

Western Education

Transforming Education. Transforming Lives.

EDUC 5466 Curriculum & Pedagogy in STEM Education

Instructor:

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Schedule:

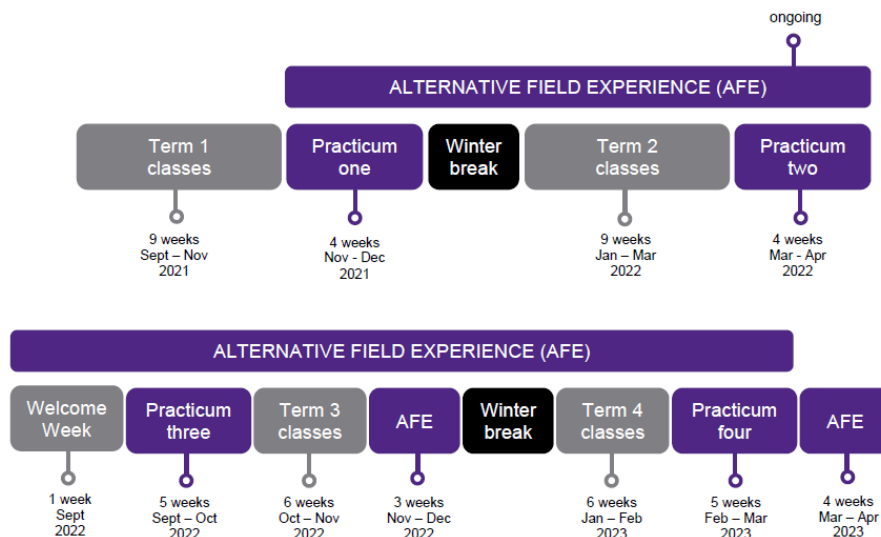
Section 001: Tuesday 9:30 AM – 12:30 PM
Room 2046

Program Context:

This is a **Specialty Course** taken by Teacher Candidates during **Year 2, Full Year** of the Bachelor of Education.

Bachelor of Education

Program Overview – Class of 2023



Syllabus Report

Curriculum & Pedagogy in STEM Education (EDUC 5466)

Course Description:

A focus on STEM education within the broader curricular spectrum. Teacher Candidates develop pedagogical content knowledge, skills, technologies, instructional strategies, and assessments to support the design and development of STEM projects. 3 hours per week, full year, 0.5 credit.

This course promotes the development of science teaching professionals through in-depth analysis of teaching procedures, constructivist models that reveal and promote student understanding of STEM, and materials for selecting and organizing instruction.

Students develop interdisciplinary focused curricula that incorporate these aspects of teaching and learning, the appropriate use of technology, authentic assessment, and current STEM and educational research. The course provides opportunity for professional growth through reviews of professional literature, participation in professional science education organizations, and contribution to national, provincial, and/or local school STEM activities.

You will be given opportunities to reflect upon:

- STEM pedagogy based on “student-centered” and “constructivist” models of learning;
- Strategies for dealing with values education, equity, and environmental issues in STEM;
- Appropriate strategies for assessing student understanding and evaluating student performance;
- How to create “non-threatening” learning environments;
- Curriculum planning and design and program modification strategies;
- Strategies for planning lessons and units of study incorporating STEM education;
- Different backgrounds, levels, interests, and needs of all students; and
- Your own teaching performance and professional growth.

