Beijing Advanced Innovation Center for Future Education (AICFE)

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FUTURE SCHOOL 2030

Reimagining Technology-Enhanced STEM Teacher Education for 21st Century: From more technology to increased quality of teaching and learning

Dr. Marina Milner-Bolotin

Seminar 2 – January 15, 2017 Beijing Normal University

Dr. Marina Milner-Bolotin

- Associate Professor in

  STEM Education, UBC, Canada

- Department of Curriculum & Pedagogy

- **e-mail:** marina.milner-bolotin@ubc.ca

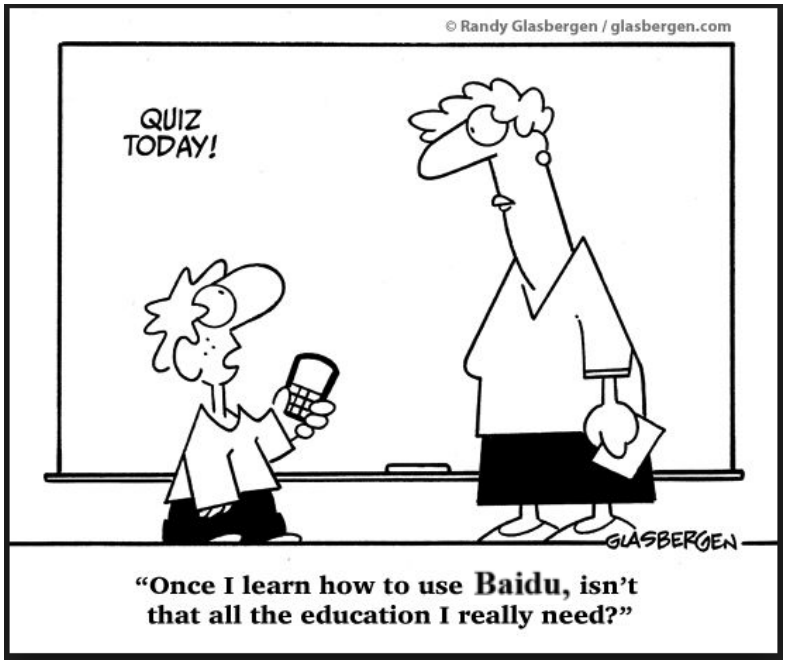
- **Web site:** http://blogs.ubc.ca/mmilner/

If we teach today as we taught yesterday, then we rob our students of tomorrow.

John Dewey (1859-1952)

Content

1. Introduction
2. Research Progress Report:
   a. Literature review/analysis
   b. New Theoretical Framework
3. Case analysis: MET Online Program
4. Future Research

