SALTISE

Proceedings from the 9th Annual Meeting

2020 COVID-19 Pivot

LES TRANSFORMATIONS EN ENSEIGNEMENT:
Petits changements, grands impacts

TEACHING TRANSFORMATIONS:
Small changes, big impact

Connect with SALTISE

Visit our website at:
www.saltise.ca

Find us on Twitter, Facebook and Linkedin YouTube.

Connectez avec SALTISE

Visitez notre site web:
www.saltise.ca

Retrouvez-nous sur Twitter, Facebook et Linkedin YouTube.

Table of Contents | Table des matières

Please note that some papers are in French

Introduction 8

Active Learning Practices & Strategies

Oral communication in Science: Self-efficacy and other factors influencing performance of college science students.. 10
Caroline Cormier, Simon Langlois

Approaches for Decolonizing and Indigenizing Education: Lessons from the Intercollegiate Decolonization Network -- a grassroots collective 11-12
Debbie Lunny, Alyson Jones, Jennifer Qupunuaq May, Jennifer Savard

Creating of online courses and MOOC with Agile. 13
Orzu Kamolova, Chloe Lei, Cristina Sanza, David Secko, Andrea Hunter

Developing 21st C Skills with Online Curation and Social Annotation 14
Patti Kingsmill, Kelly Macdonald, Phoebe Jackson, Kevin Lenton, Heather Roffey, Toby Moneit, Aurora Flewwellyng-Skup

Making online course materials accessible: Impactful guidelines.. 15
Maggie Lattuca, Claire Walker, Jennie Ferris

A study of the effectiveness of the redesign of a large introductory mathematics course 16
Alex Rennet, Jaimal Thind, Parker Glynn-Adey, Micheal Pawliuk

Transforming the Instructional Landscape: Dialogues Between Pedagogy and Space 17-18
Carol Rolheiser, Hedieh Najafi, Kelly Gordon, Susan McCahan

FSCI 396 brings undergraduate students into the course assessment and design process.. 19
Tamara Western, Rebecca Brosseau, Iris Guo, Other FSCI 396/397 Course Alumni (Students and Supervisors)

Connecting Research to Practice

Artificial Intelligence in Education: The fine line between a system's and a learner's performance 21
Berenger Benteux, Tanya Chichekian

Feasibility, acceptability, and effectiveness of a large multi-year initiative to support pre-service teacher well-being.. 22
Bilun Naz Boke, Amanda Argento, Stephanie Zito, Julia Petrovic, Isabel Sadowski, Dana Carsley, Nancy Heath

Active learning for high school biology: Collaboration, cooperation, and scientific argumentation in a learning community 23
Elena Boldyreva, Anja Amundrud, James Slotta, Maria Niño-Soto

Discipline-based education specialists: Big impact, one course at a time 24
Warren Code

Quantifying and Promoting Inquiry-based Practices in University-level Physics Laboratories 25
Benjamin Dringoli, Armin Yazdani, Janette Barrington, Thomas Brunner, David Cooke, Kenneth Ragan, Jack Sankey-Childress, Bradley Siwick, Marcy Slapcoff

If you build it they may not come: The essential role of facilitators in engaging youth in maker activities 26
Nathalie Duponsel, Ann-Louise Davidson

Espace Qilib'- Transformer les pratiques éducatives en mobilisant les ressources collectives................................. 27
Geneviève Emond, Delphine Parée

How do professors and students experience teaching and learning in classrooms that use active participatory learning? 28
Kylie Hartley

Exploring the role of Inquiry-based learning to combat math anxiety 29
Rajneet Kaur Maan

Conception d'un outil méthodologique, le « double QCM », pour évaluer les conceptions alternatives d'étudiants du collégial sur la chaleur et la température 30
Abdeljalil Métioui, Louis Trudel

Interprofessional Medical Education (IPE): Using video to Help Students Learn with, from, and about each other 31
Tim Miller

3D Printing as an Educational Technology: Theoretical Perspectives, Learning Outcomes, and Recommendations for Practice 32-33
Heather Pearson, Adam Dubé

Fostering self-regulated learning in the classroom 34
Costanza Piccolo

Results of an action-research with flipped classrooms in 6 institutions; lessons learned and implications for practice 35-36
Bruno Poellhuber, Normand Roy, Vincent Laberge

Misconceptions in University Physics: Example-based Content Promotes the Strongest Conceptual Change 37
Thomas Rademaker, Ben Dringoli, Juliann Wray, Michael Hilke, Ksenia Kolosova

Learning and teaching English vocabulary with clickers 38
Anne-Marie Sénécal, Vanessa Mezzaluna, Walcir Cardoso

The discussion method in physics classrooms: Overcoming pitfalls to elaborate and lead efficient discussions 39
Louis Trudel, Abdeljalil Métioui

OCLaRE — A platform for scaffolding student lab report writing. Update on development 40
Petra Turkewitsch, Michael Dugdale, Murray Bronet, Eric Waldman, Mitchell Babin, Knealand Yates

WebWork Interface implementation in advanced engineering courses 41
David Urman, Maria Orjuela-Laverde, Mathias Legrand

Theoretical Perspectives on Active Learning 42-43
Joel Wiebe, Rubaina Khan, Renato Carvalho, Preeti Raman, Garrick Burron, Ju (Rebecca) Jeong, Allison Van Beek, Susan McCahan, Olivier St-Cyr, James D. Slotta,

New literacies, social practices and active learning in e-discussions 44-45
Lesley Wilton

Educational Technology

CRE-ate: Bringing Research Experience to Undergraduate Lab Courses 47
Veronique Brule, Hugo Zheng, Rodrigo Reyes-Lamothe, Tamara Western, Paul Harrison

Undergraduates can publish too! Biology writing assignments leading to publication..48-49
Chiara Gamberi, Katharine Hall

Corriger avec un cellulaire pour orienter la réussite étudiante en arts visuels... 50
Stéphanie Granger, Jules Massé

Using collaboration technology to transform anatomy education for health professionals..................................51-52
Krista Johansen, Leslie Schneider, Ellie Glasgow

Small changes to shift classroom learning culture.. 53
Tamara Kelly, Paula Wilson

Why this app? How educators choose a good educational app 54
Armaghan Montazami, Heather Pearson, Adam Dubé

Warp Zones for Higher Education: Designing Teaching and Learning in Flexible Spaces..................................55-56
Nadia Naffi, Ann-Louise Davidson, Ndèye Rokhy Diongue

Fostering Intercultural Competences for International Virtual Engineering Student Teams (InVEST): A Knowledge Community and Inquiry (KCI) Approach 57-58
Anuli Ndubuisi, Rubaina Khan, Anuli Ndubuisi

"Group First" - New methods of two-stage exams implementation in organic chemistry 59
Laura Pavelka

La prise de décisions pédagogiques appuyée sur les données locales de sources multiples : analyse réflexive sur l'implantation d'une pratique professionnelle en CAP 60-61
André Villeneuve, Yamina Bouchamma

Active Learning Designs for Calculus: Approach, patterns and impact 62
Xinli Wang, Yanhong Li, Jim Slotta, Dai Jinjun

Engaging the Learner

Improving students' understanding of the Nature of Science and supporting STEM identity development in a Grade 11 Biology class: A learning community approach 64
Elena Boldyreva, James Slotta

Better learning of calculus concepts through more active learning:
Details of a teaching methods comparison study 65
Warren Code, Costanza Piccolo

Going beyond maker fundamentals to unleash innovation in higher education 66-67
Ann-Louise Davidson, Nadia Naffi, Nathalie Duponsel, Houda Jawhar, Ivan Ruby, Farnaz Gholami, Aniklet Zefi, Clarissa Verish, Bojana Krsmanovich, Abe Kamel

Embodying your learning journey, from an inside-out perspective 68
Geneviève Emond, Sonia Di Maulo

Keys to the Multimedia City: Leveraging open educational resources (OER) to produce
affordable, flexible and interactive course materials for students 69
Chloe Lei, Cristina Sanza

Can we engage students by letting them use Cellphones in Class: Yes or No? 70
Madona Moukhachen, Bruno Poellhuber

Analyse des données et apprentissage automatique : nouvelles orientations
à la suite de l'EDUsummIT 2019 71
Severine Parent, Michelle Deschenes

Advancing Creativity in Postsecondary STEM Contexts: Students' Understandings
and Experiences of Creativity and Risk in Science Learning 72-73
Claire Paton, Jennifer Adams, Kristal Turner

Perimeter Institute; Process of Science and Tools for Teaching Science 74
Laura Pankratz, Nanouk Paré

Professional Development

Supporting faculty supervisors to foster the reflective practice of student teachers 76
Eva Mary Bures, Avril Aitken

Eliciting and responding: Shifts in novice teachers' noticing of teaching practice in math 77
Vandana Chandrasekhar

Quick Last-Minute Fixes: Making Your Word and PowerPoint Documents Accessible 78-79
Catherine Fichten, Mary Jorgensen, Alice Havel, Christine Vo

Exploring the Role of Post-Secondary Instructors in Promoting Student Mental Health 80
Kira Smith

PolyTeam : quand l'intelligence artificielle s'invite dans le processus de formation d'équipes 81-82
Lévis Thériault, Olivier Gendreau, François Guibault

Learning Analytics - AI

Les environnements immersifs au service des apprenants : un partenariat innovant
pour la réussite scolaire des élèves ayant des difficultés d'apprentissage. 84
Mariève Blanchet, Philippe Chaubet, Fabienne Venant, Véronique Carbonneau, Stéphane Villeneuve, Geneviève Cadoret

L'apprentissage actif par le vécu moteur dans la classe :
une stratégie pédagogique efficace pour les enseignants. 85
Geneviève Cadoret, Stéphanie Boyer, Philippe Chaubet

Weaving Maker Skills That Meet the Demands of the 21st Century 86-87
Houda Jawhar, Ann-Louise Davidson

Three computer programming scenarios and recommendations for practice in a makerspace setting 88-89
Ivan Ruby ,Ann-Louise Davidson

Co-learning about Artificial Intelligence, digital citizenship and the ethics of technology in the classroom 90
Kate Arthur

