Authentic and Problem-based Education Articles. |

## **Week 4:** Introduction to STEM Pedagogy and Curricular Learning

Establishing a relevant authentic problem-based approach to STEM ensures student engagement and develops learning within a discovery and constructivist context.

An introductory examination of key pedagogical strategies utilized in establishing and maintaining an engaging STEM learning environment while also ensuring student and curricular accountability.

Establishing effective cooperative learning is vital for STEM success.

| Learning Activities | | |
|---|---|---|
| **Type** | **Name** | **Description** |
| **Discussion** | Week 4 Discussion | Outlining integration of a problem-based approach in STEM projects. Establishing STEM pedagogy and Ontario Intermediate/Senior Ministry Curriculum expectations. Class participation, discussions, and ad-hoc reflection exercises. |
| **Reading** | Week 4 Materials & Readings | Cooperative Learning and STEM Pedagogy Articles. |

## **Week 5:** The T in Stem

An examination of the technology emphasis within the STEM framework including the need for embedded technology learning, a curriculum-focused approach and essential/key aspects for successful implementation.

STEM technology examples and issues will also be explored.

Integrating technology into STEM is multi-faceted.

| Learning Activities | | |
|---|---|---|
| **Type** | **Name** | **Description** |
| **Discussion** | Week 5 Discussion | An exploration of the importance and various roles of technology in STEM education. Class participation, discussions, and ad-hoc reflection exercises. |
| **Reading** | Week 5 Materials & Readings | Incorporating Technology in STEM Articles. |

## **Week 6:** The E in STEM

An engineering approach to STEM education ensures cooperative learning is optimized.

An examination of the engineering emphasis within the STEM framework including the distinctive role of engineering, a curriculum-related approach and essential/key aspects for successful implementation.

STEM engineering examples and issues will also be explored.

Engineering in STEM is multi-faceted.

| Learning Activities | | |
|---|---|---|
| **Type** | **Name** | **Description** |
| **Discussion** | Week 6 Discussion | An exploration of the importance and roles of engineering in STEM education. Class participation, discussions, and ad-hoc reflection exercises. |
| **Reading** | Week 6 Materials & Readings | Engineering as a Component of STEM Articles. |

## **Week 7:** The M in STEM

An examination of the mathematical emphasis within the STEM framework including the need for embedded mathematical learning, a curriculum-focused approach and essential/key aspects for successful implementation.

STEM math examples and issues will also be explored.

Integrating math into STEM is multi-faceted.

| Learning Activities | | |
|---|---|---|
| **Type** | **Name** | **Description** |
| **Discussion** | Week 7 Discussion | An exploration of the importance and various roles of math in STEM education. Class participation, discussions, and ad-hoc reflection exercises. |
| **Reading** | Week 7 Materials & Readings | Embedding and Encouraging Math in STEM Articles. Complete the Rough Draft of the First Assignment. |

## **Week 8:** STEM Small Activity Lesson Plan Sharing

Consolidation and refinement of education concepts demonstrated in a specific embedded STEM Science small activity lesson plan.

Lesson plans will be informally shared for peer review to enable growth and enhancement.

| Learning Activities | | |
|---|---|---|
| **Type** | **Name** | **Description** |
| **Discussion** | Week 8 Discussion | Present your draft lesson plan to facilitate group collaboration. |
| **Reading** | Week 8 Materials & Readings | Complete the First Assignment. |

## **Week 9:** STEM Small Activity Lesson Plan Presentations

Consolidation of education concepts demonstrated in a specific embedded STEM Science small activity lesson plan.

Final examination of STEM components and key pedagogical strategies.

| Learning Activities | | |
|---|---|---|
| **Type** | **Name** | **Description** |
| **Discussion** | Week 9 Discussion | Present your group lesson plan. |
| **Reading** | Week 9 Materials & Readings | Optimizing STEM Articles. Enhancing STEM Engagement Articles. |

## **Week 10:** Progressing the STEM Learning Environment

Final examination of STEM components and key pedagogical strategies.

Maintaining and progressing the STEM learning environment is a careful balance among proper facilitation, collaboration, questioning techniques interspersed with teaching and learning emphasis,

Curriculum planning and mapping are essential for successful STEM education.

| Learning Activities | | |
|---|---|---|
| **Type** | **Name** | **Description** |
| **Discussion** | Week 10 Discussion | Outlining how to maintain student engagement to create a robust thriving STEM learning environment. Class participation, discussions, and ad-hoc reflection exercises. |

| Learning Activities | | |
|---|---|---|
| **Type** | **Name** | **Description** |
| **Reading** | Week 10 Materials & Readings | STEM Curriculum Planning/Mapping Articles. |

## **Week 11:** Curriculum Planning for STEM

An introduction to mapping overall/specific curriculum expectations across specific STEM disciplines with emphasis on integration and timing.

Managing sustained versus dispersive STEM education while dealing with curriculum-dependency and overload will be explored.