Course Resources:

- Differentiated Instruction Educator’s Package. (2010). Retrieved from <http://www.edugains.ca/resourcesDI/EducatorsPackages/DIEducatorsPackage2010/2010EducatorsGuide.pdf>
- Ontario College of Teachers. (2016). Foundations of Professional Practice. Retrieved from https://www.oct.ca/-/media/PDF/Foundations%20of%20Professional%20Practice/Foundation_e.pdf
- Ontario’s Education Equity Action Plan. (2017). Retrieved from http://www.edu.gov.on.ca/eng/about/education_equity_plan_en.pdf
- Ontario Ministry of Education. (2007). The Ontario Curriculum Grades 1-8: Science and Technology. Toronto: Queen’s Printer.
- Ontario Ministry of Education. (2007). The Ontario Curriculum Grades 9 and 10: Science. Toronto: Queen’s Printer.
- Ontario Ministry of Education. (2008). The Ontario Curriculum Grades 11 and 12: Science. Toronto: Queen’s Printer.
- Ontario Ministry of Education. (2009). The Ontario Curriculum Grades 1-8: Environmental Education.
- Ontario Ministry of Education. (2009). The Ontario Curriculum Grades 9-12: Environmental Education.
- Ontario Ministry of Education. (2010). Growing success: Assessment, evaluation, and reporting in Ontario schools. Toronto, ON: Queen’s Printer for Ontario. Retrieved from <http://www.edu.gov.on.ca/eng/policyfunding/growsuccess.pdf>

Number of Credits: 0.5

Number of Weeks: 12

Week 1: Introduction and EDID in STEM Education (October 18, 2022)

- Syllabus
- Introductions
- STEM Education in Ontario/Canada
- Equity, Diversity, Inclusion, and Decolonization in STEM Education: Principles and Practices

Learning Activities

Type	Name	Description
Formative Assessment	Week 1 Activities	<ul style="list-style-type: none"> • Before Class: Introduce yourself (Prezi, Reel...) • In-class: Class discussions and workshop tasks

Week 2: Scientific Literacy and Nature of Science (NOS) (October 25, 2022)

- Scientific Literacy
- NOS
- Digital Scientific Timelines: Research and Development

Learning Activities

Type	Name	Description
Formative Assessment	Week 2 Activities	<ul style="list-style-type: none"> • Before Class: Readings • In-class: Class discussions and R&D-timelines
Reading	Week 2 Readings	<ul style="list-style-type: none"> • Bybee, R., McCrae, B., & Laurie, R. (2009). PISA 2006: An assessment of scientific literacy. <i>Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching</i>, 46(8), 865-883. • Morrell, P. D., & Popejoy, K. (Eds.). (2014). <i>A few of our favorite things: teaching ideas for K-12 science methods instructors</i>. Springer.

Week 3: Digital Timelines (November 1, 2022)

- Timelines: Research and Development

Learning Activities

Type	Name	Description
Formative Assessment	Week 3 Activities	<ul style="list-style-type: none"> • Before Class: Timelines content • In-class: R&D-timelines • After class: Finish the timelines
Reading	Week 3 Reading	DeCoito, I. (2014). Teaching about the nature of science through digital scientific timelines. <i>A few of our favorite things: Teaching ideas for K-12 science methods instructors</i> . Sense Publishers.

Week 4: Digital Timelines and STEM Projects (November 8, 2022)

- Timelines: Presentation, Discussion, and Reflection
- STEM Projects

Learning Activities

Type	Name	Description
Formative Assessment	Week 4 Activities	<ul style="list-style-type: none"> • Before Class: Finish the timelines • In-class: Present, discuss, and reflect on timelines and R&D-projects

Week 5: Project-based and Inquiry-based Teaching (November 15, 2022)

- STEM Projects
- Inquiry in STEM Education

Learning Activities

Type	Name	Description
Formative Assessment	Week 5 Activities	<ul style="list-style-type: none"> • Before Class: Readings • In-class: R&D-projects and class discussions
Reading	Week 5 Readings	Each student will be assigned one reading of the following list:

Learning Activities

Type	Name	Description
		<ul style="list-style-type: none"> • Capraro, M. M., & Jones, M. (2013). Interdisciplinary STEM project-based learning. In <i>STEM project-based learning</i> (pp. 51-58). Brill Sense. • Capraro, R. M., & Slough, S. W. (2013). Why PBL? Why STEM? Why now? An introduction to STEM project-based learning: An integrated science, technology, engineering, and mathematics (STEM) approach. In <i>STEM project-based learning</i> (pp. 1-5). Brill Sense. • Duran, L. B., & Duran, E. (2004). The 5E instructional model: A learning cycle approach for inquiry-based science teaching. <i>Science Education Review</i>, 3(2), 49-58.