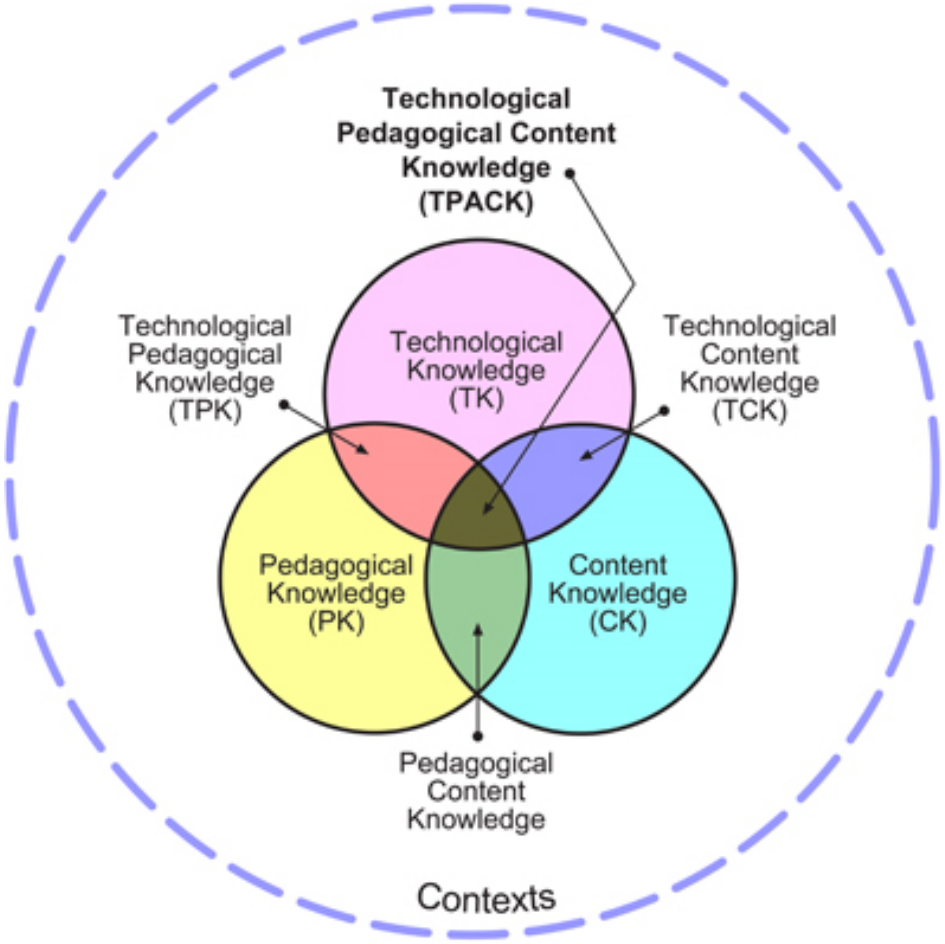


1. Introduction: Key Questions

- **Why & how** should we use technology?
- **What new opportunities** does it offer?
- **What** are teachers' incentives for adopting them?
- **How** do we support teachers?
- **How will technology inspire** new pedagogies?

ON TEACHERS, not TECHNOLOGY

2. Theoretical Framework: (a) TPACK



Teachers should experience learning STEM with technology as learners and as future teachers.

[Koehler, M. J., & Mishra, P. (2009). What is technological pedagogical content knowledge? *Contemporary Issues in Technology and Teacher Education,* **9** (1), 60-70.]

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Rethinking Technology-Enhanced Physics Teacher Education: From Theory to Practice