Assessment

Small but Mighty: Using Students Smartphones in College Teaching 92
Anick Legault, Mary Jorgensen, Laura King

Assessment and Intervention in a Large Enrollment Course 93
Pallavi Sirjoosingh

Introducing Metacognitive Skills for Undergraduate Students in Engineering Courses 94
Armin Yazdani, Alexander Liepins, Maria Orjuela-Laverde

Bibliographic Anthology

The Foundations of Student Learning: Lessons from the Research Literature on Perennial
Challenges of Pre-Class Work, Note-Taking, Interactivity, Prior Learning, and Assessment 96-104
Saul Carliner, Monica Lopez, Nadine Bekkouche, David Jones,
Wenbin Liu, Ezgi Ozyonum, Alexis Stylianou

Practitioner Reflections

Small Data: A humble inquiry into online learning behaviour of students through LMS logs 106
Eric Francoeur

From high-impact extra-curricular activity to the class-room: Challenges. 107
Hélène Nadeau, Sylvia Cox

A quantitative analysis of career path of PhD graduates from Canadian universities 108
Shanmugavalli Narayanan

Teaching the Social Considerations of Materials Engineering Through Podcasts 109
Michael Wood, Anne-Marie Kietzig, Maria Orjuela-Laverde

The Future of STEM Education 110
Armin Yazdani, Brule Veronique, Anita Parmar, Joel Trudeau, Iris Guo, Robert Cassidy

Kahoot une application ludique au service de la pédagogie, boosteur dénergie positive 111
Fethi Boutelaa

La classe l'ère du numérique : impacts sur les apprentissages 112
Fethi Boutelaa

Introduction

SALTISE (Supporting Active Learning & Technological Innovation in Studies of Education) is a professional learning community composed of post-secondary educators (instructors, educational researchers, educational/faculty developers and instructional designers). Our community proudly shares the goal of advancing evidence-based pedagogies and design-based research initiatives focused on leveraging technologies (soft and hard) to support and promote learning. New research (cite) has strengthened our belief that implementation of such instructional approaches can make positive steps towards closing achievement gaps by supporting students' academic success and perseverance through the post-secondary levels. This is being more important than ever given recent acknowledgement of the ongoing inequities to opportunities in higher education among racialized and marginalized populations.

This year, for the first time, SALTISE decided to produce a Conference Proceedings. Our reasons are twofold: (1) we wished to showcase the diversity of our community, despite the cancellation of the Conference, due to COVID-19 pandemic; and (2), we believe the time has come to shine a light on how far our community has come in promoting the practitioner researcher. This first set of proceedings, while modest, shows readers the breath of work/project being undertaken by SALTISE members. Additionally, and importantly, they show where these works/projects fit into the larger body of research or informed practices of the field. We have made a point to ask each author to include references for their piece; the purpose is to provide the clear links between research and practice that grounds the work of our practitioners, with the exception of in the practitioner reflections section. The published pieces are a place to find information within the developing best practices within the context of the disciplines represented.

We look forward to seeing you in person at the 10th Annual SALTISE Conference in 2021. Enjoy the Proceedings!

Kind regards,
Michael Dugdale & Liz Charles
Co-Chairs of the Proceedings

Acknowledgements
We wish to thank the following individuals for their support in the production of these Proceedings:
Suéli Bonafim
Chao Zhang
Lorraine Chiarelli

Graphic Designer: *Isabelle Kalekas*

Active Learning Practices & Strategies

Oral communication in Science: Self-efficacy and other factors influencing performance of college science students

Caroline Cormier, Cégep André-Laurendeau, caroline.cormier@claurendeau.qc.ca
Simon Langlois, Cégep Marie-Victorin, simon.langlois@collegemv.qc.ca

Oral communication in science (OCS) is an important skill for future scientists to develop in college and university. However, oral presentations are often stressful for students, which leads them to disengage. This lack of motivation can be linked to students' self-efficacy, because a good predictor of motivation in a task is the self-efficacy one has about his or her capacity at succeeding in this task (Bandura, 1986; Schunk, 1991). Other personal factors can influence performance in a task such as oral presentation, including anxiety or enjoyment, or the perceived relevance students place on oral communication (Aalderen-Smeets et al., 2012).

In this research project, we studied OCS in the CEGEP Science program. This form of communication is part of the learning objectives in the program albeit it is seldom taught or assessed in science class (Dumais, 2017).

We surveyed 1,292 Science students from seven CEGEPs in the fall of 2018 on their S-E, anxiety, enjoyment, and perceived relevance they place on oral communication. We surveyed them again in the winter of 2020. In addition, a subsample of 25 students were interviewed and observed in class during an oral presentation that was part of a science course.

Their skills in OCS were assessed with the Assessment of Oral Communication in Science Skills (AOCSS) rubric, developed for this study. We found that even if there is a correlation between S-E and oral performance for most students, some of them have a deformed perception of their actual skills in OCS. Indeed, some students have a high self-efficacy while demonstrating low skills in OCS, seeming to think that a minimal preparation of their oral presentation is enough. Conversely, some students with low self-efficacy and high anxiety demonstrate nevertheless good skills at oral presentation. These students seem to be anxious about the teacher's assessment and claim that they are often unsure of the teacher's expectations.

Analysis of the interviews with students confirmed that observation, demonstrating that some students are more anxious about this uncertainty about the assessment than of speaking in front of an audience.

Further analysis revealed that several high performers in OCS describe a defining moment, which founded their S-E about oral communication, or personal experiences related to orality: they were day camp counsellors, sports team coaches, volunteers in their community, etc. However, the causal link between these personal experiences and S-E has yet to be confirmed.

On the other hand, some students have very low S-E in scientific oral communication and feel high anxiety and low pleasure, and even adopt avoidance behaviors to OCS.

Based on the results of this study, we recommend that CEGEP science teachers offer more occasions of oral communications in different settings and to provide clearer assessment criteria for OCS.

References:

Aalderen-Smeets, S. I. van, Molen, J. H. W. van der, & Asma, L. J. F. (2012). Primary teachers' attitudes toward science: A new theoretical framework. *Science Education*, *96*(1), 158–182. https://doi.org/10.1002/sce.20467

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Prentice-Hall.

Dumais, C. (2017). Communiquer oralement: Une compétence à développer au collégial. *Pédagogie Collégiale*, *31*(1), 13–19.

Schunk, D. H. (1991). Self-efficacy and academic motivation. *Educational Psychologist*, *26*, 207–231.

Acknowledgements

This research was funded by the *Programme d'aide à la recherche sur l'enseignement et l'apprentissage from Quebec's Ministère de l'Éducation et de l'Enseignement supérieur* (PA2017-016).

Approaches for Decolonizing and Indigenizing Education: Lessons from the Intercollegiate Decolonization Network

Alyson Jones, Vanier College, jonesa@vaniercollege.qc.ca
Debbie Lunny, John Abbott College, debbie.lunny@johnabbott.qc.ca
Jennifer Savard, Dawson College, jsavard@dawsoncollege.qc.ca
Jennifer Qupunuaq May (student, John Abbott College)

This interactive panel will present the work of the Intercollegiate Decolonization Network (IDN), an informal grassroots collective that is composed of Indigenous and non-Indigenous Cégep staff, professionals, teachers, and students from English-language Cégeps in the Tio'tia:ke (Montreal) area, as well as Indigenous partners from local communities. The presenters will include four active members of the IDN, at least one of whom is an Indigenous partner.

As research by Jean-Paul Restoule (2017) and others demonstrates, Indigenous ways of learning are beneficial for all students. But how do we appropriately adapt these pedagogical approaches to our specific contexts and classrooms? What are the overlaps among Indigenous, Indigenizing and decolonizing pedagogies? This Interactive Presentation addresses concrete strategies—"small changes" with a potentially great impact—to advance the decolonization and Indigenization of college education.

The break-out groups will address themes such as relationship-building, concrete classroom activities, navigating whiteness and allyship, and Indigenous students' experiences. Participants who are new to this field will take away concrete ideas, texts, and processes to explore in their own learning about decolonizing and Indigenizing education. We will share a "getting started" document, sample teacher training models, resource lists, and sample action plans.

More experienced participants will have the chance to discuss concrete ways of adapting pedagogical approaches for decolonizing and Indigenizing to their local contexts. This will offer an opportunity for participants to share challenges and get immediate practical suggestions and feedback. We will share models of well-supported Indigenous student engagement, with at least one student present, as well as the importance of relationship-building with support staff, professionals, and community partners. Overall we will discuss what small changes we can make as we participate in a larger movement towards the decolonization and Indigenization of education across the province and country.

References:

Battiste, Marie. *Decolonizing Education: Nourishing the Learning Spirit.* Purich Publishing, 2013.

Dion, Susan. *Braiding Histories: Learning from Aboriginal Peoples' Experiences and Perspectives*. UBV Press, 2009.

Carr-Stewart, Sheila. *Knowing the Past, Facing the Future: Indigenous Education in Canada*. UBC Press, Purich Books, 2019.

Côté-Meek, Sheila. *Colonized Classrooms: Racism, Trauma and Resistance in Post-Secondary Education.* Black Point, NS: Fernwood Publishing, 2014.

Gaudry, Adam and Danielle Lorenz. "Indigenization as inclusion, reconciliation, and decolonization: navigating the different visons for indigenizing the Canadian Academy." *AlterNative*, vol. 14, no. 3, 2018, pp. 218-227.

Goulet, L.M. & Goulet, K.N. (2014). *Teaching each other: Nehinuw concepts and Indigenous pedagogies.* Toronto: UBC Press.

Iseke-Barnes, Judy M. "Pedagogies for Decolonizing." *Canadian Journal of Native Education*, vol. 31, no. 1, 2008, pp. 123-148.

Madden, Brooke. "Pedagogical pathways for Indigenous education with/in teacher education." *Teaching and Teacher Education*, vol. 51, 2015, pp. 1-15.

Munroe, Elizabeth Ann, Lisa Lunney Borden, Anne Murray, Denise Toney, and Jane Meader. "Decolonizing Aboriginal Education in the 21st Century." *McGill Journal of Education,* vol. 48, no. 2, 2013, pp. 317-338.

