EDUC 427.01: STEM Education
Early Childhood
Fall, 2024

Land Acknowledgement: *The University of Calgary, located in the heart of Southern Alberta, both acknowledges and pays tribute to the traditional territories of the peoples of Treaty 7, which include the Blackfoot Confederacy (comprised of the Siksika, the Piikani, and the Kainai First Nations), the Tsuut'ina First Nation, and the Stoney Nakoda (including Chiniki, Bearspaw, and Goodstoney First Nations). The City of Calgary is also home to the Métis Nation of Alberta (Districts 5 and 6).*

Class Dates: September 3- December 6, 2024

Term Break: November 10-16, 2024

Field Experience I: October 7-18, 2024

Last Day to Add/Drop/Swap: Due to the non-standard dates associated with this program, please check your Student Centre for the important dates pertaining to your section.

Pre-requisite: Due to the multiple pathways in the Bachelor of Education, please consult Undergraduate Programs in Education for questions related to pre-requisite courses.

Office Hours: By appointment only

Email: Students are required to use a University of Calgary (@ucalgary.ca) email address for all correspondence.

COURSE DESCRIPTION:

EDUC 427 (STEM Education): This course introduces key elements of Science, Technology, Engineering, and Mathematics (STEM) education, including curriculum, pedagogy, standards, and assessment. This interdisciplinary course is for all first-year education students. The intent of the course is to foster an understanding of how STEM can inform and be used to shape teaching and learning across grade levels and subject areas. In so doing, participants will attend to STEM's role in culture and society.

LEARNER OUTCOMES:

Course participants will:

1) Develop a foundational understanding of the nature of discourse in STEM disciplines;
2) Understand and appreciate the STEM disciplinary processes of mathematics, science, and computational thinking, and the engineering design process that contribute to teaching and learning of mathematics and science;
3) Develop pedagogical knowledge through the work of *relearning* mathematics curriculum content. The *relearning* of a math concept is a method for developing mathematical thinking and understanding math for teaching and learning;
4) Design learning environments in STEM; and,
5) Apply introductory literature related to the teaching of STEM with an emphasis on mathematics, the implementation of resources, the classroom environment, diverse and innovative methods of teaching within STEM, and an introduction to the Alberta Curriculum and Programs of Study.

COURSE DESIGN AND DELIVERY: This course will be delivered face-to-face on campus with possible engagement in a D2L environment. The course will be delivered through a design-based and inquiry-focused approach where learning intent, expectations and assessment processes are made visible and transparent. Participation is crucial to the knowledge building in this course. Students will require access to a computing device that contains current software and hardware capable of running D2L, creating documents for learning tasks, and running free programming platform software such as Scratch. If you do not own a personal device, there are computers available for student use in the Doucette library and the Taylor Family Digital Library.

After the *course is completed*, you may be invited to participate in research involved in this course. The instructors will not know whether you will be participating in the research.

REQUIRED RESOURCES:

Alberta Education (2022). *Mathematics Kindergarten to Grade 6 Curriculum.* Learn Alberta: Government of Alberta. https://curriculum.learnalberta.ca/printable-curriculum/en/home

Alberta Education (2022). *Science Kindergarten to Grade 6 Curriculum.* Learn Alberta: Government of Alberta. https://curriculum.learnalberta.ca/printable-curriculum/en/home

Boaler, J. (2016). Chapter 2: The power of mistakes and struggle. *Mathematical Mindsets*, (pp. 11-20). Jossey-Bass. https://ebookcentral-proquest-com.ezproxy.lib.ucalgary.ca/lib/ucalgary-ebooks/detail.action?docID=4444210

Clements, D., & Sarama, J. (2023). Rethinking STEM in the elementary grades: Honoring the special role of math in cognitive development. *American Educator. 47*(1), 16-21. https://ezproxy.lib.ucalgary.ca/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=ehh&AN=162608765&site=ehost-live

CS Unplugged (n.d.). What is computational thinking? CS Unplugged. https://csunplugged.org/en/ https://csunplugged.org/en/

Davis, B., Francis, K., & Friesen, S. (2019). STEM Education by Design. https://ebookcentral-proquest-com.ezproxy.lib.ucalgary.ca/lib/ucalgary-ebooks/detail.action?docID=5763030

Langevin, N., Takeuchi, M.A., Yuen, J., & Jacques, S. (2021). Fostering geometric mathematical understanding through the early STEM classroom. *Delta-K: Journal of the Mathematics Council of the Alberta Teacher's Association, 57*(1), 29-34. https://prism.ucalgary.ca/bitstream/handle/1880/114415/Langevin,%20Takeuchi,%20Yuen%20and%20Jaques%202021.pdf?sequence=1

Maiorca, C. & Roberts, T. (2022). Problem-solving by design: The integrated STEM practices. *Elementary STEM Journal, 27*(5), 20-21. https://ezproxy.lib.ucalgary.ca/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=sch&AN=158676077&site=ehost-live

National Council of Teachers of Mathematics-NCTM (n.d.). *Building STEM Education on a Sound Mathematical Foundation.* Retrieved from https://www.nctm.org/Standards-and-Positions/Position-Statements/Building-STEM-Education-on-a-Sound-Mathematical-Foundation/

National Science Teaching Association-NSTA (n.d.). *STEM Education Teaching and Learning.* Retrieved from https://www.nsta.org/nstas-official-positions/stem-education-teaching-and-learning