Marina Milner-Bolotin

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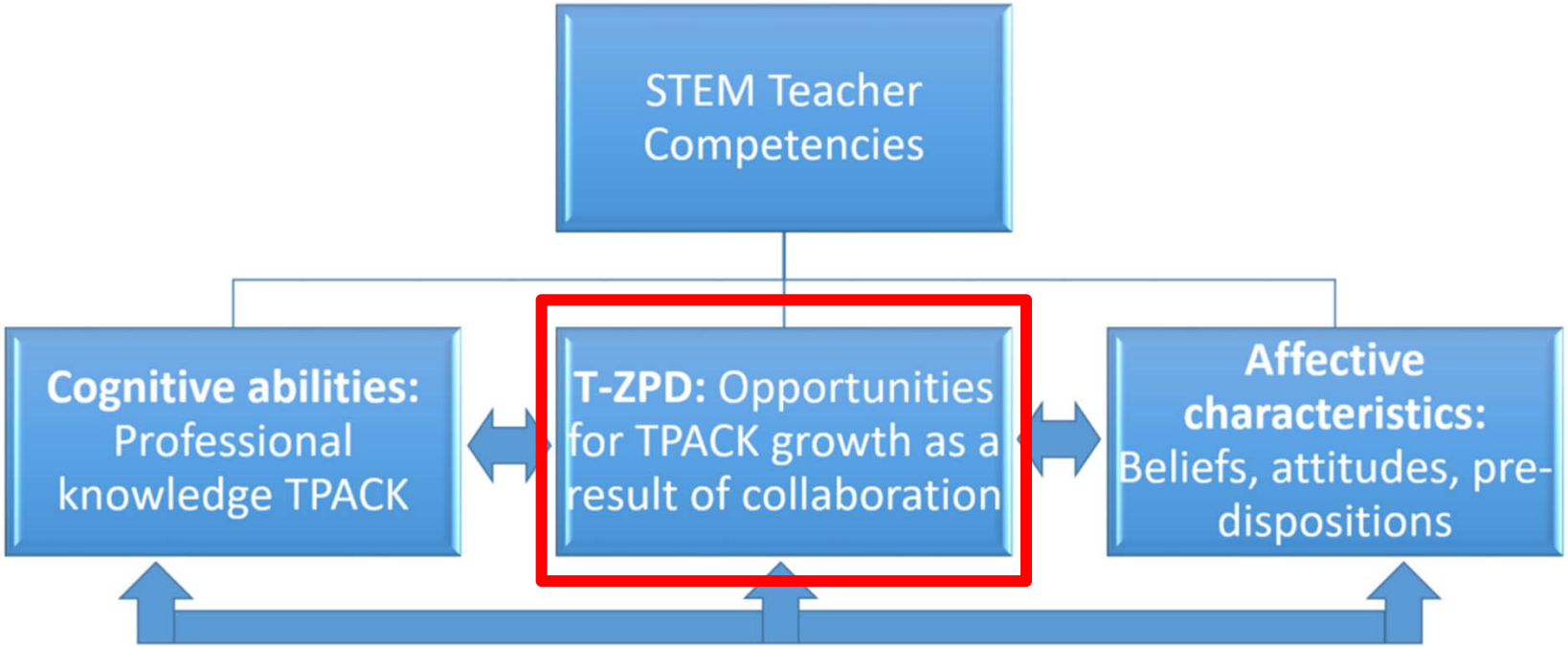
To link to this article: http://dx.doi.org/10.1080/

[M. Milner-Bolotin, "Rethinking technology-enhanced physics teacher education: From theory to practice", *Canadian Journal of Science, Mathematics and Technology Education,* **16**, 284-295 (2016).]

Theoretical Framework: (b) Teacher-Zone of Proximal Development – T-ZPD



[Milner-Bolotin, M. (2017). Technology-supported inquiry in STEM teacher education: Collaboration, challenges and possibilities. In I. Levin & D. Tsybulsky (Eds.), *Digital Tools and Solutions for Inquiry-Based STEM Learning* (pp. 20): IGI-Global.]

Modeling Active Engagement Pedagogy through Classroom Response Systems in a Physics Teacher Education Course

Marina Milner-Bolotin
Department of Curriculum and Pedagogy, Faculty of Education, The University of British Columbia • marina.milner-bolotin@ubc.ca

Heather Fisher
Department of Curriculum and Pedagogy, Faculty of Education, The University of British Columbia

Alexandra MacDonald
Department of Curriculum and Pedagogy, Faculty of Education, The University of British Columbia

Abstract One of the most commonly explored technologies in Science, Technology, Engineering, and Mathematics (STEM) education is Classroom Response Systems (clickers). Clickers help instructors generate in-class discussion by soliciting student responses to multiple-choice conceptual questions and sharing the distribution of these responses with the class. The potential benefits of clicker-enhanced pedagogy include: increased student engagement, reduced anxiety, continuous formative assessment, and enhanced conceptual understanding. Most studies, however, [illegible] the effects of clicker-enhanced instruction in large undergraduate STE[illegible] pedagogy on learning in small secondary or post-seconda[illegible] ntext of this study is a secondary physi[illegible]

[M. Milner-Bolotin, H. Fisher, & A. MacDonald, "Modeling active engagement pedagogy through classroom response systems in a physics teacher education course", LUMAT: *Research and Practice in Math, Science and Technology Education*, 1, 523-542 (2013).]