Maintaining optimal student engagement and growth requires careful corrective feedback and well-planned peer and teacher collaboration.

| Learning Activities | | |
|---|---|---|
| **Type** | **Name** | **Description** |
| **Discussion** | Week 11 Discussion | Summarizing how to successfully manage the integration of Ontario Intermediate/Senior Ministry Curriculum expectations, student learning needs and STEM education. Class participation, discussions, and ad-hoc reflection exercises. |
| **Reading** | Week 11 Materials & Readings | Articles Outlining the Use of Feedback to Progress Competencies. |

## **Week 12:** Student Learning in STEM

Facilitation of the STEM learning environment requires carefully planned student-teacher interactions and feedback.

Ensuring a growth mind-set learning environment must be direct, purposeful and encompass a process/learning-centered approach in terms of student work and expected learning outcomes.

The STEM learning environment must also be flexible to emphasis both individual and group work.

The STEM learning environment is greatly enhanced by effective assessment and evaluation.

| Learning Activities | | |
|---|---|---|
| **Type** | **Name** | **Description** |
| **Discussion** | Week 12 Discussion | Outlining how to maintain optimal student engagement and growth through use of careful corrective feedback and well-planned peer and teacher collaboration. An analysis of strategies to ensure the STEM learning environment is constructive and nurturing for all students. Class participation, discussions, and ad-hoc reflection exercises. |
| **Reading** | Week 12 Materials & Readings | STEM Assessment and Evaluation Articles. |

## **Week 13:** STEM Assessment and Evaluation

Different types of assessment and evaluation enhance STEM teaching and learning.

Assessment, evaluation, and reporting practices must be fair, transparent, and equitable for all students, and are ongoing, varied in nature, and administered over a period of time to provide multiple opportunities for students to demonstrate the full range of their learning.

With the STEM growth-centered environment, emphasis must be given to evidence of learning, triangulation and methods of measurement.

Utilizing assessment and evaluation technology to document and facilitate incremental growth and learning capacity.

Assessment and evaluation must also reflect optimal equity and inclusion of the STEM learning environment.

| Learning Activities | | |
|---|---|---|
| **Type** | **Name** | **Description** |
| **Discussion** | Week 13 Discussion | Outlining assessment and evaluation concerns and strategies related to STEM education. Outlining strategies and technology to enhance evaluation. Class participation, discussions, and ad-hoc reflection exercises. |

## Learning Activities

| Type | Name | Description |
|---|---|---|
| **Reading** | Week 13 Materials & Readings | Stem-related Equity, Diversity and Inclusion Articles. |

## **Week 14:** Equity and Inclusiveness in STEM

Global Competencies encompass knowledge, skills and attitudes/values.

Integration of learning technology expands and progresses student learning competencies.

STEM education is built on a learning environment that is non-threatening, respectful, equitable and inclusive to nurture student diversity.

## Learning Activities

| Type | Name | Description |
|---|---|---|
| **Discussion** | Week 14 Discussion | Successful STEM education integrates and demonstrates these competencies in a non-threatening, respectful, equitable and inclusive learning environment that supports individual methods and outcomes of learning. Addressing how technology plays a prominent role in the learning environment. Class participation, discussions, and ad-hoc reflection exercises. |
| **Reading** | Week 14 Materials & Readings | Complete the Rough Draft of the Second Assignment. |

## **Week 15:** STEM Large Activity Lesson Plan Sharing

Consolidation and refinement of education concepts demonstrated in an integrated STEM large activity lesson plan.

Lesson plans will be informally shared for peer review to enable growth and enhancement.

## Learning Activities

| Learning Activities | | |
|---|---|---|
| Type | Name | Description |

| Type | Name | Description |
|---|---|---|
| **Discussion** | Week 15 Discussion | Present your draft lesson plan to facilitate group collaboration. |
| **Reading** | Week 15 Materials & Readings | Complete the Second Assignment. |

## **Week 16:** STEM Large Activity Lesson Plan Presentations

Consolidation and refinement of education concepts demonstrated in an integrated STEM large activity lesson plan.

STEM education typically integrates a large extent of the Ontario Ministry Curriculum ultimately resulting in dispersive interdisciplinary learning.

| Learning Activities | | |
|---|---|---|
| **Type** | **Name** | **Description** |
| **Discussion** | Week 16 Discussion | Present your group lesson plan. |
| **Reading** | Week 16 Materials & Readings | Complete the Second Assignment. |

## **Week 17:** STEM Large Activity Lesson Plan Presentations

Consolidation and refinement of education concepts demonstrated in an integrated STEM large activity lesson plan.

STEM education typically integrates a large extent of the Ontario Ministry Curriculum ultimately resulting in dispersive interdisciplinary learning.

| Learning Activities | | |
|---|---|---|
| **Type** | **Name** | **Description** |
| **Discussion** | Week 17 Discussion | Present your group lesson plan. |
| **Reading** | Week 17 Materials & Readings | Complete the Second Assignment. |

## **Week 18:** STEM Large Activity Lesson Plan Presentations

Consolidation and refinement of education concepts demonstrated in an integrated STEM large activity lesson plan.

STEM education typically integrates a large extent of the Ontario Ministry Curriculum ultimately resulting in dispersive interdisciplinary learning.