Week 6: Socio-Scientific Issues (SSI); Science, Technology, Society, and Environment (STSE); and Case Studies (November 22, 2022)

- SSI
- STSE
- Argumentation
- Case Studies: Research and Development

Learning Activities

Type	Name	Description
Formative Assessment	Week 6 Activities	<ul style="list-style-type: none"> • Before Class: Readings • In-class: Class discussions + R&D-Case Studies
Reading	Week 6 Readings	<p>Each student will be assigned one reading of the following list:</p> <ul style="list-style-type: none"> • DeCoito, I., & Fazio, X. (2017). Developing case studies in teacher education: Spotting socioscientific issues. <i>Innovations in Science Teacher Education</i>, 2(1). • Sibiç, O., & Topçu, M. (2020). Pre-service science teachers' views towards socio-scientific issues and socio-scientific issue-based instruction. <i>Journal of Education in Science, Environment and Health</i>. https://doi.org/10.21891/jeseh.749847 • Pedretti, E., & Bellomo, K. (2013). A time for change: Advocating for STSE education through

Learning Activities

Type	Name	Description
		professional learning communities. <i>Canadian Journal of Science, Mathematics and Technology Education</i> , 13(4), 415-437.

Week 7: Case Studies (January 3, 2023)

- Case Studies: Research and Development

Learning Activities

Type	Name	Description
Formative Assessment	Week 7 Activities	<ul style="list-style-type: none"> • Before Class: Work on case studies • In-class: R&D-case studies • After class: Case study ppt and finalization

Week 8: Case Studies (January 10, 2023)

- Case Studies: Presentations, Peer Feedback, Discussion, and Reflection

Learning Activities

Type	Name	Description
Formative Assessment	Week 8 Activities	<ul style="list-style-type: none"> • Before Class: Case study ppt • In-class: Case studies: presentations, peer feedback, and reflections • After class: Reflection & final submission-case study

Week 9: TPACK; Digital Literacy; and Digital Curriculum Resources (January 17, 2023)

- TPACK
- Digital Literacy
- Developing and Choosing Digital Educative Curriculum Materials
- Curriculum Resources Websites: Research and Development

Learning Activities

Type	Name	Description
Formative Assessment	Week 9 Activities	<ul style="list-style-type: none"> • Before Class: Readings • In-class: R&D-websites and class discussions • After Class: Website structure
Reading	Week 9 Readings	<p>Each student will be assigned one reading of the following list:</p> <ul style="list-style-type: none"> • DeCoito, I., & Estaiteyeh, M. (2022). Online teaching during the COVID-19 pandemic: Exploring STEM teachers' curriculum and assessment practices in Canada. <i>Disciplinary and Interdisciplinary Science Education Research</i>, 4(8). https://doi.org/10.1186/s43031-022-00048-z • Ng, W. (2011). Why digital literacy is important for science teaching and learning. <i>Teaching Science</i>, 57(4), 26-32. • Davis, E. A., & Krajcik, J. (2005). Designing educative curriculum materials to promote teacher learning. <i>Educational Researcher</i>, 34(3), 3-14. • DeCoito, I., & Richardson, T. (2018). Beyond Angry Birds™: Using web-based tools to engage learners and promote inquiry in STEM learning. In <i>Information and Technology Literacy: Concepts, Methodologies, Tools, and Applications</i> (pp. 410-433). IGI Global.