Next Generation Science Standards-NGSS (n.d.). *Engineering design.* Retrieved from https://www.nextgenscience.org/topic-arrangement/msengineering-design

Roberts, T. & Maiorca, C. (2023). Revisiting the integrated STEM practices. *Elementary STEM Journal,27*(4), 19-20. https://ezproxy.lib.ucalgary.ca/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=sch&AN=163577231&site=ehost-live

Small, M. (2015). Chapter 7: Representing Multi-digit Whole Numbers. (pp. 138-155). *Making Math Meaningful to Canadian Students, K-8* (3rd Ed.). Nelson. [pdf in Leganto D2L]

Small, M. (2015). Chapter 8: Computation with Whole Numbers. (pp. 159-189). *Making Math Meaningful to Canadian Students, K-8* (3rd Ed.). Nelson. [pdf in Leganto D2L]

Swecker, M. (2020). Coding in the primary classroom. *Elementary STEM Journal, 25*(1), 26-27. https://ezproxy.lib.ucalgary.ca/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=sch&AN=145712727&site=ehost-live

Watson, L.A., Bonnesen, C.T., & Strayer, J.F. (2021). The nature of mathematics: Let's talk about it. *Mathematics Teacher: Learning & Teaching PK-12. 114*(5), 352-361. DOI: 10.5951/MTLT.2020.0226 [pdf in Leganto D2L]

Wilcox, J., & Lake, A. (2018). Teaching the Nature of Science to Elementary Students. *Science & Children, 55*(5), 78–85. https://ezproxy.lib.ucalgary.ca/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=sch&AN=126968551&site=ehost-live

Wilcox, J., Kruse, J., & Decker, S. (2021). Exploring the STEM landscape: Integrating the natures of STEM to elementary Earth science. *Science and Children, 58*(6), 30-37. DOI: 10/1080/19434812.2021.12291692 https://ezproxy.lib.ucalgary.ca/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=sch&AN=151165800&site=ehost-live

Williams, K. (2023). Problem-based learning in computer science. *Elementary STEM Journal, 27*(4), 6-8. https://ezproxy.lib.ucalgary.ca/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=sch&AN=163577226&site=ehost-live

Wing, J.M. (2006). Computational Thinking. *Communications of the ACM, 24*(3), 33. 10.1145/1118178.1118215 https://dl-acm-org.ezproxy.lib.ucalgary.ca/doi/abs/10.1145/1118178.1118215

Van de Walle, J.A., Karp, K.S., Bay-Williams, J.M., & McGarvey, L.M. (2022). Chapter 1: Teaching and learning mathematics in the twenty-first century. (pp. 1-4, 8-13). *Elementary and middle school mathematics: Teaching Developmentally (6th Canadian ed.).* Pearson Canada. [pdf in Leganto D2L]

Van de Walle, J.A., Karp, K.S., Bay-Williams, J.M., & McGarvey, L.M. (2022). Chapter 2: Exploring what it means to know and do mathematics. (pp. 24-31). *Elementary and middle school mathematics: Teaching Developmentally (6th Canadian ed.).* Pearson Canada. [pdf in Leganto D2L]

Van de Walle, J. A., Karp, K.S., Bay-Williams, J. M., & McGarvey, L.,M. (2022). Chapter 3: Math inquiry through rich tasks and classroom discourse (pp. 35-46). *Elementary and middle school mathematics: Teaching Developmentally (6th Canadian ed.).* Pearson Canada. [pdf in Leganto D2L]

Van de Walle, J.A., Karp, K.S., Bay-Williams, J.M., & McGarvey, L.M. (2022). Chapter 7: Developing Early Number Concepts and Number Sense (pp. 118-144) *Elementary and middle school mathematics: Teaching Developmentally (6th Canadian ed.).* Pearson Canada. [pdf in Leganto D2L]

Van de Walle, J.A., Karp, K.S., Bay-Williams, J.M., & McGarvey, L.M. (2022). Chapter 13: Algebra thinking, equations and functions (pp. 326-327). *Elementary and middle school mathematics: Teaching Developmentally (6th Canadian ed.).* Pearson Canada. [pdf in Leganto D2L]

Readings and Resources that may be helpful for the Learning Tasks:

To find e-books in the library, enter the title in the *search box* on the library's home page at http://library.ucalgary.ca/

Alberta Regional Professional Development Consortium (2024). *Curriculum Resources: Mathematics.* Retrieved from https://arpdc.ab.ca/focuses/math/?site_language=english

Alberta Regional Professional Development Consortium (2024). *Curriculum Resources: Science.* Retrieved from https://arpdc.ab.ca/focuses/science/?site_language=english

Alonso Yanez, G., Thumlert, K., de Castell, S., & Jenson, J. (2019). Toward a production pedagogy model for critical sciences and technology interventions. In P. Sengupta., M.-C. Shanahan., & B. Kim (Eds.). *Critical, transdisciplinary and embodied approaches in STEM education* (pp. 41–60). Springer. https://ebookcentral-proquest-com.ezproxy.lib.ucalgary.ca/lib/ucalgary-ebooks/reader.action?docID=6000776&ppg=57