Theoretical Framework: (c) Deliberate Pedagogical Thinking with Technology

When teachers deliberately use specific technologies to improve student learning – this thinking is driven by a goal of improving student learning.

[Milner-Bolotin, M. (2016). Rethinking technology-enhanced physics teacher education: From theory to practice. *Canadian Journal of Science, Mathematics and Technology Education, 16*(3), 284-295. doi:10.1080/14926156.2015.1119334]

PHYSICAL REVIEW PHYSICS EDUCATION RESEARCH **12,** 020128 (2016)

Investigating the effect of question-driven pedagogy on the development of physics teacher candidates' pedagogical content knowledge

Marina Milner-Bolotin, Davor Egersdorfer, and Murugan Vinayagam
Department of Curriculum and Pedagogy, Faculty of Education, The University of British Columbia, 2329 West Mall, Vancouver, British Columbia V6T 1Z4, Canada
(Received 29 April 2016; published 7 September 2016)

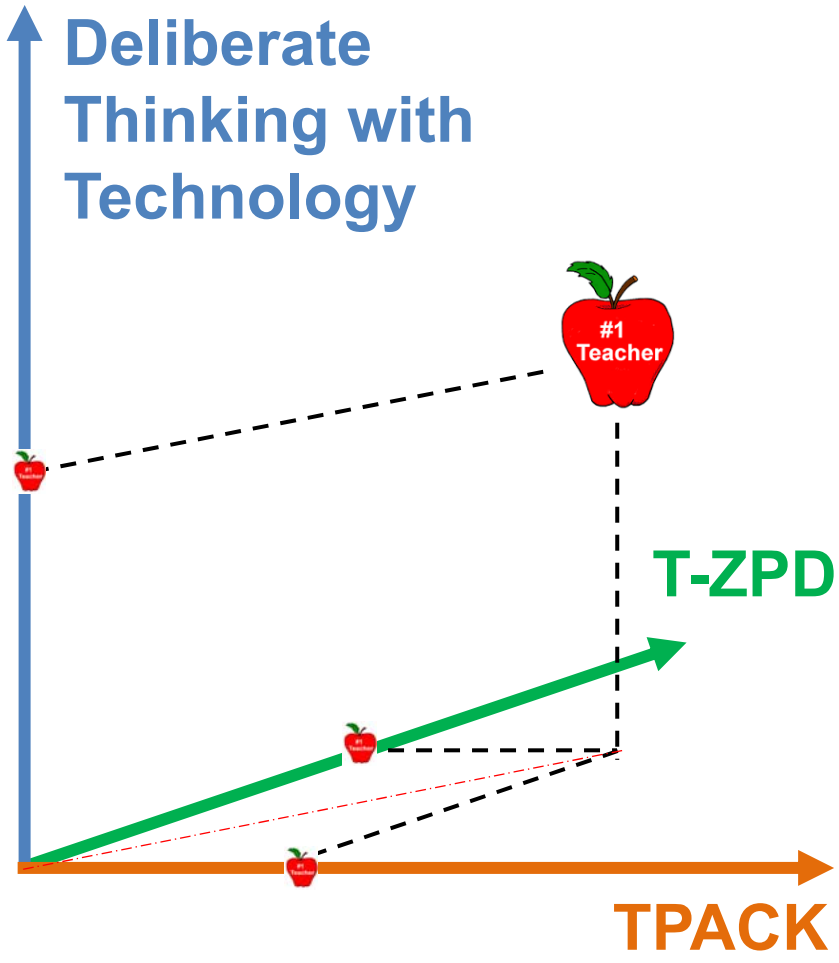
This paper describes the second year of a multi-year study on the implementation of Peer Instruction and PeerWise-inspired pedagogies in a physics methods course in a teacher education program at a large research university in Western Canada. In the first year of this study, Peer Instruction was implemented consistently in the physics methods course and teacher candidates were asked to submit five conceptual multiple-choice questions as a final assignment. In the second year of the study we incorporated PeerWise online tool to facilitate teacher candidates' design of conceptual questions by allowing them to provide and receive feedback from their peers, and consequently improve their questions. We have found that as a result of this collaboration teacher candidates improved their pedagogical content knowledge as measured by the rubric developed for the study.