Week 10: Digital Curriculum Resources (January 24, 2023)

- Developing and Choosing Digital Educative Curriculum Materials
- Curriculum Resources Websites: Research and Development

Learning Activities

Type	Name	Description
Formative Assessment	Week 10 Activities	<ul style="list-style-type: none"> • Before Class: Continue your website work • In-class: R&D-websites • After Class: Website progress report

Week 11: Digital Curriculum Resources (January 31, 2023)

- Curriculum Resources Websites: Research and Development

Learning Activities

Type	Name	Description
Formative Assessment	Week 11 Activities	<ul style="list-style-type: none"> • Before Class: Continue your website work • In-class: R&D-websites

Week 12: Consolidation (February 7, 2023)

- Curriculum Resources Websites: Presentations and discussion
- Course Wrap-up
- Looking ahead...

Learning Activities

Type	Name	Description
Formative Assessment	Week 12 Activities	<ul style="list-style-type: none"> • Before Class: Websites submission • In-class: Websites: presentation and peer feedback • After Class: Websites: final submission and reflection

Supplementary Readings:

STEM Education:

- Brown, R., Ernst, J., DeLuca, B., & Kelly, D. (2017). STEM curricula. *Technology and Engineering Teacher*, 77(1), 26.
- DeCoito, I. (2016). STEM education in Canada: A knowledge synthesis. *Canadian Journal of Science, Mathematics and Technology Education*, 16(2), 114-128.

EDID:

- Tomlinson, C. A., Brighton, C., Hertberg, H., Callahan, C. M., Moon, T. R., Brimijoin, K., Conover, L. A., & Reynolds, T. (2003). Differentiating instruction in response to student readiness, interest, and learning profile in academically diverse classrooms: A review of literature. *Journal for the Education of the Gifted*, 27(2–3), 119–145.
<https://doi.org/10.1177/016235320302700203>
- Tomlinson, C. A., & Imbeau, M. B. (2012). Common sticking points about differentiation. *School Administrator*, 69(5), 18-22.
- Capacity Building Series (2013). Culturally responsive pedagogy: Towards equity and inclusivity in Ontario schools. Retrieved from https://thelearningexchange.ca/wp-content/uploads/2017/02/CBS_ResponsivePedagogy.pdf
- Ladson-Billings, G. (2014). Culturally relevant pedagogy 2.0: aka the remix. *Harvard Educational Review*, 84(1), 74-84.
- https://youtu.be/ALZGKImD7_I

Scientific Literacy:

- Laugksch, R. C. (2000). Scientific literacy: A conceptual overview. *Science education*, 84(1), 71-94.

STEM Projects:

- Hynes, M. (2012). Middle-school teachers' understanding and teaching of the engineering design process: A look at subject matter and pedagogical content knowledge. *International Journal of Technology and Design Education*, 22, 345- 360.
- Rockland, R., Bloom, D. S., Carpinelli, J., Burr-Alexander, L., Hirsch, L. S., & Kimmel, H. (2010). Advancing the "E" in K-12 STEM education. *Journal of Technology Studies*, 36(1), 53-64.

Active Learning Strategies:

- Brame, C. (2016). Active learning. *Vanderbilt University Center for Teaching*.
- Chinn, C. A., & Malhotra, B. A. (2002). Epistemologically authentic inquiry in schools: A theoretical framework for evaluating inquiry tasks. *Science Education*, 86(2), 175-218.
- Colburn, A. (2000). Constructivism: Science education's "grand unifying theory". *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, 74(1), 9-12.
- Wiggins, G. & McTighe, J. (2005). *Understanding by Design*. Expanded 2nd Ed. USA: Association for Supervision and Curriculum Development
- Black, P., & William, D. (1998). Inside the black box - raising standards through classroom assessment. *Phi Delta Kappan*, 80(2). 139-148.