Boaler, J. (2016). Chapter 3: The creativity and beauty in mathematics. *Mathematical Mindsets*, (pp. 11-20). Jossey-Bass. https://ebookcentral-proquest-com.ezproxy.lib.ucalgary.ca/lib/ucalgary-ebooks/detail.action?docID=4444210

CS Unplugged https://csunplugged.org/en/

Finkle, Dan (2016 February). *Five Principles of Extraordinary Math Teaching* [Video]. Ted Talks. https://www.ted.com/talks/dan_finkel_5_ways_to_share_math_with_kids?language=en

Fry, K, & English, L. (2023). How big is a leaf? Mathematical modeling through STEM inquiry. *Mathematics Teacher: Learning and Teaching PK-12, 116*(2), 99-107. DOI: 10.5951/MTLT.2022.0219 [pdf in Leganto D2L]

Hour of Code. (n.d.) https://hourofcode.com/ca/learn

Kimmer, R.W. (2013). Planting Sweetgrass (pp. 1-51). *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge and the Teaching of Plants. (*First Edition.). Milkweed Editions. https://ebookcentral-proquest-com.ezproxy.lib.ucalgary.ca/lib/ucalgary-ebooks/reader.action?docID=1212658&query=

Posamentier, A. (2003). *Math Wonders to Inspire Teachers and Students.* ASCD. https://ebookcentral-proquest-com.ezproxy.lib.ucalgary.ca/lib/ucalgary-ebooks/detail.action?docID=3002073

Small, M. (2013). *Eyes on Math: A Visual Approach to Teaching Math Concepts.* Nelson.

Small, M. (2015). Chapter 16: Measuring Capacity, Volume, Mass, Time, and Angle. (pp. 415-469), *Making Math Meaningful to Canadian Students, K-8* (3rd Ed.). Nelson. [pdf in Leganto D2L, book in Doucette Library]

-Chapter 16 has pictures of how to use base ten blocks, linking blocks, and other common manipulatives for learning measurement and math concepts within the context of specific units.

Small, M. (2014). *Uncomplicating Fractions to Meet Common Core Standards in Math, K-7*. Teachers College Press. [Doucette Library]

Taylor, C. & Lee, J. (2021). Ready, set, launch!- The engineering cycle for productive struggle. *Mathematics Teacher: Learning and Teaching PK-12, 114* (2), 117-124. DOI: 10.5951/MTLT.2019.0218 [pdf in Leganto D2L]

Truesdell, P. (2014). The engineering design process. In *Engineering essentials for STEM instruction: How do I infuse real-world problem solving into science, technology, and math?* (p. 7-15) Alexandria, VA: ASCD. [library e-version available] http://ebookcentral.proquest.com.ezproxy.lib.ucalgary.ca/lib/ucalgary-ebooks/reader.action?ppg=12&docID=1709532&tm=1500497319721

Watson, L.A., Bonnesen, C.T., & Strayer, J.F. (2021). The nature of mathematics: Let's talk about it. *Mathematics Teacher: Learning & Teaching PK-12. 114*(5), 352-361. DOI: 10.5951/MTLT.2020.0226 [pdf in Leganto D2L]

Van de Walle, J.A., Karp, K.S., Bay-Williams, J.M., & McGarvey, L.M. (2022c). *Elementary and middle school mathematics: Teaching Developmentally (6th Canadian ed.).* Pearson Canada. [Doucette Library – multiple editions available]

Software and other resources that *might* be used in the course:

- *Desmos* Open Software: https://desmos.com
- *Scratch* Open Software: https://scratch.mit.edu/
- *Hour of Code* Open Software: hourofcode.com
- *CS Unplugged* https://csunplugged.org/en/
- *Minecraft* Open Software**:** https://education.minecraft.net/hour-of-code
- *Makerspaces* https://library.ucalgary.ca/services/makerspace
  - Makerspace UCalgary provides students and staff access to 3D printing, 3D Milling, Rasberry Pis, and Arduino board kits with laptops

LEARNING TASKS OVERVIEW

Completion of all assigned tasks is required for a passing grade in the course. All tasks should follow the American Psychology Association (APA) style 7th Edition for in-text citations and references.

Regular and active participation is an essential aspect of any community knowledge building. Participation means interacting during class conversations and discussions, engaging in class tasks and activities.

You are expected to engage fully in the knowledge building community, demonstrating that you have reviewed the assigned weekly readings, reflected critically on what you have read and what you have contributed to knowledge building, and that you are engaging with peers in a collaborative and supportive dialogue.

Note: Each instructor will bring different sets of expertise to this course and therefore each course might be enacted slightly differently, including the **pace** for **Topics** and **specifics** from **Readings**. Each instructor may supplement weekly readings from the Additional Resource List. Please refer to instruction from your course instructor on specific enactment of the learning tasks and activities for your section, including engagement with generative AI (see AI statement for Learning Tasks below).