Restoule, Jean-Paul and Chaw-win-is. "Old ways are the new way forward: How Indigenous pedagogy can benefit everyone." The Canadian Commission for UNESCO's IdeaLab, 2017.

Simpson, Leanne. "Land as Pedagogy: Nishnaabeg intelligence and rebellious transformation." *Decolonization: Indigeneity, Education and Society*, vol. 3, no. 3, 2014, pp. 1-25.

Simpson, Leanne Betasamosake. *Dancing on Our Turtle's Back: Stories of Nishnaabeg Re-Creation, Resurgence, and a New Emergence*. Winnipeg: ARP Press, 2011.

Smith, Linda Tuhiwai, Eve Tuck, and K. Wayne Yang. *Indigenous and Decolonizing Studies in Education: Mapping the Long View.* Routledge, 2019.

Stonechild, Blair. *The Knowledge Seeker: Embracing Indigenous Spirituality*. U. Regina Press, 2016.

Tanaka, Michele TD. *Learning and Teaching together: Weaving Indigenous Ways of Knowing into Education*. UBC Press, 2017.

Tuck, Eve, and K. Wayne Yang. 2012. "Decolonization Is Not a Metaphor." *Decolonization: Indigeneity, Education & Society* 1 (1): 1–40.

Acknowledgements

Diane Labelle, Vicky Boldo, Jennifer Campbell, Angie Ikuallaq, Louise Legault, Michelle Smith, Alison Tett, Jacky Vallée, representatives from Indigenous school boards that work with IDN, students and our other Indigenous partners.

Creating of online courses and MOOC with Agile

Orzu Kamolova, Université de Montréal, orzu.kamolova@umontreal.ca
Chloe Lei, Library, Concordia University, chloe.lei@concordia.ca
Cristina Sanza, Department of Journalism, Concordia University, cristina.sanza@concordia.ca
David Secko, Department of Journalism, Concordia University, david.secko@concordia.ca
Andrea Hunter, Department of Journalism, Concordia University, andrea.hunter@concordia.ca

At the Center for Teaching and Learning of the University of Montreal, we provide support and training to the faculty to enhance their teaching.

One of the mandates of our Center is to assist the faculty members in creating online courses on StudiUM (local Moodle LMS) as well as MOOC (Massively open online courses) on Edulib (EdEx platform) platforms, in collaboration with professors.

In order to start any project of this range, the Center receives a lot of proposals with the content description, goals and the budget, as well as human and technical recourses needed from different faculties and units of the University. Around fifty projects are accepted every year, making a lot of professionals and teachers from different domains work together for different projects and meet deadlines. Instructional designers, graphic artists, moviemakers, subject matter experts (teachers), administrators, managers, project managers, education advisors collaborate together to deliver each project within tight deadlines and constantly adjust with time, budget, and priorities. Although collaborating with several parties could be rewarding and fulfilling, it could also be challenging and logistically laborious due to numerous teams, email exchanges, several reviews, lots of comments and stages of approval of macro and micro designs for multiple projects. Technical and human errors are unavoidable. All this process has been coordinated by two coordinators, one who coordinates the work of instructional designers and subject matter experts, and another one who coordinates the work of graphic artists. After some time, both coordinators decided to change things for a better, as silos and miscommunication between lots of people started taking its toll and effecting the quality and deadlines of the work planned. After all these challenges and AHA! moments, came "now, how we are going to fix this" moment. One of the coordinators started thinking of implementing an Agile methodology which might be a solution to eradicate the constant issues with "communication between teams, increase transparency and break silos". After some research and reflection the strategic path has been set and the pilot has started. To eradicate the potential pitfalls and "avoidance of technical and human errors", and to stay proactive with all the projects, and ready to work on one project at a time, the team started using Agile methodology which made creation of media resources, videos, teasers for online courses and MOOC easier and more transparent. It broke silos and made all parties involved work as a team. During the implementation of this methodology, we took into consideration tools, services and technical resources in order to meet academic objectives and legal requirements. So basically, with this method of course design cycle, the planning of the work was done for a three -week-period in one planning day, then teams start working on their tasks planned for those three weeks. A JIRA platform (task management platform) allowed to keep track of all people on task, how long the tasks takes to do, who is working on it, what is the stage of the task, whether it is in progress, for testing or done. After three weeks of work, a retrospective and quality assurance meetings are planned to review all media and other resources produced during those three weeks and approve it all. During these meetings, all must have and nice to have issues and priorities are discussed and approved. Everybody works at the same task management software, and everybody can contact each other and see who is doing what and when this or that task will be delivered. The whole process is overseen by a Planner who is in charge to keep track of new tasks and plans them. This process really improved the productivity of each member of numerous teams and made projects be delivered on time. The moral and effectiveness of each team member have increased with the personal satisfaction from work and positively showed in their creativity.

References

Eby, Kate (2016). Comprehensive Guide to the Agile Manifesto. Smartsheet. https://www.smartsheet.com/comprehensive-guide-values-principles-agile-manifesto

Segue Technologies (2015). 8 Benefits of Agile Software Development. https://www.seguetech.com/8-benefits-of-agile-software-development

Developing 21st C Skills with Online Curation and Social Annotation

Patti Kingsmill, Vanier College, kingsmip@vaniercollege.qc.ca
Kelly Macdonald, Vanier College, macdonak@vaniercollege.qc.ca
Phoebe Jackson, John Abbott College, phoebe.jackson@johnabbott.qc.ca
Kevin Lenton, Vanier, Heather Roffey, Vanier, Toby Moneit, Vanier, Aurora Flewwellyng-Skup, Vanier,

We live in an era of rapid change, including how we live, learn, and work. For example, the smartphone and cloud computing have changed the way we access information, consume media, communicate, and entertain ourselves. The impacts of these changes are evident in the classroom. Increasingly, teachers wonder how to engage and motivate students who have more access to information and are surrounded by more stimuli than previous generations. The market place is changing as well thanks to emerging technologies like artificial intelligence, extended reality, robotics, and the internet of things (Philbeck & Davis, 2018, p. 18). As educators, how do we prepare our students for this new world when many of the jobs of the future have yet to be created? While the future is unknown, it's clear that change and continuous learning are now a constant. So too is an overload of information.

An important key to preparing our students for the future is to help them develop transversal 21st century skills that will allow them to adapt to new situations and challenges: skills such as digital and media literacy, critical thinking, communication, collaboration and adaptability (Royal Bank of Canada, 2018, pp. 26-27).

Two strategies will be shared in this workshop that are useful for developing 21st century skills: online curation (OC) and social annotation (SA). OC, recognized as a necessary skill for managing information, involves purposefully collecting online content on a given topic, selecting the most relevant or interesting information, summarizing its significance for the collection, organizing it, and sharing it on a platform. Cloud-based platforms like Netboard.me and Padlet facilitate publication and collaboration. Students can curate individually or collaboratively and receive feedback on what they have curated from their teacher and peers. They can also publish their work to the class or the web for an authentic learning experience. .

To curate well, students must know how to consume media critically. Social annotation (SA) helps students learn to do so. Also cloud-based, SA platforms such as Perusall, Hypothes.is, or Classroom Salon allow students to comment on elements of a discourse as well as each other's comments, thus allowing them to co-construct their understanding of a discourse while offering helpful feedback to their peers and developing their ability to self-reflect.

Both activities develop critical thinking, research, reading, communication, and collaboration, and both support peer-teaching.

This workshop will introduce online curation and social annotation, briefly discuss a few useful platforms that support them, as well as the benefits and challenges of working with these strategies. One John Abbott and five Vanier teachers from various disciplines (history, physics, business administration, biology, and English) will then share their experiences working with these strategies, as well as OC and SA resources they have developed to support others in implementing them into their own classes.

References:

Philbeck, T., & Davis, N. (2018). The fourth industrial revolution: Shaping a new era. *Journal of International Affairs, 72*(1), 17–22. http://proxy4. vaniercollege.qc.ca:2067/login.aspx?direct=true&db=bsh&AN=134748789&site=ehost-live

Royal Bank of Canada (RBC). (2018). Humans wanted: how Canadian youth can thrive in the age of disruption. https://www.rbc.com/dms/enterprise/futurelaunch/_assets-custom/pdf/RBC-Future-Skills-Report-FINAL-Singles.pdf

Acknowledgements

We would like to thank Vanier College for supporting the OCSA team Development Support Opportunity Funding (2018-2019 and 2019-2020) without which this project would not have been possible.

Making online course materials accessible: Impactful guidelines

Maggie Lattuca, McGill University, maggie.lattuca@mcgill.ca
Claire Walker, McGill University, claire.walker@mcgill.ca
Jennie Ferris, McGill University, jennie.ferris@mcgill.ca

Have you ever wondered whether your online course materials are accessible to all learners? Web accessibility is the inclusive practice of ensuring that no barriers prevent people with disabilities from accessing or interacting with online content (W3C Web Accessibility Initiative, 2019). However, web accessibility can help foster an online learning experience that benefits all users (McAlvage & Rice, 2018). As an example, text or audio alternatives for visual content can help users viewing small images on mobile devices. For students to fully engage in active learning, they must be able to access relevant course materials. Indeed, relatively minor changes to online course materials can improve their accessibility, with a potential for substantial impact on students' ability to access those course materials, and ultimately support their learning in active learning contexts.

The Web Content Accessibility Guidelines (WCAG) 2.1 provide extensive guidance in considering aspects of designing accessible online materials (W3C Web Accessibility Initiative, 2018). They are used by educational institutions worldwide to address web accessibility issues for desktops, laptops and mobiles. These guidelines can be challenging to understand, due in part to opaque terminology (Kaspi et al., 2009) and the number of guidelines presented. Thus, the McGill University Accessibility Work Group performed a detailed review of the guidelines to assess their relevance to different instructional roles. The Work Group then operationalized the guidelines in checklists that individuals involved in course design and development can use to ensure that online materials are accessible. Recognizing that people in different roles are involved in ensuring accessible online course materials (McAlvage & Rice, 2018), the Working Group created checklists for people in four different roles: instructors, developers, integrators, and instructional designers. These checklists are intended to promote the development of accessible materials in a variety of pedagogical contexts. Indeed, they can be used by instructors of face-to-face courses as well – for instance, when preparing course materials to be uploaded within a learning management system.