DOI: 10.1103/PhysRevPhysEducRes.12.020128

I. INTRODUCTION: ADDRESSING THE CHALLENGES OF PHYSICS TEACHER EDUCATION

often question driven, it is not surprising that a key element of PCK is teacher's ability to ask questions that elicit student conceptual difficulties and promote meaningful

3-D Theoretical Framework for Teacher Professional Development



We can think of teachers in terms of their knowledge (TPACK), ability to extend it as a result of peer collaboration (T-ZPD), and their ability to think deliberately about technology-enhanced teaching and learning

PROMOTING RESEARCH-BASED PHYSICS TEACHER EDUCATION IN CANADA: BUILDING BRIDGES BETWEEN THEORY AND PRACTICE

BY MARINA MILNER-BOLOTIN

More than 25 years ago, Lee S. Shulman, then president of the American Educational Research Association [1], challenged us to re-think how we prepare teachers through focussing on *Pedagogical Content Knowledge* (PCK) - the knowledge of content and content-specific pedagogies. Shulman pointed out that in their attempt to incorporate generic educational research, many Teacher Education Programs suffered from the "missing paradigm" problem. They neglected the nature

content-specific professional development, teacher education programs should emphasize the development of teacher-candidates' PCK.

Lastly, there is a significant gap between the findings of Physics Education Research (PER) [4] and current physics teaching practices. In the words of [illegible] Laureate, Prof. Carl Wieman

[M. Milner-Bolotin, "Promoting research-based physics teacher education in Canada: Building bridges between theory and practice", *Physics in Canada,* **70**, 99-101 (2014).]

3. Case Analysis: MET at UBC

UBC100

THE UNIVERSITY OF BRITISH COLUMBIA

Vancouver Campus

Faculty of Education
Master of Educational Technology

Home | Program Overview | Courses | How to Apply | MET Faculty | For Students | FAQs

MET

Program Overview

The Master of Educational Technology (MET) is a graduate-level program offered by The University of British Columbia, a world-renowned university, located in Vancouver BC, Canada. The MET curriculum is designed for educators at all levels and in diverse contexts:

- K-12 teachers
- college and university educators
- adult/industry educators
- course designers

Three Program Options

The program offers three internationally recognized credentials:

PROGRAM OVERVIEW

- Master's Program
- Certificate Options
- Admission Requirements
- Tuition and Fees
- ePortfolio

Master of Educational Technology (MET) at UBC

- **Fully online** graduate level program
- **Instructors:** UBC faculty members
- **Participants:** K-12 teachers, college instructors, industry professionals, course designers
- **Graduation options:** Masters, Graduate certificate in technology-based learning
- **Extensive use of technology** in the program
- **Collaborative, diverse and motivated** learners

MET Demographics & Feedback

Locations of participants of an ETEC 533 graduate course in the MET program taught by the author in 2013

When a document begins in BC, is refined in China, polished in Ontario, proofed in Japan, and submitted from New York, you know you've been part of a truly global learning experience.

Pros and Cons

	PROS	CONS
For instructors	Opportunities for international collaboration, learning about new technologies, curricula, teaching ideas. Flexibility in course delivery Ability to address current trends and issues and tailor the program to students	Very time consuming, labour intensive, requires strong skill in student engagement. Requires a lot of personal contact with students, mentorship. Requires a lot of planning and structuring (more is often less…).
For students	Grants a graduate degree by a world-class university. Small groups, learning flexibility (online). Opportunities for international collaboration, learning about new technologies, curricula, teaching ideas.	Requires a lot of discipline, ability to learn, be open to collaboration. Can be very overwhelming. Relatively expensive. Significant time commitment – requires a lot of discipline.
This professional development opportunity is initiated by the students. Most often, the incentive is a salary increase and a requirement for job advancement.		