LEARNING TASK	DESCRIPTION OF LEARNING TASK	GROUP / INDIVIDUAL	WEIGHT	DUE DATE
LT1	***LT1 – Build Understanding of STEM Disciplines, STEM as Interdisciplinary Problem Solving, and Teaching STEM* (Reflective Learning)** **Part A: Journal Entry: Initial Thoughts** **Part B: Journal Entry: End of Course Understandings** Learning Outcomes 1, 2, 3, and 5	Individual	**Part A**: 15% **Part B:** 25%	**Part A**: Due **Sept. 16** in D2L Dropbox **Part B:** Due **Dec. 6** in D2L Dropbox
LT2	***LT2 – Building Understanding of the M in STEM through Relearning a Key Math Concept.*** Learning Outcome 1, 2, and 3	Individual	30%	Due: **Oct. 4** in D2L Dropbox
LT3	***LT3 – Building Understanding of STEM concepts through Engineering Design [Team work]*** Learning Outcome 4 and 5	Group	30%	Due: **Dec. 6** in D2L Dropbox

Further grading details on Learning Task Assessments are included in the Learning Task Rubrics.

WEEKLY COURSE SCHEDULE:

Date	Topic	Readings and Tasks	Due Dates
Week 1 Sept. 3-6	Introduction to STEM Education **Big Ideas**: Discuss the disciplinary processes within STEM. What are some distinctions and connections?	NSTA (n.d.) STEM Education Wilcox et al. (2021) Exploring the STEM Landscape	
Week 2 Sept. 9-12	Introduction STEM Education **Big Ideas:** Considerations for the M in STEM: re-experiencing math problems and activities to invite dialogue, collaboration, and knowledge building. Why emphasize math concepts in early years of STEM?	NCTM (n.d.). Building STEM Education on a Sound Math Foundation Clements & Sarama (2023) Rethinking STEM in the elementary grades **Note for LT2 – select a secondary math concept for *relearning*.** You may want to select from additional resources list to support your work for LT2	
Week 3 Sept. 16-20	*Relearning* Mathematics for teaching math and STEM **Big Ideas:** Invitation to Learn as Math Teacher. What does it mean to *learn* and *relearn* math content?	Boaler (2016) Chapter 2: Power of Mistakes Van de Walle et al., (2022). Chapter 1 (pp. 1-4, 8-13): Culturally responsive pedagogies in Canadian context Van de Walle et al., (2022). Chapter 2 (pp. 24-31) : Math proficiency	**LT1: Part A** **Due September 16**

Week 4 Sept. 23-27	*Relearning* Mathematics for teaching math and STEM **Big Idea:** Explore the difference between *visuals*, *manipulatives*, and *symbolic* **(digits, operation symbols, and math expressions)** mathematical representations.	Van de Wall et al., (2020). Chapter 7: (pp. 118-144) Developing early number concepts and number sense. And/or: Small (2015). Chapter 7: Representing Multi-digit Whole Numbers (pp. 138-155) **Link LT2 math concept to learning outcomes after you had time for relearning the concept:** Alberta Education (2022). Math K-6 curriculum	
Week 5 Sept. 30-Oct. 4	Mathematical and Computational Thinking **Big Ideas:** What are the connections between mathematical thinking and computational thinking?	Van de Walle et al. (2020). Chapter 3 (pp. 35-46): Math inquiry and mathematical thinking Van de Walle et al. (2020). Chapter 13: (pp. 326-327) Computational Thinking And/or: Small (2015) Chapter 8: (pp.159-189) Computation with Whole Numbers	**LT2 Due October 4**
Oct. 7-11		Field I – no STEM classes	
Oct. 14-18		Field I – no STEM classes	
Week 6 Oct. 21-25	Technology: Plugged and Unplugged **Big Ideas:** How does programming and unplugged activities develop computational thinking?	Wing (2006) Computational Thinking CS Unplugged (n.d.). What is computational thinking? Swecker (2020). Coding in the primary classroom Davis et al., (2019) Chapter 4: Technology *Instructor will decide on technology will be used in this course section.	
Week 7 Oct. 28-Nov. 1	Technology: Programming and Computational Thinking **Big Ideas:** What and how does technology support STEM	Williams (2023). Problem-based learning in computer science Langevin et al. (2021). Enriching geometric understanding through early STEM pedagogy	

	(interdisciplinary problem-solving)?	Alberta Education (2022). Science K-6 Curriculum (Computational Thinking)	
Week 8 Nov. 4-8	STEM Education **Big Ideas**: The importance of understanding the nature of science and connections between math, science, and computational thinking for interdisciplinary problem solving	Wilcox & Lake (2018) Teaching the nature of science Watson et al. (2021) The nature of math	
Nov. 11-15		Fall Break	
Week 9 Nov. 18-22	STEM and Engineering Design Process **Big Ideas:** The importance and purpose of the engineering design process within STEM education.	Maiorca & Roberts (2022) Problem-solving by design: The integrated STEM practices Davis et al., (2019) Chapter 5: Engineering *or* NGSS: Engineering Design	
Week 10 Nov. 25-29	Interdisciplinary Problem Solving and STEM design **Big Ideas:** Understand importance of collaboration, team work, STEM education as a way to approach problem solving	Roberts & Maiorca (2023) Revisiting the integrated STEM practices Davis et al., (2019) Chapter 7: STEM Education	
Week 11 Dec. 2- 6	STEM Education **Big Ideas:** Collaboration for teaching and learning	STEM LT3 Presentations	**LT1 Part B: Due December 6** **LT3:** **Due December 6**

CHANGES TO SCHEDULE:
Please note that changes to the schedule may occur to meet the emerging needs and dynamics of the participants in the course.