We will share how the checklists were developed. For ease of reference, each checklist has four categories: student experience, multimedia, text-based content and university support. Each category includes the accessibility criteria and describes how to put them into practice.

Participants will familiarize themselves with the relevant checklist, identify which elements of their online course materials are already accessible to students, and consider whether they would like to make changes in other areas, to support increased access to equitable learning opportunities for students in active learning contexts and beyond.

References:

Kaspi, M., Vlachogiannis, E., Darzentas, J., & Spyrou, T. (2009). The usability of web accessibility guidelines: An approach for evaluation. *Proceedings of the 5th International Conference on Universal Access in Human-Computer Interaction: Applications and Services*. 716-724. Berlin: Springer. Retrieved from https://link.springer.com/content/pdf/10.1007/978-3-642-02713-0_76.pdf

McAlvage, K., & Rice, M. (2018). Access and accessibility in online learning: Issues in higher education and K-12 contexts. From *OLC* [Online Learning Consortium] *Outlook: An environmental scan of the digital learning landscape*. Retrieved from https://files.eric.ed.gov/fulltext/ED593920.pdf

W3C Web Accessibility Initiative. (2019). Introduction to Web Accessibility. Retrieved from https://www.w3.org/WAI/fundamentals/accessibility-intro/

W3C Web Accessibility Initiative. (2018). Web Content Accessibility Guidelines (WCAG) Overview. Retrieved from https://www.w3.org/WAI/standards-guidelines/wcag/

A study of the effectiveness of the redesign of a large introductory mathematics course

Alex Rennet, University of Toronto, Mississauga, alex.rennet@utoronto.ca
Jaimal Thind, University of Toronto, Mississauga, jaimie.thind@utoronto.ca
Parker Glynn-Adey, University of Toronto, Mississauga, parker.glynn.adey@utoronto.ca
Micheal Pawliuk, University of Toronto

The authors recently redesigned a large introductory mathematics course (enrollment ~1200/yr, divided into coordinated sections). The redesign targeted mathematical reading comprehension and literacy by focusing the course around a series of "scaffolded readings" (rather than a standard textbook). Readings were combined with various pre/in/post-class components to create a partially-flipped classroom.

To measure the effectiveness of this redesign we will analyze quantitative data from a number of channels, including: surveys of attitudes related to mathematics (adapting questions from a validated instrument (Code et al., 2016)), mathematical reading comprehension tests (developed by the authors), and marks and attrition rates in this and the sequel course.

We see this study as part of a movement from studying "active learning versus lecture" (Freemen et al., 2014) towards comparing the effectiveness of different active learning approaches, and towards finding different dimensions of student learning to examine as part of an overall picture of the effectiveness of a course design.

In this session, we give an overview of the course structure and delivery before and after the redesign, including coordinating and training multiple instructors of varying experience with active learning. We outline details of the design of the study, what has been done so far (and what preliminary results we have). Solicit feedback from participants on the course and study design to improve future iterations.

After our presentation participants will have a concrete example of how a large coordinated class can implement active learning uniformly across many class sections (even when taught by inexperienced instructors. And, an understanding of the multi-channel study we are running, how the particular channels line up with the research questions we have, and our choices in course design, and how the study fits in with our research.

References:

Code, W., Merchant, S., Maciejewski, W., Thomas, M., & Lo, J. (2016). The Mathematics Attitudes and Perceptions Survey: an instrument to assess expert-like views and dispositions among undergraduate mathematics students. International Journal of Mathematical Education in Science and Technology, 47(6), 917-937.

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. Proceedings of the National Academy of Sciences, 111(23), 8410-8415.

Transforming the Instructional Landscape: Dialogues Between Pedagogy and Space

Carol Rolheiser, University of Toronto, carol.rolheiser@utoronto.ca
Hedieh Najafi, University of Toronto, hedieh.najafi@utoronto.ca
Kelly Gordon, University of Toronto, kelly.gordon@utoronto.ca
Susan McCahan

Purpose:

Since 2010, the number of Active Learning Classrooms (ALCs) at the University of Toronto (U of T) has increased to promote active learning (AL) pedagogy. While varying in technological affordances, these ALCs accommodate group work in classes of 30 to 450 students. Existing research supports the effectiveness of AL approaches in higher education both in low-tech (Carlson & Winquist, 2014) and high-tech classrooms (Gordy et al., 2018). While the effectiveness of AL in ALCs depends on instructors' pedagogical decision-making, a review of 37 studies showed that instructors' teaching preparation and their teaching experience in ALCs are understudied (Talbert & Mor-Avi, 2018).

In this assessment project we examined U of T administration and instructors' experiences allocating resources to ALCs and teaching in the ALCs, respectively. Here, we focus on the instructors' perspectives.

Methods

We interviewed 21 instructors who had taught in the ALCs. Course syllabi and classroom observations provided complementary data sources. Through iterative open-coding, we developed themes to explain participant's teaching practices in the ALCs.

Findings

Course redesign. Very few interviewees redesigned their courses for the specific type of ALCs assigned to them. Lack of sufficient time between classroom allocation and the start of classes, and uncertainty about continued assignment to the same type of ALC limited instructors' motivation to significantly change their courses.

ALC orientation. The most technologically advanced ALC has dedicated orientation sessions and tech-support staff. Some interviewees had booked individual time in this room to test the teaching station and other technological affordances. Instructors teaching in smaller high-tech ALCs could request similar orientations. However, there were no orientation provisions for lower-tech ALCs. Most instructors teaching in lower-tech ALCs visited the classrooms on their own prior to teaching in them.

Fostering student engagement. While ALCs facilitated increased interactions, the largest ALC, a 450-seat auditorium, presented unique classroom management challenges. Due to the size of this room and the table configurations, bringing students' attention back to whole-class instruction was sometimes challenging. Instructors used strategies including timers or signals to announce transitioning between group work and whole-class instruction.

Teaching Assistants (TAs) training. Contractual restrictions prevented most TAs from receiving ALC-specific training. However, creative models included training aimed at increasing TA-student interactions and developing deeper understandings of effective pedagogical practices in ALCs.

Implications

In our final report we proposed a set of recommendations for stakeholders across U of T who manage access to ALCs or provide instructional support to instructors teaching in them (CTSI, 2020). Establishing common language around ALCs (e.g., definition of AL, types of ALCs) was a foundational step in this assessment process. We developed an ALC classification matrix to be used across U of T to support common language in classroom allocation processes and to ease user navigation. Another resource developed is a continuum of annotated AL strategies (https://teaching.utoronto.ca/teaching-support/active-learning-pedagogies/continuum/) with multimedia examples. Findings support the need for a responsive classroom booking system to match courses with ALCs that best suit desired student experience. Furthermore, developing pre-teaching educational resources linked to various ALCs types, along with providing just-in-time support, can promote increased student engagement in ALCs.

References:

Carlson, K. A., & Winquist, J. R. (2011). Evaluating an active learning approach to teaching introductory statistics: A classroom workbook approach. *Journal of Statistics Education*, *19*(1), 1-23. https://doi.org/10.1080/10691898.2011.11889596

Centre for Teaching Support & Innovation. (2020). *Assessing targeted objectives of the transforming the instructional landscape (TIL) project: Active learning classrooms at the University of Toronto.* Toronto, ON: Centre for Teaching Support & Innovation, University of Toronto.

Gordy, X. Z., Jones, E. M., & Bailey, J. H. (2018). Technological innovation or educational evolution? A multidisciplinary qualitative inquiry into active learning classrooms. *Journal of the Scholarship of Teaching and Learning*, *18*(2), 1-23.

Talbert, R., & Mor-Avi, A. (2018, October 19). A space for learning: A review of research on active learning spaces. https://doi.org/10.31235/osf.io/vg2mx

FSCI 396 brings undergraduate students into the course assessment and design process

Tamara Western, McGill University, tamara.western@mcgill.ca
Rebecca Brosseau, McGill University, rebecca.brosseau@mail.mcgill.ca
Iris Guo, McGill University, iris.guo@mail.mcgill.ca
Other FSCI 396/397 Course Alumni (Students and Supervisors)

It is well established that active learning strategies in undergraduate STEM classrooms improve students' learning and retention of concepts, as well as their ability to apply their learning to new situations (Bradforth et al., 2014). There have been multiple calls to action, but still many professors and institutions have not made the change in a comprehensive manner. This is especially true for large research universities, where the pressure on faculty to publish and obtain grants is intense, and professors often lack time or incentive to engage in course (re-)development (Bradforth et al., 2014; Brownell & Tanner, 2012). One way to facilitate educational change is through the framework of Students as Partners (SaP) in higher education, in which students collaborate with faculty in the design, assessment and implementation process. Working with students as partners has a number of benefits to faculty, including the provision of an invested, innovative partner with experience on the other side of the learning process (Cook-Sather et al., 2014; Mercer-Mapstone et al., 2017).

Using the SaP model, we have developed a new research project course for science undergraduate students: FSCI 396 – Research Project in Science Teaching and Learning. Students in FSCI 396 partner with professors to engage in the pedagogical literature to design and/or assess active learning strategies within the context of one or more undergraduate science courses. Like in a "typical science" research project, students work closely with their faculty partner to write a research proposal, collect and analyze data (from the literature and/or course feedback), design a product (strategy) or write recommendations, and communicate their results through both an oral and written report. These projects are facilitated for each cohort of students through activity of a course coordinator, who introduces the students to evidence-based pedagogy through weekly cohort meetings, as well as aids in identifying pedagogical resources (people, strategies or literature) for the student-professor pairs.

In this session, we will introduce FSCI 396 through student presentations of their work as an implementation of the SaP framework to provide faculty with partners to allow them to: (a) engage in evidence-based pedagogy, (b) make changes to their courses, (c) assess those changes, and (d) facilitate the creation of a student-and-faculty learning community. By the end of the session, participants will gain an understanding of how bringing undergraduate students into the course design and assessment process can lead to productive change and enrich learning for both sides of the podium.