Participants' Feedback

Teacher-participants value:

- Practicing of technologies as students before implementing them as teachers (**TPACK)**
- Collaboration with other teachers focussed on implementation of new technologies **(T-ZPD)**
- Interactions with the instructor and prompt feedback
- Understanding of pedagogical goals of technology use (Deliberate Pedagogical Thinking)

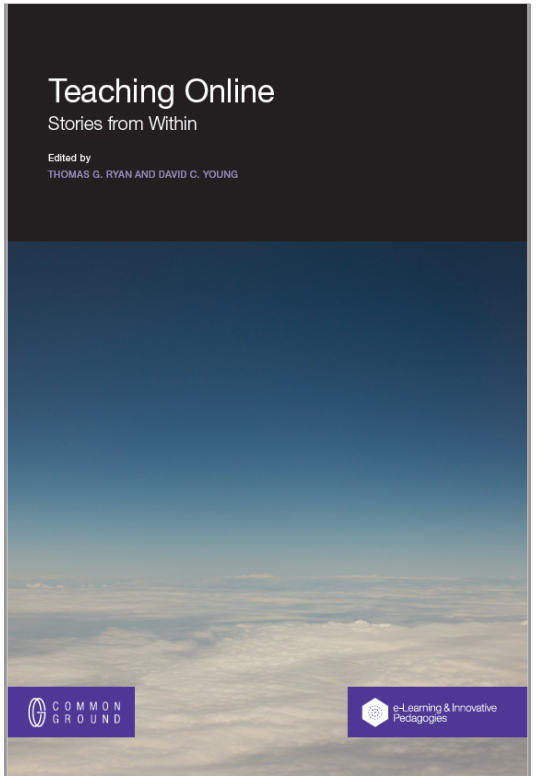
Chapter 2: Making Online Graduate Teacher Education Courses Matter—From Theory to Successful Technology-enhanced Practice

Dr. Marina Milner-Bolotin

Skilled Educators create rich learning environments where students are introduced to new ideas, develop new skills, and expand their perspectives. The informed use of technology can *engage students* in new experiences and *create a community of learners* across geographical boundaries. The University of British Columbia Master of Educational Technology is a fully online graduate-level program offered by a world-renowned university that has attracted students from over 35 countries. (met.ubc.ca)

Let the Journey Begin: Getting Involved with Online Graduate Teacher Education

In the winter of 2009, a month before I officially became a member of the Faculty of Education at the University of British Columbia (UBC), I was asked to teach an online course titled "Technology in the Mathematics and Science Classroom" (http://met.ubc.ca/etec-533/). This course is a part of the UBC Master of Educational Technology (MET) fully online graduate program that attracts hundreds of educators from all over the world (http://met.ubc.ca/). Si
never taught an online undergraduate or graduate course befo
discover that the course had already been offered in
asked to be an instructor of the course "rea
educator knows that teaching a cours