LEARNING TASKS AND ASSESSMENT

Generative AI :

- AI tools can be used for creating assignment outlines or critiquing drafts, but the final work must be original.
- Students must not copy or paraphrase from AI applications for assignments
- AI tools will be prohibited for major assignments, or research papers but allowed for information gathering.
- All other considerations for AI use must be cleared with the instructor.

There are three required Learning Tasks for this course.

LT1 – Build Understanding of STEM Disciplines, STEM as Interdisciplinary Problem Solving, and Teaching STEM – Reflective Learning (40%) – Due: September 16 and December 6

This learning task has two parts. The intent is to capture your initial understandings and then reflect upon your growth of new insights about STEM education. *You may find that daily journal writing, photos, or videos of your thinking/work will support your knowledge development for LT1.*

Part A (15%): Students will write an initial summary of their understanding about what the purpose of STEM Education and the nature of the STEM disciplines. This will be in the form of a journal narrative or essay format with a 500 word maximum.

Part B (25%): Students will write about their new insights of STEM Education, nature of STEM disciplines, and how inquiry-based, problem-based STEM pedagogies will inform their future teaching practices. This work will be in the form of a journal narrative or essay format within a range of 500-750 words.

Criteria For Assessment of Learning Task 1: Part A

Criteria	Excellent (A+ to A)	Good (A- to B)	Satisfactory (B- to C)	Unsatisfactory
STEM Education. (25%)	Student can demonstrate an honest statement of place in understanding of STEM Education through meaningful reflections and references to course readings and learning experiences	Student demonstrates a good understanding of their initial understanding of STEM Education through course reflections and some meaningful references to course readings and learning experiences.	Student is still developing an understanding of STEM Education and from the course readings and course learning experiences.	Student is not demonstrating an understanding of STEM Education from the course readings and learning experiences.
Developing knowledge about the nature of STEM disciplines. (25%)	Student can demonstrate an honest statement about current understandings regarding the nature of STEM disciplines through meaningful reflections and thoughts about	Student demonstrates a reasonable statement of initial understandings regarding of the nature of STEM disciplines through course reflections and some meaningful	Student is still developing an understanding of the nature of STEM disciplines from the course readings and course learning experiences.	Student is not demonstrating an understanding of the nature of STEM disciplines from the course readings and learning experiences.

	excitements, and concerns about this knowledge.	references to course readings and learning experiences.		
Correct and meaningful citations of course readings and other resources (35%)	The references are meaningful and properly cited in APA 7th edition.	Most of the citations are meaningful to the student's work. There are one to two mistake(s) found in the APA 7 references (e.g. missing comma, period, italics, etc.).	Few of the citations are meaningful to the student's work. There are three to four mistakes in the APA 7 references.	Citations are not meaningful for the student's work. There are more than four mistakes in the APA 7 reference list.
Organization and Presentation Clarity (15%)	The student's journal writing of STEM learning is easy to follow, clarity in thoughts, and relatability to course readings and/or course learning experiences.	The student's journal writing of STEM learning has some key points, sections of work may lack clarity or relatability to the course readings and/or course learning experiences.	The student's journal writing of STEM learning is difficult to understand and does not present a progression of developing a deeper understanding of STEM education. Points lack clarity or relatability to course readings and/or learning experiences.	Student is unable to present a coherent demonstration of work and learning.

Criteria For Assessment of Learning Task 1: Part B

Criteria	Excellent (A+ to A)	Good (A- to B)	Satisfactory (B- to C)	Unsatisfactory
Knowledge Development about STEM Education and disciplinary thinking processes. (30%)	Student can demonstrate a robust understanding of STEM Education and disciplinary thinking processes through meaningful reflections and references to course readings and learning experiences	Student demonstrates a good understanding of STEM Education and disciplinary thinking processes through course reflections and some meaningful references to course readings and learning experiences.	Student is still developing an understanding of STEM Education and disciplinary thinking processes from the course readings and course learning experiences.	Student is not demonstrating an understanding of STEM Education and disciplinary thinking processes from the course readings and learning experiences.

Reflection on how inquiry-based, problem-based pedagogies will inform future teaching practices. (25%)	Student can demonstrate a robust understanding of how STEM pedagogies will inform their future teaching practices through meaningful reflections and references to course readings and learning experiences	Student demonstrates a good understanding of STEM pedagogies will inform their future teaching practices through course reflections and some meaningful references to course readings and learning experiences.	Student is still developing an understanding of STEM pedagogies from the course readings and course learning experiences.	Student is not demonstrating an understanding of STEM pedagogies from the course readings and learning experiences.
Correct and meaningful citations of course readings and other resources (30%)	The references are meaningful and properly cited in APA 7th edition.	Most of the citations are meaningful to the student's work. There are one to two mistake(s) found in the APA 7 references (e.g. missing comma, period, italics, etc.).	Few of the citations are meaningful to the student's work. There are three to four mistakes in the APA 7 references.	Citations are not meaningful for the student's work. There are more than four mistakes in the APA 7 reference list.
Organization and Presentation Clarity (15%)	The student's journal writing of STEM learning is easy to follow, clarity in thoughts, and relatability to course readings and/or course learning experiences.	The student's journal writing of STEM learning has some key points, sections of work may lack clarity or relatability to the course readings and/or course learning experiences.	The student's journal writing of STEM learning is difficult to understand and does not present a progression of developing a deeper understanding of STEM education. Points lack clarity or relatability to course readings and/or learning experiences.	Student is unable to present a coherent demonstration of work and learning.