References:

Bradforth, S. E., Miller, E. R., Dichtel, W. R., Leibovich, A. K., Feig, A. L., Martin, J. D., ... & Smith, T. L. (2015). University learning: Improve undergraduate science education. *Nature News*, *523*(7560), 282.

Brownell, S. E., & Tanner, K. D. (2012). Barriers to faculty pedagogical change: Lack of training, time, incentives, and… tensions with professional identity?. *CBE—Life Sciences Education*, *11*(4), 339-346.

Cook-Sather, A., Bovill, C., & Felten, P. (2014). *Engaging students as partners in learning and teaching: A guide for faculty*. John Wiley & Sons.

Mercer-Mapstone, L., Dvorakova, S. L., Matthews, K. E., Abbot, S., Cheng, B., Felten, P., ... & Swaim, K. (2017). A systematic literature review of students as partners in higher education. *International Journal for Students as Partners*, *1*(1).

Acknowledgements:

The authors thank the rest of the 2019-2020 FSCI 396/397 student cohort, instructor-supervisors, colleagues who gave workshops, and those students, faculty and staff who participated in surveys and interviews on learning activities in and around their classes.

Connecting Research to Practice

Artificial Intelligence in Education: The fine line between a system's and a learner's performance

Berenger Benteux, Université de Sherbrooke, berenger.benteux@usherbrooke.ca
Tanya Chichekian, Université de Sherbrooke, tanya.chichekian@usherbrooke.ca

AI-powered technologies are increasingly being developed for educational purposes (Pedro et al., 2019) with recent studies showing how they contribute to increased academic performance and overall better learning outcomes among students (Luckin et al., 2016). Despite its effectiveness in terms of performance outcomes, very few make their way as applications in actual classrooms (Luckin et al., 2016).

Findings from the field of Artificial Intelligence in Education (AIED) seem to target outcomes related more to the optimization of AI systems compared to the quality of learning itself (Benteux & Chichekian, 2020). This review sought to answer the following question: How are AI-powered tools used and evaluated in educational research?

We analyzed the findings of 84 articles used in three meta analyses (Ma et al., 2014; Steenbergen-Hu et al., 2013; Steenbergen-Hu et al., 2014) and one systematic review (VanLehn, 2011) evaluating the effectiveness of AIED systems on learning outcomes. Although these articles shared common elements, such as researching within a scientific domain of study (73.8% in mathematics, computer sciences, physics, statistics or biology), the purpose of measuring the pedagogical effectiveness of the AI-powered tool on learning gains (94%), and the use of experimental designs with control groups, as well as pre and post-tests (90.4%), they also showed large discrepancies regarding the studies' context (39.3% in classroom settings, 46.4% in computer labs, and 14.3% online), the randomization of the control groups (46.4% were randomized groupings), the time elapsed between the pre and post-tests (ranging from 1 hour to 8 months), and the sample size (ranging from n = 20 to n = 4649 participants) thus limiting the possibility of comparing results across these different studies.

Our analyses highlighted differences regarding the methodology used in AIED research, as well as the evaluative framework used when assessing outcomes. The latter seemed more aligned with a computer science perspective compared to an educational one. In order for these AI-powered tools to function optimally and bring an added value to the classroom, it is imperative to develop complementary research designs that are embedded within an educational framework (Pedro et al., 2019). Integrating interdisciplinary perspectives about how to use AI for learning in educational settings is a future avenue worth exploring (Tuomi, 2018).

References

Benteux, B. & Chichekian, T. (2020). Impacts des intelligences artificielles en éducation sur l'optimisation de l'apprentissage. To be presented at AssoCiation FrAncophone pour le Savoir (ACFAS), Sherbrooke, Canada. CANCELLED DUE TO COVID-19

Luckin, R., Holmes, W., Griffiths, M. & Forcier, L. B. (2016). Intelligence Unleashed. An argument for AI in Education. London: Pearson.

Ma, W., Adesope, O. O., Nesbit, J. C., & Liu, Q. (2014). Intelligent tutoring systems and learning outcomes: A meta-analysis. *Journal of Educational Psychology, 106*(4), 901-918. https://doi.org/10.1037/a0037123

Pedro, F., Subosa, M., Rivas, A., & Valverde, P. (2019). Artificial intelligence in education: challenges and opportunities for sustainable development.

Steenbergen-Hu, S., & Cooper, H. (2013). A meta-analysis of the effectiveness of intelligent tutoring systems on K–12 students' mathematical learning. *Journal of Educational Psychology, 105*(4), 970-987. https://doi.org/10.1037/a0032447

Steenbergen-Hu, S., & Cooper, H. (2014). A meta-analysis of the effectiveness of intelligent tutoring systems on college students' academic learning. *Journal of Educational Psychology, 106*(2), 331-347. https://doi.org/10.1037/a0034752

Tuomi, I. (2018). The impact of artificial intelligence on learning, teaching, and education. Policies for the future, available at: https://publications.jrc.ec.europa.eu/repository/bitstream/JRC113226/jrc113226_jrcb4_the_impact_of_artificial_intelligence_on_learning_final_2.pdf

VanLehn, K. (2011). The Relative Effectiveness of Human Tutoring, Intelligent Tutoring Systems, and Other Tutoring Systems. *Educational Psychologist*, *46*(4), 197-221. https://doi.org/10.1080/00461520.2011.611369

Feasibility, acceptability, and effectiveness of a large multi-year initiative to support pre-service teacher well-being

Bilun Naz Boke, McGill University, bilun.boke@mail.mcgill.ca
Amanda Argento, McGill University, amanda.argento@mcgill.ca
Stephanie Zito, McGill University, stephanie.zito@mail.mcgill.ca
Julia Petrovic, Isabel Sadowski, Dana Carsley, Nancy Heath

Teachers are expected to support the well-being of their students yet receive little training for this during teacher preparation, further adding to the stress teachers experience once they enter the profession. The Regulating Emotions and Stress in pre-Service Teachers (RESST) program was developed with generous support from the Rossy Foundation as part of McGill's Faculty of Education initiative to integrate well-being instruction within the teacher education program. This program provides strategies for teachers' personal well-being as well as for their use with students in the classroom. This presentation will outline the development, delivery, and evaluation of the RESST program including sample strategies for stress-management and well-being.

The RESST program was piloted in winter 2018 with students in their final year of teacher preparation as a manualized program. Based on feedback from multiple stakeholder groups (i.e., students, instructors that delivered RESST, and university administrators), minor revisions were made to the program and it was delivered a second time in Fall 2019. Students who provided feedback on the pilot also suggested that the program would be more beneficial for pre-service teachers in earlier years of teacher preparation, therefore, the second implementation of RESST took place within a course for students in their third year. The research outlined in this presentation will include information on feasibility, acceptability, and effectiveness of the program based on the two separate implementations of the RESST program. In addition, the presenters will highlight recommendations for future initiatives as well as discuss the next steps for the RESST program.

References

Böke, B. N., Argento, A., Heath, N. L. (2019, October) *Brief RESST: A stress-management and well-being program for pre-service teachers*. Invited talk presented at the 2nd annual National Forum for Wellness in Post-Secondary Education. Vancouver, BC.

Böke, B. N., Zito, S., Sadowski, I., Carsley, D., & Heath, N. L. (2019, June). *A national survey on pre-service teachers' stress-management and well-being needs.* Talk presented at the 47th Canadian Society for the Study of Education Conference, Vancouver, BC.

Heath, N. L., Argento, A., Böke, B. N., Zito, S., Sadowski, I., & Carsley, D. (2019, November). *Development, implementation and evaluation of a pre-service teacher's stress management and resilience program*. Invited webinar presentation for Physical and Health Education (PHE) Canada's Teach Resiliency Education Series.

Heath, N. L., Rassier, D., Mettler, J., Böke, B. N., & Bloom, E. (2017, November). *A national initiative to enhance teachers' mental health and well-being.* Talk presented at the Physical & Health Education National Conference, Ottawa, ON.

Nancy, N. L., & Böke, B. N. (2018, November) *Regulating emotions and stress for pre-service teachers (RESST)*. Invited talk presented at the National Forum for Wellness in Post-Secondary Education. Edmonton, AB.

Sadowski, I., Böke, B.N., Zito, S., Petrovic, J., Carsley, D., Argento, A., Rodger, S., Heath, N.L. (2020, May). *Tracking the trajectory of integrating well-being education in a teacher preparation program.* Talk accepted for presentation at the 48th Canadian Society for the Study of Education Conference, London, ON.

Zito, S., Böke, B. N., Sadowski, I., Carsley, D., Petrovic, J. & Heath, N. L. (2019, June). *Supporting pre-service teachers' mental health and well-being.* Poster presented at the Canadian Association of College & University Student Services (CACUSS) Conference, Calgary, AB.

Active learning for high school biology: Collaboration, cooperation, and scientific argumentation in a learning community

Elena Boldyreva, University of Toronto, elena.boldyreva@mail.utoronto.ca
Anja Amundrud, University of Oslo, anja.amundrud@iped.uio.no
James Slotta, University of Toronto, jim.slotta@utoronto.ca
Maria Niño-Soto, University of Toronto Schools

The purpose of our research was to explore the potential of learning community approach for improving students' communication, cooperation, scientific argumentation and understanding of scientific concepts, as well as critical thinking about credibility of primary and secondary sources. Research literature addresses the benefits of a learning community approach, such as developing and advancing a shared community knowledge base (Bereiter & Scardamalia, 2014) and supporting inquiry-oriented discourse (Fong & Slotta, 2018). It has also been shown that students make sense of scientific concepts during inquiry projects where they work in groups, analyze data and come to conclusions through explanations and evidence-based argumentation (Driver et al., 2000; Kuhn, 2010).

In our research, throughout a semester-long Grade 12 Advanced Placement Biology course, students worked on a shared community knowledge base, supported by such technologies as Google Docs and Google Classroom. A new technology environment called TalkWall was also employed, to encourage students to engage in discussions and share their developing ideas individually, in groups and as a whole class. We designed activities that engaged students in exploring primary and secondary resources (i.e., scientific journal articles) concerned with the use of GMOs, including materials from The Great Diseases project hosted by Tufts University. Using the TalkWall platform, students collectively created a "classroom set" of hashtags that were further developed during group discussions using the Currency-Relevance-Authority-Accuracy-Purpose rubric designed at the California State University (Blakeslee, 2004). To evaluate resources on the production and use of GMOs, students worked in groups and participated in whole-class discussions resulting in final debates.