SSI and Case Studies:

- Evagorou, M., Albe, V., Angelides, P., Couso, D., Chirlesan, G., Evans, R.H., Dillon, J., Garrido, A., Guven, D., Mugaloglu, E., & Nielsen, J.A. (2014). Preparing pre-service science teachers to teach socio-scientific (SSI) argumentation. *Science Teacher Education*, 69, 39-48.
- Gray, D. S. & Bryce, T. (2006). Socio-scientific issues in science education: Implications for the professional development of teachers. *Cambridge Journal of Education*, 36(2), 171-192.
- Hughes, G. (2000). Marginalization of socioscientific material in science-technology-society science curricula: Some implications for gender inclusively and curriculum reform. *Journal of Research in Science Teaching*, 37(5), 426-440.
- Seethaler, S. (2005). Helping students make links through science controversy. *The American Biology Teacher*, 67(5), 265-274.

Technology:

- Bowers, J. S., & Stephens, B. (2011). Using technology to explore mathematical relationships: A framework for orienting mathematics courses for prospective teachers. *Journal of Mathematics Teacher Education*, 14, 285-304.
- Annetta, L. A. (2008). Video games in education: Why they should be used and how they are being used. *Theory into Practice*. 47(3), 229-39.
- Arbaugh, J., Bangert, A., & Cleveland-Innes, M. (2010). Subject matter effects and the community of inquiry (CoI) framework: An exploratory study. *The Internet and Higher Education*, 13(1), 37–44. <https://doi.org/10.1016/j.iheduc.2009.10.006>
- DeCoito, I., & Estaiteyeh, M. (2022). Transitioning to online teaching during the COVID-19 pandemic: An exploration of STEM teachers' views, successes, and challenges. *Journal of Science Education and Technology*, 31(3). 340–356. <https://doi.org/10.1007/s10956-022-09958-z>
- DeCoito, I., & Richardson, T. (2018). Teachers and technology: Present practice and future directions. *Contemporary Issues in Technology and Teacher Education*, 18(2), 362-378.

Assessment Activities

Type	Name	Description
Summative Assessment	Due Wk 04: Digital Scientific Timelines	In groups of 3, teacher candidates are required to prepare a digital-based timeline presentation. The contents of the timelines should be based on significant STEM discoveries and inventions that occurred within an assigned period of time. The contents of the presentation should include technical/scientific information about the discovery or invention; information about the individuals involved; relevant particulars about the personal lives, education, places of study and work, etc.; and information about the sociocultural milieu during the assigned time period. The information should be presented in a 10-minute visually engaging format, with concise explanatory text, audio, and/or videos, etc. The digital format may include Prezi, Movie Maker, Digital Storytelling, Tiki Toki, or other digital forms.
Summative Assessment	Due Wk 05: STEM Projects in Teacher Education	The STEM project involves 4 teacher candidates working together to prepare an inquiry STEM project for a topic in one of the strands from the Ministry of Education Ontario Curriculum: Science, Grades 10-12.
Summative Assessment	Due Wk 08: Case Studies in STEM Education	This assignment involves a team of 4 teacher candidates working together to develop a digital case study that is interactive (including videos, images, simulations, etc.). The digital case study will be based on a socio-scientific issue around STEM education (e.g., environmental sustainability, healthcare, social issues, etc.). It should be aligned with the Application expectations of the Ministry of Education Ontario Curriculum: Science, Grades 10-12.
Summative Assessment	Due Wk 12: Curriculum Resources Website	In groups of 4, teacher candidates will develop and produce a multimedia resource website suitable for use by grades 10, 11 or 12 science teachers. Each resource will address topics within one unit/strand of the Biology, Chemistry or Physics curriculum (not including Unit A). Each resource will include a variety of instructional and assessment exercises with an emphasis on digital resources. The included

Assessment Activities

Type	Name	Description
		resources need to showcase student-centered and inquiry-based pedagogical strategies.
Summative Assessment	Ongoing Self-Assessment: Professionalism	Course participation focuses 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 will also reflect appropriate attendance and punctuality. Teacher candidates are asked to keep a weekly record of their self-assessment and submit their final recommendation at the end of the course supported by documentation.
Formative Assessment	Learning Activities	Please refer to the weekly content.

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 policies 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:

<https://www.edu.uwo.ca/csw/bed/index.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.
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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