LT2 – Building Understanding of the M in STEM through *Relearning* a Key Math Concept (30%)– Due: October 4

Students will:

- Select a math concept for developing deeper understanding of symbolic notations, operations, and/or contextual meanings (units and measurement);
- Explore multiple representations for a math concept that is present within the Alberta Curriculum;
- Explain the difference between a math visual and manipulative;
- Discuss your role as a math learner and math teacher;
- Discuss what you learned through the *relearning* process and how this will inform your future teaching practice.

You may find that daily journal writing, photos, or videos of your thinking/work will support your knowledge development for LT2.

This learning task is a personal narrative to share your insights from this *relearning* process. This personal narrative will include a detailed description of the selected math concept, knowledge development of the concept through definitions, visuals, manipulatives, context (units), and connections to other math concepts. Photos of your personal work with math visuals, manipulatives, and/or paper and pencil work will accompany your written descriptions. This can be composed through PowerPoint slides, Word document, or a medium acceptable by your instructor. As a guide for written text, please consider 500-1000 words for your written work.

Criteria For Assessment of Learning Task 2

Criteria	Excellent (A+ to A)	Good (A- to B)	Satisfactory (B- to C)	Unsatisfactory
Knowledge Development through *relearning* of a Math Concept(s) **(30%)**	Student can demonstrate a robust understanding of a select mathematics concept. Multiple representations and/or connections to other mathematics concepts are accurately portrayed in student work.	Student demonstrates a good understanding of select mathematics concept(s). Minimal representations and/or connections to other mathematics concepts are portrayed in student work.	Student is still developing a conceptual understanding of the selected mathematics concept. Only one representation of the mathematics concept(s) is portrayed in student work.	Student is not demonstrating/sharing work evident of relearning or unpacking a math concept.
Relearning math concept with reflections on course readings **(25%)**	Student can demonstrate a robust understanding of their relearning/unpacking a math concept with excellent (meaningful) references to the course readings or resources that are specifically related to mathematics thinking, teaching and learning.	Student demonstrates a good understanding of course readings about mathematical thinking, learning and teaching. Moderate references made with meaningful connections to the student's work.	Student is still developing an understanding of the course readings regarding mathematical thinking, learning and teaching. Minimal references are made that have meaningful connections to the student's work.	Student does not understand the course readings regarding mathematics thinking, learning and teaching. No meaningful references are made regarding their work.
Correct citations of course readings and other resources **(15%)**	The references are properly cited in APA 7th edition.	There are one to two mistake(s) found in the APA 7 references (e.g. missing comma, period, italics, etc.).	There are three to four mistakes in the APA 7 references.	There are more than four mistakes in the APA 7 reference list.
Organization and Presentation Clarity **(15%)**	Students' presentation of mathematical learning is easy to follow (has a beginning, middle, end, and future	Students' presentation of mathematical learning has some key points, sections of work may lack clarity or relatability	Students' presentation of mathematical learning is difficult to understand and does not present a progression of	Student is unable to present a coherent demonstration of work and learning.

	considerations for mathematics learning and teaching).	to the course readings.	developing a deeper understanding of the mathematical concept.	
Addressing Future Applications for the Mathematical Knowledge Learned and Presented in this Assignment (15%)	Student clearly articulates how (such as what grade or specific learning outcomes) their new mathematical knowledge can be used for the future work of teaching.	Student communicates some insight about how their new mathematical knowledge can be applied in their future work of teaching.	Student is still developing an understanding about how new mathematical understandings from relearning a math concept can assist their future work of teaching.	Student does not mention any future applications of their presented mathematical knowledge.

LT3: Building Understanding of STEM through the Engineering Design Process (30%) – Due: December 6

* Instructor will have final decision on which technology may be used for the STEM design. The software list in the course resources are suggestions, if and when the instructor requires student use of such resources. Instructor may incorporate other software/hardware not included in that list.

The group (maximum of 4 members) will design a STEM challenge for *Making the World a Better Place.* This STEM challenge will clearly reflect the engineering design process, address an authentic real-world problem, and state for whom this real-world design will benefit (purpose). The main curriculum content can include any disciplinary area (or multiple disciplinary areas) as well as specific mathematics content and science content (from Alberta Education Curriculum). Students are expected to design this STEM challenge keeping in mind how this could be addressed/implemented in a grade school classroom.

This design STEM challenge will:

- State a description of the STEM challenge;
- incorporate interdisciplinary problem solving through engaging the STEM disciplinary processes (scientific inquiry, mathematical thinking, computational thinking, and engineering design process);
- engage students in collaborative team work;
- explicitly describe which learning outcomes from Alberta Education curriculum (including grade and discipline) and at least one math and science curriculum outcome being addressed in the STEM challenge, along with reasoning for why these learning outcomes were selected for this STEM challenge.

Presentation: The format for which the group will share the STEM challenge will be through an appropriate medium that is suitable for demonstrating the STEM challenge description, processes, and learning outcomes. This format will be discussed with the instructor.

Group members will receive the same grade.