This was a design-based study that examined the potential of a learning community approach to engage students in such critical uses of evidence and argumentation. A pre-post test of students' epistemological ideas was developed and included a measure of our lessons' impact. We analyzed students' written responses, and recorded observations of their interactions through recordings of their conversations and debates. The study supports an overall finding that collective inquiry can support students' development of critical scientific literacies. Our curriculum also had a positive impact on students' epistemological beliefs about the value of collaboration, sources of knowledge and nature of argumentation.

References:

Bereiter, C., & Scardamalia, M. (2014). Knowledge building and knowledge creation: One concept, two hills to climb. In *Knowledge creation in education* (pp. 35-52). Springer, Singapore.

Blakeslee, S. (2004). The CRAAP Test. *LOEX Quarterly, 31*(3), Article 4. Retrieved from https://commons.emich.edu/loexquarterly/vol31/iss3/4

Driver, R., Newton, P., & Osborne, J. (2000). Establishing the norms of scientific argumentation in classrooms. *Science Education, 84*(3), 287-312.

Fong, C. & Slotta, J.D. (2018). Supporting communities of learners in the elementary classroom: The common knowledge learning environment. *Instructional Science, 46*(4), 533-561.

Kuhn, D. (2010). Teaching and learning science as argument. *Science Education, 94*(5), 810-824.

Discipline-based education specialists: Big impact, one course at a time

Warren Code, University of British Columbia, warcode@science.ubc.ca

The 10-year Carl Wieman Science Education Initiative at the University of British Columbia (UBC) has transformed teaching in mathematics and science courses at UBC and beyond with the integration of research-informed teaching practices. As with the similar Science Education Initiative at the University of Colorado Boulder (also founded by Wieman), the initiative began with a competitive internal grant process (funded primarily by UBC and partially by donors) to fund departments in substantial teaching change efforts. The main mechanism for change was the hiring and training of discipline-based education specialists (i.e., educational developers based in departments, with the title of "Science Teaching and Learning Fellow") at the post-doc or contract faculty level to partner with faculty members in bringing the principles of scientific teaching (Handelsman et al., 2007) into courses: (a) establishing what students should learn; (b) determining what students are actually learning by systematically gathering data; (c) deploying, adapting, or designing research-based instructional methods, assessments, and curriculum that support the intended learning; and (d) evaluating and disseminating what "works".

Beyond the primary goal of transforming undergraduate science education - with a majority of faculty having engaged with the specialists, resulting in about three quarters of all credit hours having been influenced by the initiative's work - and an associated shift in department cultures around teaching and learning, other accomplishments include a substantial base of local data, a well-used resource collection for evidence-based teaching practices, over 100 research publications including new measurement tools and teaching practice implementations, shaping the careers of dozens of specialists, and inspiring similar work at a number of institutions.

A large number of resources and a list of publications are available at the initiative's website: cwsei.ubc.ca. The main story of the initiative and its results appear in Carl Wieman's 2017 book (Wieman, 2017). For more detail on the "how to" of the discipline-based education specialists model and what it has looked like elsewhere, see "The Science Education Initiative Handbook" (Chasteen et al., 2018), available for free at: https://pressbooks.bccampus.ca/seihandbook/. This presentation will highlight components of the initiative, share lessons learned, and discuss costs and benefits of this model.

References:

Chasteen, S., Stephanie V, & Code, W. (2018). The Science Education Initiative Handbook. BCCampus Pressbooks. https://pressbooks.bccampus.ca/seihandbook/.

Handelsman, J., Miller, S., & Pfund, C. (2007). *Scientific teaching*. Macmillan.

Wieman, C. (2017). *Improving how universities teach science*. Harvard University Press. http://www.hup.harvard.edu/catalog.php?isbn=9780674972070.

Acknowledgements:

This work was funded by the Carl Wieman Science Education Initiative at the University of British Columbia, including generous donations from Professor David Cheriton (Stanford University) and John and Deb Harris.

Quantifying and Promoting Inquiry-based Practices in University-level Physics Laboratories

Benjamin Dringoli, McGill University, benjamin.dringoli@mail.mcgill.ca
Armin Yazdani, McGill University, armin.yazdani@mcgill.ca
Janette Barrington, McGill University, janette.barrington@mcgill.ca
Thomas Brunner, David Cooke, Kenneth Ragan, Jack Sankey-Childress, Bradley Siwick, Marcy Slapcoffall from McGill University

There is a recognized disconnect in student learning outcomes between the lecture and lab content even though labs were designed to be complementing lectures (Holmes et al., 2017). Prompted by a call to evaluate laboratory courses by the physics department at McGill University, the Office of Science Education initiated a learning community consisting of physics professors, students, and educational developers. A clear purpose for undergraduate physics labs started to emerge as the group came to the consensus that the true purpose of the laboratory experience is to learn experimental skills, data handling, and critical evaluation of procedures. To objectively measure these goals, we instituted four validated instruments to evaluate student performance as well as the lab structure itself. The Concise Data Processing Assessment (CDPA) test (Buck et al., 2008) was used to measure student data interpretation skills. The Colorado Learning Attitudes about Science Survey for Experimental Physics (E-CLASS) (Zwickl et al., 2013) probed students' attitudes compared to experts'. The Laboratory Observation Protocol for Undergraduate STEM (LOPUS) (Velasco et al, 2016) was used to better understand student-TA interaction. An inquiry-guided lab rubric (Buck et al., 2008) was used to assess the level of inquiry in physics labs. These validated instruments were used to obtain baseline data regarding student conceptual understanding of the concept of uncertainty in physics, student attitudes while conducting experiments, student-TA interaction during labs, and the level of inquiry that the lab manuals target. The preliminary data collected will be used to measure changes as the physics department collectively moves away from expository labs towards a more inquiry-guided approach.

References:

Holmes, N. G., Olsen, J., Thomas, J. L., & Wieman, C. E. (2017). Value added or misattributed? A multi-institution study on the educational benefit of labs for reinforcing physics content. Physical Review Physics Education Research, 13(1), 010129.

Buck, L. B., Bretz, S. L., & Towns, M. H. (2008). Characterizing the level of inquiry in the undergraduate laboratory. Journal of College Science Teaching, 38(1), 52-58

Zwickl, B. M., Finkelstein, N., & Lewandowski, H. J. (2013, January). Development and validation of the Colorado learning attitudes about science survey for experimental physics. In AIP Conference Proceedings (Vol. 1513, No. 1, pp. 442-445). American Institute of Physics.

Velasco, J. B., Knedeisen, A., Xue, D., Vickrey, T. L., Abebe, M., & Stains, M. (2016). Characterizing instructional practices in the laboratory: The laboratory observation protocol for undergraduate STEM. Journal of Chemical Education, 93(7), 1191-1203.q

Acknowledgements

We would like to thank Sangyong Jeon for his support as the McGill Physics Department head, our undergraduate TEACH fellows who helped complete the LOPUS observations, Veronique Brule for sharing her experiences improving pedagogy in biology courses, and Natasha Holmes for helpful discussions.

If you build it they may not come: The essential role of facilitators in engaging youth in maker activities

Nathalie Duponsel, Concordia University, nathalie.duponsel@concordia.ca
Ann-Louise Davidson, Concordia University, ann-louise.davidson@concordia.ca

Progressive educators and researchers have argued for centuries that learning is more relevant when the learner has the opportunity to apply theoretical concepts in hands-on activities and when learners are intrinsically interested in the subject matter (e.g. Dewey, 1966; Montessori, 1912; Papert, 1980; Piaget, 1950; Vygotsky, 1978). Maker education is a promising avenue for such learning as it both offers students hands-on experiences and is student-interest driven (Martinez & Stager, 2013). The underlying assumption among many proponents of experiential learning and maker education is that when given the freedom to choose the subject of their learning experience, and driven by their interest in it, learners will automatically engage with the learning activity and pursue it to its end. Some research has suggested that this is not the case, however, and that learners may need significant scaffolding in order to engage with a learning experience and persevere with it when challenges arise (Blikstein, 2013).

In our study, we investigated how youth engage with maker activities (creating or modifying an artefact by hand or with digital fabrication tools, like 3D printers, using skills from multiple domains) and what factors were necessary to motivate youth to engage with making and pursue projects to their end. Our findings are drawn from a participatory action research project that we have been undertaking in collaboration with the director and staff at an urban youth centre in Montreal, Canada.

We found that our observations of the patterns of youth engagement with maker activities parallel the basic psychological needs posited by Self-Determination Theory (Ryan & Deci, 2000). While the youth certainly preferred being given the autonomy to choose the maker activities we pursued as a group, they responded more positively (i.e. increased participation) to maker activities that included a focus on developing their competence in the basic skills needed for the projects they showed interest in. In the absence of these skills, youth were extremely reluctant to engage in making activities, even with the promise of our help. The youth also had a strong need to have a sense of relatedness with the facilitators and the environment in which the activities were taking place before they engaged with the activities. As the research team was new to the community, including members of the staff in the activities was necessary at first to get youth to engage with the activities, a need that declined with time. Group activities in this context were also far more successful than one-on-one interactions, which is a reflection of the collectivist culture of the neighbourhood in general.

These findings suggest that educators and makerspace facilitators need to be cognizant of participants' needs for autonomy, competence and relatedness. This is particularly relevant when working with youth who may be reluctant to participate if they do not already identify with the maker movement or the particular environment/group where the activity is taking place, or if participants have a lack of confidence in their abilities or skills. Although our findings definitely support the benefit of pursuing maker projects that interest the participants and foster their sense of autonomy, failing to cater to participants' needs for competence and relatedness hinders the success of the activities with such youth groups.