Course Assignment 1: Ongoing Contributions to Classwork and Assignments

Course Assignment 2: Group Small STEM Lesson Plan

Course Assignment 3: Group Large STEM Lesson Plan

## Learning Activities

| Type | Name | Description |
|---|---|---|
| **Discussion** | Week 18 Discussion | Present your group lesson plan. A conclusion to concepts explored during the course. |
| **Reading** | Week 18 Materials & Readings | Contemporary STEM Issues Articles. |

## Assessment Activities

| Type | Name | Description |
|---|---|---|
| **Assignment** | Ongoing: Class participation, discussions and ad-hoc reflection exercises. | Professionalism includes how well each teacher candidate contributes to their own learning and to the learning of others.<br><br>Teacher candidates are expected to demonstrate participation through diligent preparation, critical analysis, and thoughtful commentary on the material being discussed in each class.<br><br>Periodically reflections based on class concepts/discussions/assignments may be due during/after class. |

## Assessment Activities

| Type | Name | Description |
| --- | --- | --- |
| **Summative Assessment** | Due Week 9: Lesson Plan Report 1 | Design a detailed lesson plan for a small activity (3-5 periods) which integrates Ontario Intermediate/Senior Ministry Curriculum addressing how it embeds all of the components of STEM and will be effectively delivered.<br>This assignment is completed in groups (size will be determined during the course based on time needed) and cannot utilize STEM activities already covered in this course.<br>Groups will present this lesson plan to peers for review/evaluation.<br>The submitted lesson plan will only be evaluated by the instructor. |
| **Summative Assessment** | Due Weeks 16-18: Lesson Plan Report 2 | Design a detailed lesson plan for a large activity (10-15 periods) which integrates Ontario Intermediate/Senior Ministry Curriculum addressing how it embeds all of the components of STEM and will be effectively delivered.<br>This assignment is completed in groups (size will be determined during the course based on time needed) and cannot utilize STEM activities already covered in this course.<br>Groups will present this lesson plan to peers for review/evaluation.<br>The submitted lesson plan will only be evaluated by the instructor. |

# How to Protect Your Professional Integrity:

The Bachelor of Education is an intense and demanding program of professional preparation. Teacher Candidates are expected to demonstrate high levels of academic commitment and professional integrity that align with both Western University's Academic Rights and Responsibilities and the Professional Standards and Ethical Standards set by the Ontario College of Teachers. These expectations govern your time in class, in your Practicum, in your Alternative Field Experiences, and include the appropriate use of technology and social media.

The Teacher Education Office will only recommend teacher candidates for Ontario College of Teachers certification when candidates have demonstrated the knowledge of, and adherence to, the faculty polices throughout the two-year program.

To review the policies and practices that govern the Teacher Education program, including attendance, plagiarism, progression requirements, safe campus and more, visit: edu.uwo.ca/CSW/my-program/BEd/policies.html

# Faculty of Education Pass/Fail Policy:

All courses and assignments in the Bachelor of Education are assessed as Pass/Fail.

Instructors will make the Success Criteria of the assignments clear, and refinements of the criteria may take place in class as a means of co-constructing details of the assignments in the first two weeks of a course. This will allow for differentiation of process, product and timeline depending upon student needs.

Success Criteria will

- Articulate what needs to occur to demonstrate learning outcomes for a course/assignment;
- Inform the instructional process so that teaching can be adapted to ensure students continue to remain on track to meet the criteria as needed and appropriate.
- Align with the assignments created to provide opportunities for students to demonstrate the knowledge, skills and abilities they are working toward;
- Establish clear descriptive language that allows Teacher Candidates to identify, clarify and apply the criteria to their work and to their engagement in peer feedback;
- Focus the feedback on progress toward meeting the overall and specific tasks/assignment goals for the course.

# Participation

Participation is essential to success in the Teacher Education program. As a professional school, you need to treat coming to class as showing up for work in the profession. If you are not in class, you cannot participate. Actively participating in discussions, peer reviews/feedback, group work and activities is integral to the development of your own learning and to the learning within your classroom community.

Given the varied experiences of Teacher Candidates in the program, you may engage with ideas/concepts or skills that are familiar or unfamiliar to you.

A Professional Teacher Candidate is one who:

- Arrives in class (virtual or on-site) on time, and prepared. This includes completing any readings, viewing assignments or tasks in advance of class as requested.
- Listens to others and contributes thoughtfully to discussions;
- Models respectful dialogue and openness to learn, monitors, self-assesses and reformulates one's prior beliefs and understandings in light of new information;
- Monitors and addresses their wellness, practices self-care, and seeks appropriate support when necessary.

# Ontario Curriculum & Supplementary Resources:

**Curriculum & Resources**
dcp.edu.gov.on.ca/en

# Campus Services & Resources:

**Health and Wellness**
uwo.ca/health

**Peer Support**
westernusc.ca

**Learning Skills**
uwo.ca/sdc/learning

**Indigenous Services**
Indigenous.uwo.ca

**Student Accessibility Services**
sdc/uwo.ca/ssd

**Writing Support**
writing.uwo.ca

**Financial Assistance**
registrar.uwo.ca

**Not sure who to ask?**
Contact the Teacher Education Office at eduwo@uwo.ca