Criteria For Assessment of Learning Task 3

Design Challenge	Excellent (A+ to A)	Good (A- to B)	Satisfactory (B- to C)	Unsatisfactory
Challenge (40%)	Created an authentic, and inquiry-based STEM challenge, that centralizes the theme of *Making the World a Better Place.* There is clear communication about a real world *need* for this design and how (and whom) the design may benefit.	Created a STEM challenge that is authentic, that touches upon the theme of *Making the World a Better Place*. There is moderate communication about the real world *need* for this design and how (and for whom) this design may benefit.	Created a STEM challenge but does not accurately reflect the expectation for this challenge. May not have all needed information. There is no communication about the *need* for the design and how (whom) this design may benefit.	Did not create STEM challenge.
Concept Identifications Minimum to incorporate- Mathematics x 2 Science x 1 (15%)	All concepts are clearly, accurately, and sufficiently identified and developed within the challenge. Direct connections are made to the Alberta curriculum.	Most concepts are accurately identified and developed within the challenge. Connections are made to the Alberta curriculum. More detail is required, or a concept is missing.	Concepts are insufficiently identified, underdeveloped, and/or missing.	Concepts are not stated and/or inaccurate.
Concept Explanations (15%)	Reasoning for why these concepts were selected for the challenge are clearly articulated. Strong ways the concepts connect to the challenge are clearly and accurately explained.	Reasoning for why the concepts were selected for the challenge lacks sufficient description. Concept connections to STEM challenge are explained. More detail is needed.	Reasoning for why the concepts were selected for the STEM challenge are not sufficient or underdeveloped. The ways the concepts are connected or addressed by the challenge are vague.	Reasoning for why the concepts were selected was not stated. Concept connections to the STEM challenge are not evident.

Engineering Design Process (15%)	Clearly articulates and illustrates how learners will recognize and apply the components of the engineering design process as found in the challenge.	Articulates how learners will recognize and apply the components of the engineering design process as found in the challenge.	Articulates an engineering design process that is generic and/or superficial to the challenge.	Does not articulate an engineering design process.
Presentation (in-class) (15%)	Presentation of challenge is ready, easily accessible to understand the purpose and learning outcomes. STEM Education goals and processes are clearly articulated and evident.	Presentation of challenge is ready and mostly accessible to understand the purpose and learning outcomes. STEM Education goals and processes are somewhat evident and/or articulated.	Presentation of challenge is mostly ready. Group work is still developing in the purpose and clarity of the learning outcomes. STEM Education goals and processes are not clear or evident.	Presentation is not ready and/or does not provide the purpose or any connection to curricular learning outcomes.

THE EXPECTATION OF EXCELLENCE IN PROFESSIONAL WORK

Please review the Academic Calendar carefully. It describes the program and provides detailed schedules and important dates. It contains information on expectations for student work and professional conduct. In addition, procedures are described regarding concern about student performance in the program. Please pay especially careful attention to details and descriptions in the following topic areas:

- *The Importance of Attendance and Participation in Every Class*

As this is a professional program, experiences are designed with the expectation that all members will be fully involved in all classes and in all coursework experiences. As you are a member of a learning community your contribution is vital and highly valued, just as it will be when you take on the professional responsibilities of being a teacher.

- *Engagement in Class Discussion and Inquiry*

Another reason for the importance of attendance and participation in every class is that the course involves working with fellow students to share ideas and thinking. For example, each class you will work with a small group to engage fellow students in discussions on work being considered in class. You will also help other groups by providing ideas for scholarly inquiry in assignments. If you find that you are experiencing difficulties as a group collaborating, please inform the instructor.

EXPECTATIONS FOR WRITING

All written assignments (including, to a lesser extent, written exam responses) will be assessed at least partly on writing skills. Writing skills include not only surface correctness (grammar, punctuation, sentence structure, etc.) but also general clarity and organization. Sources used in research papers must be properly documented. If you need help with your writing, you may use the writing support services in the Learning Commons. For further information, please refer to the official online University of Calgary Calendar, Academic Regulations, E. Course Information, E.2: Writing Across the Curriculum: http://www.ucalgary.ca/pubs/calendar/current/e-2.html

MISSING OR LATE SUBMISSIONS

All late submissions of assignments must be discussed with the instructor **prior to the due date.** A deferral of up to 30 days may be granted at the discretion of the Associate Dean of Undergraduate Programs prior to the end of the course with accompanying written evidence. https://calendar.ucalgary.ca/pages/jyekfh6xwhoHwxcetCi1

ISSUES WITH GROUP TASKS

With respect to group work, if your group is having difficulty collaborating effectively, please contact the instructor immediately. If a group is unable to collaborate effectively or discuss course materials online in a timely manner, the instructor may re-assign members to different groups or assign individual work for completion.

GRADING: https://calendar.ucalgary.ca/pages/fc4adb8643f84441ab32300237b80df1

Grade	GPA Value	%	Description
A+	4.0	95-100	Outstanding
A	4.0	90-94	Excellent – Superior performance showing comprehensive understanding of the subject matter
A-	3.7	85-89	
B+	3.3	80-84	
B	3.0	75-79	Good - clearly above average performance with knowledge of subject matter generally complete
B-	2.7	70-74	
C+	2.3	65-69	
C	2.0	60-64	Satisfactory - basic understanding of the subject matter
C-	1.7	55-59	
D+	1.3	52-54	Minimal pass - Marginal performance
D	1.0	50-51	
F	0.0	49 and lower	Fail - Unsatisfactory performance

Students in the B.Ed. program must have an overall GPA of 2.5 in the semester to continue in the program without repeating courses.