References:

Blikstein, P. (2013). Digital fabrication and 'making' in education: The democratization of invention. In J. Walter-Herrmann & C. Büching (Eds.), *FabLabs: Of Machines, Makers and Inventors*. Bielefeld, Germany: Transcript Publishers, pp. 1-21.
Dewey, J. (1966). *Experience and education.* New York: Collier Books.
Martinez, S. L., & Stager, G. S. (2013). *Invent to learn: Making, tinkering, and engineering in the classroom*. Constructing Modern Knowledge Press.
Montessori, M. (1912). *The Montessori method*. New York, NY: Frederick Stokes Co.
Papert, S. (1980). Mindstorms: *Children, computers, and powerful ideas*. NY, New York: Basic Books, Inc.
Piaget, J. (1950). *The psychology of intelligence*. New York, NY: Harcourt Brace.
Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*, 68-78.
Vygotsky, L. S. (1978). *Mind in society.* Cambridge, MA: Harvard University Press.

Espace Qilib'- Transformer les pratiques éducatives en mobilisant les ressources collectives

Geneviève Emond, MUZA - Solutions créatives en éducation, emondgenev@gmail.com
Delphine Parée, MUZA, delphineparee@gmail.com

Les acteurs de l'éducation sont poussés à ajuster leurs pratiques à la diversité changeante des besoins de leurs élèves. Qu'est-ce qui se trouve au centre de leurs pratiques, en tant que posture commune? Comment évoluer à partir de cette posture commune pour adapter les réponses aux besoins des élèves, en collaborant entre collègues? Dans la situation actuelle, comment s'ajuster en plus au passage vers l'enseignement à distance?

Nous construirons la séance en tant que communauté de pratique pour les pairs (Wenger, 1995). Nous suivons une approche constituée d'outils d'éducation somatique (Eddy, 2016), soutenant un travail expérientiel de conscience de la corporéité (embodiment = soi, les autres, l'environnement, Emond, 2018), et de retours réflexifs sur la cohérence de la pratique enseignante (Korthagen, 2004). À partir des questions évoquées, nous explorerons la méthode d'intervention Qilib': 1/ poser le sujet, 2/ s'engager dans des explorations en mouvement, 3/ effectuer un retour réflexif sur les pratiques d'enseignement, guidé par les expériences faites en (2), 4/ se projeter vers la suite pour des postures professionnelles renouvelées en équipe.

Les participants sont amenés à explorer des postures enseignantes en salle de classe et à distance, ainsi que des postures communes d'équipe, permettant d'accommoder la diversité des besoins des élèves. Ils lient ces explorations à leur pratique éducative directe, en visualisation. Ils repartent avec des outils pour explorer des adaptations à effectuer en salle de classe, dans leurs équipes et établissements scolaires.

Les changements effectués dans les pratiques offrent des occasions de renforcer la relation pédagogique; d'apprendre à se connaître pour arriver notamment à mieux poser ses limites; d'améliorer ses compétences d'autorégulation; de gérer fluidement l'organisation du temps et de l'espace; tout en maintenant son bien-être. Les changements effectués individuellement dans la relation pédagogique ont des impacts à l'échelle tant des équipes de travail que de l'établissement scolaire.

References:

Eddy, M. (2016). *Mindful Movement: The Evolution of the Somatic Arts and Conscious Action.* Chicago, The University of Chicago Press.

Emond, G. (2018). *L'apprentissage de la conscience de la corporéité chez des enseignantes et formatrices et ses influences sur la cohérence interne-externe de la leur pratique*. Thèse de doctorat. Université du Québec à Montréal.

Korthagen, F. A. (2004). In search of the essence of a good teacher: Towards a more holistic approach in teacher education. *Teaching and teacher education*, *20*(1), 77-97.

Wenger (1995). *Communities of Practices. Learning, Meaning and Identities.* Cambridge University Press.

How do professors and students experience teaching and learning in classrooms that use active participatory learning?

Kylie Hartley, Sheridan College, kylie.hartley@sheridancollege.ca

It has been over 30 years since Chickering and Gamson (1987) noted good practices in undergraduate education include the encouragement of active learning and, among other principles, respecting diverse talents and ways of learning. Together, these principles speak to Universal Design for Learning (UDL) and how active learning can be a major part of that framework. The quantity and quality of research indicating the benefits and effectiveness of active learning strategies for student success is extensive (e.g. Cherney, 2008; Prince, 2004; Thaman, 2013). In addition, there are many diverse resources available on how to go about incorporating these strategies in the classroom (e.g. Barkley, 2009, https://www.saltise.ca/resources/strategies/). What seems to be missing in the conversation is better understanding how professors and students experience learning in classrooms that use active participatory design.

I am engaged in the beginning stages of a qualitative phenomenology research study investigating this very question. Initial findings demonstrate small changes toward more active learning contribute to positive experiences for professors and students. For example, When I informally asked one of my students what he liked about active learning, he said: “It seems obvious, but it’s kind of amazing how by doing something, you learn it so much better. Especially when you approach it [the content] from different perspectives.” Without explicitly knowing the UDL framework and how I had attempted to incorporate it into the classroom, this student spoke earnestly about how it had made a difference in his learning. Additionally, I have found that the culture of supporting a positive active participatory learning experience can help students find more courage in the classroom. A student in a different course noted in their end of course review, “It [this course] also helped me to not be afraid of speaking and generating new ideas.”

Active learning is not always a rosy experience though, some professors and students are resistant toward this type of learning experience. Informal student feedback indicates some students want to be told what to learn and not spend the time creating knowledge themselves. I and my colleagues have heard more than once some sort of iteration along the lines of “Just tell me what you want me to do”. It can take time for some students to warm up to these strategies and that can have a negative impact on the learning community. Additionally, some professors find the process too time consuming and for others, they are anxious about the lack of control they perceive to have during in-class activities.

Luckily, Tharayil et al. (2018) provide many useful strategies on how to mitigate student resistance. These are sorted in two categories, explanation strategies (explain the purpose, explain course expectations, explain activity expectations) and facilitation strategies (approach non-participants, assume an encouraging demeanor, grade on participation, walk around the room, solicit student feedback, invite questions, develop a routine, design activities for participation, and use incremental activities). I have had the most success when I use these strategies as a framework for planning and implementing active learning in the classroom.

References:

Cherney, I. D. (2008). The effects of active learning on students’ memories for course content. *Active Learning in Higher Education*, *9*(2), 152-171.

Chickering, A. W. & Gameson, Z. F. (1987). *Seven Principles for Good Practice in Undergraduate Education*. Washington Center News. http://www.lonestar.edu/multimedia/SevenPrinciples.pdf

Prince, M. (2004). Does active learning work? A review of the research. *Journal of Engineering Education*, *93*(3), 223-231.

SALTISE (2020). Strategies and Approaches. SALTISE. https://www.saltise.ca/resources/strategies/

Thaman, R. G. (2013). Promoting active learning in respiratory physiology – positive student perception and improved outcomes. *National Journal of Physiology, Pharmacy, and Pharmacology*, *3*(1), 27-34

Tharayil, S., Borrego, M., Prince, M., Nguyen, K. A., Shekhar, P., Finelli, C. J., & Waters, C. (2018). Strategies to mitigate student resistance to active learning. *International Journal of STEM Education*, *5*(1), 7.

Exploring the role of Inquiry-based learning to combat math anxiety

Rajneet Kaur Maan, McGill University, rajneet.maan@mail.mcgill.ca

Math anxiety (MA) is a "feeling of tension and anxiety that interferes" with doing math (Hopko et al., 2003, p. 648). Teachers who have MA have low math self-concept and do not feel qualified in their math teaching (e.g., Ahmed, 2018). This problem is dominant in elementary teachers. One promising approach to alleviate MA is inquiry-based learning (IBL). IBL is a student-centered instruction method where students learn to explore by asking questions and teachers act as facilitators (Maaß & Artigue, 2013). However, research is lacking on the use of IBL to combat MA in elementary teachers. Thus, I will share preliminary results of an upcoming design-based research (DBR) study (Cobb et al., 2003) in which I will engage 2-3 pre-service elementary teachers (PSTs) in several IBL sessions. DBR focuses on designing and testing interventions to study learning. I ask: (1) How does an IBL module affect PSTs' MA (if at all)? (2) How are PSTs' experiences with engaging in IBL responsible for their changes?

My research is based on theories of social constructivism and situated learning, which suggest that mathematics is a dynamic and social construction (Ernest, 1992), where learning occurs through interactions among people and the context (Korthagen, 2010, p.99).

Data will include video-recordings of IBL sessions and pre- and post-interviews to understand PSTs' MA, experience with IBL, and changes in MA, if any. By contributing suggestions for teacher education, this research is a step towards alleviating elementary PSTs' MA, so they do not transfer their MA to children they teach.

The results for this study and the instruction module used might also be shared using technological means like a website or an online learning/instruction module in addition to the final research report so that they are easily accessible by the community of interested pre-service and in-service teachers.

References:

Ahmed, W. (2018). Developmental trajectories of math anxiety during adolescence: Associations with STEM career choice. *Journal of adolescence*, *67*, 158-166.

Cobb, P., Confrey, J., Lehrer, R., & Schauble, L. (2003). Design experiments in educational research. Educational researcher, 32(1), 9-13.

Ernest, P. (1992). The nature of mathematics: Towards a social constructivist account. *Science & Education*, *1*(1), 89-100.Hopko, D. R., Mahadevan, R., Bare, R. L., & Hunt, M. K. (2003). The abbreviated math anxiety scale (AMAS) construction, validity, and reliability. *Assessment*, *10*(2), 178-182.

Korthagen, F. A. (2010). Situated learning theory and the pedagogy of teacher education: Towards an integrative view of teacher behavior and teacher learning. *Teaching and teacher education*, *26*(1), 98-106.

Maaß, K., & Artigue, M. (2013). Implementation of inquiry-based learning in day-to-day teaching: a synthesis. *ZDM*, *45*(6), 779-795.