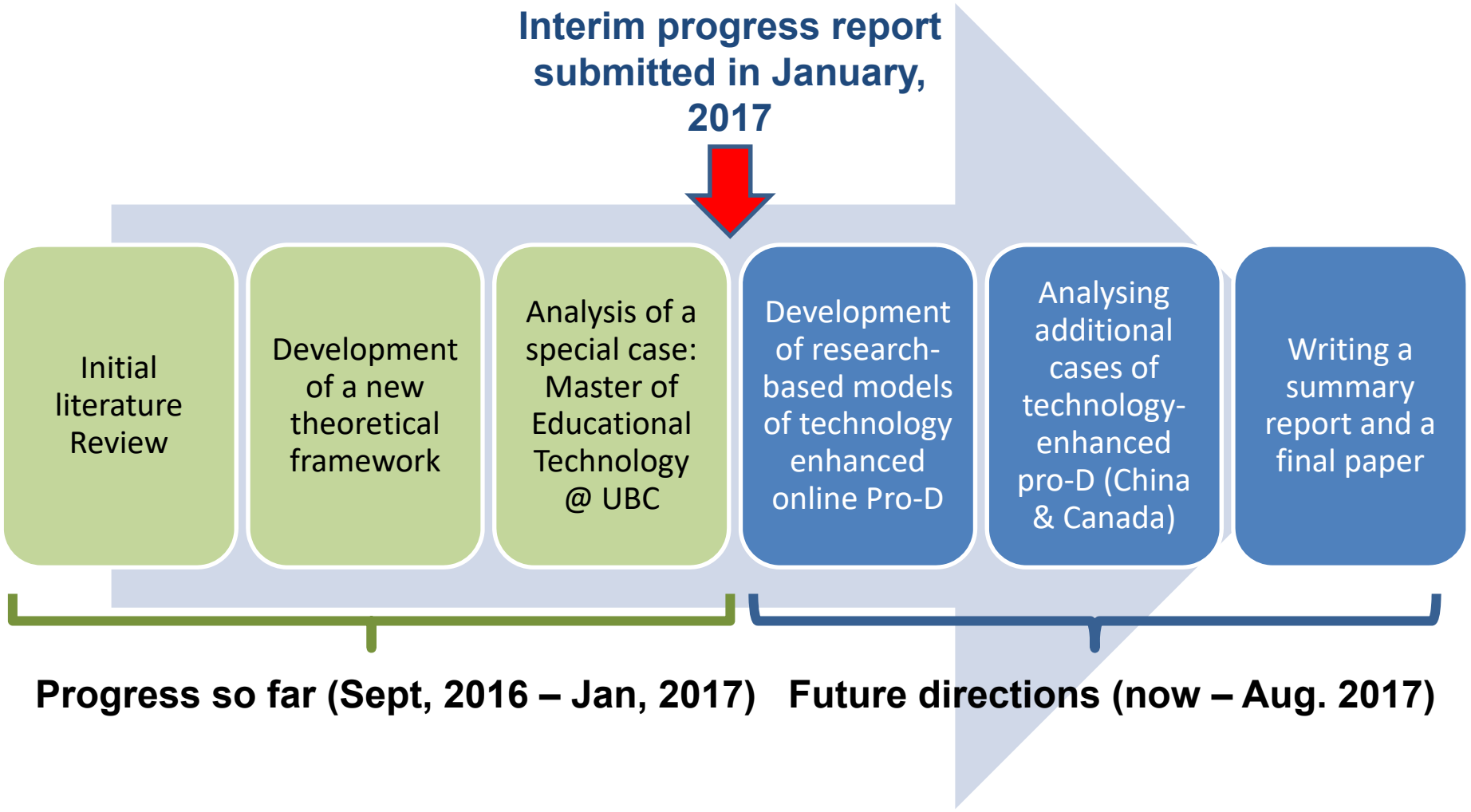


[Milner-Bolotin, M. (2014). Making online graduate teacher education courses matter - from theory to successful technology-enhanced practice. In T. G. Ryan & D. C. Young (Eds.), *Teaching Online: Stories from Within* (pp. 10-31). Champaign, IL, USA: Common Ground.]

4. Future Directions

1. **Investigate:**
   a) Key elements of successful STEM teacher professional development (literature analysis).
   b) Key pitfalls of technology-enhanced pro-development (literature analysis).
2. **Suggest** research-based models for technology-enhanced STEM teacher professional development relevant to China and Canada
3. **Suggest a research study** for conducting a comparative analysis between Chinese and Canadian teacher professional development.

Research Progress Report



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Beijing Advanced Innovation Center for Future Education