Academic Misconduct

Academic Misconduct refers to student behavior which compromises proper assessment of a student's academic activities and includes cheating; fabrication; falsification; plagiarism; unauthorized assistance; failure to comply with an instructor's expectations regarding conduct required of students completing academic assessments in their courses; and failure to comply with exam regulations applied by the Registrar.

For information on the Student Academic Misconduct Policy and Procedure please visit:

https://www.ucalgary.ca/legal-services/university-policies-procedures/student-academic-misconduct-policy

https://www.ucalgary.ca/legal-services/university-policies-procedures/student-non-academic-misconduct-policy

Additional information is available on the Academic Integrity Website at: https://ucalgary.ca/student-services/student-success/learning/academic-integrity

Academic Accommodation

It is the student's responsibility to request academic accommodations according to the University policies and procedures listed below. The student accommodation policy can be found at: https://ucalgary.ca/student-services/access/prospective-students/academic-accommodations.

Students needing an accommodation because of a disability or medical condition should communicate this need to Student Accessibility Services in accordance with the Procedure for Accommodations for Students with Disabilities: https://www.ucalgary.ca/legal-services/sites/default/files/teams/1/Policies-Accommodation-for-Students-with-Disabilities-Procedure.pdf

Research Ethics
Students are advised that any research with human participants – _including any interviewing (even with friends and family), opinion polling, or unobtrusive observation – _must have the approval of the Conjoint Faculties Research Ethics Board (https://research.ucalgary.ca/conduct-research/ethics-compliance/human-research-ethics/conjoint-faculties-research-ethics-board-cfreb) or the Conjoint Health Research Ethics Board https://research.ucalgary.ca/conduct-research/ethics-compliance/human-research-ethics/conjoint-health-research-ethics-board-chreb)

In completing course requirements, students must not undertake any human subjects research without discussing their plans with the instructor, to determine if ethics approval is required. Some courses will include assignments that involve conducting research with human participants; in these cases, the instructor will have applied for and received ethics approval for the course assignment. The instructor will discuss the ethical requirements for the assignment with the students.

For further information see E.5 Ethics of Human Studies
https://calendar.ucalgary.ca/pages/627ed88eb4b041b7a2e8155effac350

Instructor Intellectual Property
Course materials created by instructors (including presentations and posted notes, labs, case studies, assignments and exams) remain the intellectual property of the instructor. These materials may NOT be reproduced, redistributed or copied without the explicit consent of the instructor. The posting of course materials to third party websites such as note-sharing sites without permission is prohibited. Sharing of extracts of these course materials with other students enrolled in the course at the same time may be allowed under fair dealing.

Freedom of Information and Protection of Privacy
Student information will be collected in accordance with typical (or usual) classroom practice. Students' assignments will be accessible only by the authorized course faculty. Private information related to the individual student is treated with the utmost regard by the faculty at the University of Calgary. For more information, please see: https://www.ucalgary.ca/hr/work-compensation/working-ucalgary/freedom-information-and-privacy-act

Copyright Legislation
All students are required to read the University of Calgary policy on Acceptable Use of Material Protected by Copyright (https://www.ucalgary.ca/legal-services/university-policies-procedures/acceptable-use-material-protected-copyright-policy) and requirements of the copyright act (https://laws-lois.justice.gc.ca/eng/acts/C-42/index.html) to ensure they are aware of the consequences of unauthorised sharing of course materials (including instructor notes, electronic versions of textbooks etc.). Students who use material protected by copyright in violation of this policy may be disciplined under the Non-Academic Misconduct Policy https://www.ucalgary.ca/legal-services/university-policies-procedures/student-non-academic-misconduct-policy.

Sexual and Gender-Based Violence Policy
The University recognizes that all members of the University Community should be able to learn, work, teach and live in an environment where they are free from harassment, discrimination, and violence. The University of Calgary's sexual violence policy guides us in how we respond to incidents of sexual violence, including supports available to those who have experienced or witnessed sexual violence, or those who are alleged to have committed sexual violence. It provides clear response procedures and timelines, defines complex concepts, and addresses incidents that occur off-campus in certain circumstances. Please see the policy available at https://www.ucalgary.ca/legal-services/university-policies-procedures/sexual-and-gender-based-violence-policy

Other Important Information

Please visit the Registrar's website at: https://www.ucalgary.ca/registrar/registration/course-outlines for additional important information on the following:

- Wellness and Mental Health Resources
- Student Success
- Student Ombuds Office
- Student Union (SU) Information
- Graduate Students' Association (GSA) Information
- Emergency Evacuation/Assembly Points
- Safewalk

The Freedom of Information Protection of Privacy Act prevents instructors from placing assignments or examinations in a public place for pickup and prevents students from access to exams or assignments other than their own. Therefore, students and instructors may use one of the following options: return/collect assignments during class time or during instructors' office hours, students provide instructors with a self-addressed stamped envelope, or submit/return assignments as electronic files attached to private e-mail messages.

For additional resources including, but not limited to, those aimed at wellness and mental health, student success or to connect with the Student Ombuds Office, please visit https://www.ucalgary.ca/registrar/registration/course-outlines

Education Students Association (ESA) President for the academic year is Claire Gillis, esa@ucalgary.ca.

Werklund SU Representative is Tracy Dinh, educrep@su.ucalgary.ca.