Conception d’un outil méthodologique, le « double QCM », pour évaluer les conceptions alternatives d’étudiants du collégial sur la chaleur et la température

Abdeljalil Métioui, Université du Québec à Montréal, metioui.abdeljalil@uqam.ca
Louis Trudel, Université d’Ottawa, ltrudel@uottawa.ca

Dans le cadre de cette recherche, nous avons construit un double questionnaire à choix multiples (QCM) pour évaluer les conceptions alternatives des étudiants du collégial sur la chaleur et la température. Ce questionnaire permet d’évaluer rapidement leurs conceptions afin d’en rendre compte dans la préparation de stratégies constructivistes d’enseignement (Schmidt et al., 2006). Sur le plan méthodologique, deux phases ont été nécessaires à sa construction. La première consistait à construire un questionnaire papier-crayon pour identifier les conceptions de 80 étudiants inscrits en 3e année du baccalauréat en enseignement primaire. Ils ont tous étudié des thématiques en lien avec les notions de chaleur et de température lors de leurs études secondaires et ont suivi une formation de six heures dans le cadre d’un cours universitaire en didactique des sciences. Le questionnaire était composé de cinq questions et chacune était formulée sous forme d’un énoncé pour lequel ils devaient préciser s’il était vrai ou faux sur le plan scientifique et expliquer leur réponse. Les problèmes formulés étaient qualitatifs et aucun aspect quantitatif n’entrait en question. Ainsi, l’étudiant était obligé de recourir à sa structure conceptuelle et ne pouvait répondre en appliquant une formule ou une technique apprise machinalement. D’ailleurs, de nombreux chercheurs soulignent que les étudiants réussissent quelquefois à résoudre des problèmes quantitatifs complexes, mais ils ont en revanche des difficultés à analyser des problèmes qualitatifs simples (Millar & Hames, 2001). Les situations présentées rendaient compte aussi des questions formulées dans d’autres recherches qui ont porté sur les conceptions des étudiants sur les notions précitées. L’analyse des explications avancées nous a permis d’identifier plusieurs catégories de représentations conceptuelles erronées. À titre d’illustration, en voici quelques-unes : la température de l’eau bouillante peut dépasser 100 °C pendant l’ébullition, la température est une mesure de la chaleur, la température de différents corps est différente même s’ils ont été placés dans le même environnement sur une période prolongée et la transpiration réchauffe le corps. La plupart des représentations identifiées dans cette recherche sont semblables à celles publiées dans la revue de la littérature internationale et certaines représentations erronées des étudiants ressemblaient à celles développées au cours de l’histoire par des scientifiques de renom, par exemple pour la théorie du calorique. La deuxième phase était de construire le « double QCM » à partir des difficultés conceptuelles identifiées et était composé des mêmes questions que celles de la première phase. Toutefois, les étudiants n’avaient pas à expliquer leurs choix de réponse (vrai ou faux), mais devaient plutôt choisir parmi quatre catégories d’explications laquelle expliquerait leur choix.

Références:

Millar, R., and Hames, V. (2001). Using diagnostic assessment to improve students’ learning: some preliminary findings from work to develop and test diagnostic tools. In D. Psillos & al., (Eds). Proceedings of the Third international Conference on Science Education Research in the Knowledge Based Society (p. 141-143). Thessaloniki, Greece: Art of text publications.

Schmidt, D.-L., Saigo, B-W., and Stepans, J.-I. (2006). Conceptual Change Model: The CCM Handbook, Saiwood Publications.

Interprofessional Medical Education (IPE): Using video to Help Students Learn with, from, and about each other

Tim Miller, Dawson College, tmiller@dawsoncollege.qc.ca

In order to fully understand IPE it is important to understand Interprofessional Collaboration (IPC). The literature describes IPC as "…the process of developing and maintaining effective interprofessional working relationships with learners, practitioners, patients/clients/families, and communities to enable optimal health outcomes. Elements of collaboration include respect, trust, shared decision making, and partnerships" (CIHC, 2010). IPC has demonstrated enhanced patient care and patient outcomes; and for clinicians, lower stress levels and greater job satisfaction (WHO, 2010). IPC can be achieved through the coordinated implementation of Interprofessional Education.

IPE exists when two or more professions learn with, from, and about each other to improve the quality of care (WHO, 2010). IPE aims to provide students with a skill set and acumen to work together effectively for the patient. The IPE approach stems from the complex and multifaceted nature of the patient's needs as well as the ever-changing landscape of the health care system. Research demonstrates that effective collaboration amongst multiple health care professionals is essential for the existence and persistence of an all-encompassing and comprehensive health care approach (Bridges, 2011). Across the literature, a clear theme emerged; "that a successful experience among any IPE activity allows students to understand their own professional identity while gaining an understanding of other professional's roles on the health care team" (Bridges, 2011). According to the Canadian Interprofessional Health Collaborative, IPE "…has the potential to enhance practice, improve the delivery of services and make a positive impact on patient care."

IPE is a process that teaches students how to collaborate across professions. The benefit for our students is that they will be able to master their communication, critical thinking, problem solving, creativity, teamwork and leadership skills. The purpose of an interprofessional education approach is still to interact and work to a common goal, yet when the common goal is the health of the patient, a relationship between professions needs to be formed. To add to this, the word interprofessional can be used to describe the specific overlaps between the professions in the aid of the patient.

Dawson College has been working on implementing an IPE approach across its six medical technology and health programs. To date, we have been able to successfully implement numerous IPE activities where students from multiple programs interact to learn with, from, and about each other. One of these activities has been our trips to the eastern townships. Using the Mini-Grant from SALTISE allowed us to document these trips in order to have students who were not able to attend learn about the trip from the students' perspective. We have also been able to document some of the other IPE activities that have been successfully implemented at the college. One of these activities centered on role clarification. Without the Mini-Grant, the impact of these activities would not have been as wide and therefore the development of subsequent activities would have been shortened.

To get a quick look at the activities above, please see the video using the link here.
https://www.youtube.com/watch?v=4BQIu4yDMUI&feature=youtu.be

References:

Bridges, D., Davidson, R. A., Soule Odegard, P., Maki, I. V., & Tomkowiak, J. (2011). Interprofessional collaboration: three best practice models of interprofessional education. *Medical education online*, *16*(1), 6035. www.ncbi.nlm.gov/pmc/articles/PMC3081249/.

Canadian Interprofessional Health Collaborative. (2010). *A national interprofessional competency framework*. The Collaborative.

World Health Organization. (2010). *Framework for action on interprofessional education and collaborative practice* (No. WHO/HRH/HPN/10.3). World Health Organization. www.who.int/hrh/resources/framework_action/en/.

3D Printing as an Educational Technology: Theoretical Perspectives, Learning Outcomes, and Recommendations for Practice

Heather Pearson, McGill University, heather.pearson@mail.mcgill.ca
Adam Dubé, McGill University, adam.dube@mcgill.ca

Three-dimensional (3D) printing is an emerging educational technology that is being used to prepare learners for a more technologically advanced world. As an additive manufacturing tool, 3D printers create objects by heating malleable materials (i.e., most commonly plastic) that is then put down layer-by-layer to eventually form a tangible 3D object (Kostakis et al., 2015; Loy, 2014; Ratto & Ree, 2012; Trust & Maloy, 2017). Through a literature review, we examine how 3D printing works, the use cases for the technology across both formal educational settings and informal spaces, and describe how it can advance self-directed learning. Articles and conference proceedings were selected from different domains of education including medicine (e.g., Abouhashem et al., 2015), pre-service teacher education (e.g., Cohen et al., 2017), STEM (e.g., Hsiao et al., 2019), and history (e.g., Turner et al., 2017). 3D printing studies were then categorized according to their theoretical approach; the results identify five theories being used to conceptualize 3D printing as a learning tool, including situated learning (Lave & Wenger, 1991), experiential learning (Kolb & Kolb, 2005), and critical making (Ratto, 2011; Ratto & Ree, 2012). Further, we argue that concepts from constructionism (Papert, 1972; Papert & Harel, 1991) and self-directed learning (Garrison, 1997; Knowles, 1975) are common amongst all approaches. The review also identifies the specific learning outcomes attributed to 3D printing. The technology-specific skills include knowledge of the built object, curriculum knowledge, and 3D design skills. For example, multiple studies (Loy, 2014; Trust & Maloy, 2017; Trust et al., 2018; Sun & Li, 2018; Wright et al., 2018) have cited how students' design skills were augmented by creating printable 3D objects. By constantly switching back and forth between the digital design on computer software to a physical, tangible creation, 3D printing challenges the way people interact and understand the relationship between the virtual and the physical spaces (Loy, 2014). The domain-general skills attributed to 3D printing include critical thinking, creativity, design thinking, and collaboration (Trust & Maloy, 2017; Trust et al., 2018). For instance, creating a 3D printable design requires students to make adjustments and problem-solve how to change their design constantly in real-time (Kostakis et al., 2015); only once the object is printed can learners truly engage in critical reflection by deconstructing why their designs succeeded or failed. Finally, the theoretical approaches and outcomes identified in the review are leveraged to identify common challenges to successful 3D printing use in formal education settings and to make recommendations for practice for educators interested in implementing 3D printing activities in their classrooms. Currently, 3D printing in the classroom too often involves educators acting as demonstrators of the design process and giving students simple activities that teach how 3D printers work. In contrast, using 3D printing as a self-directed learning tool requires educators to act as facilitators and to develop 3D printing activities that are complex, collaborative, and differentiated to provide students with opportunities for agency-building.

References:

AbouHashem, Y., Dayal, M., Savanah, S., & Štrkalj, G. (2015). The application of 3D printing in anatomy education. *Medical education online*, *20*(1), 29847. https://doi.org/10.3402/meo.v20.29847

Cohen, J. D., Huprich, J., Jones, W. M., & Smith, S. (2017). Educators' perceptions of a maker-based learning experience. *The International Journal of Information and Learning Technology, 34,* 428-438. https://doi.org/10.1108/IJILT-06-2017-0050

Garrison, D. R. (1997). Self-directed learning: Toward a comprehensive model. *Adult education quarterly*, *48*(1), 18-33.

Hsiao, H. S., Chen, J. C., Lin, C. Y., Zhuo, P. W., & Lin, K. Y. (2019). Using 3D printing technology with experiential learning strategies to improve preengineering students' comprehension of abstract scientific concepts and hands-on ability. *Journal of Computer Assisted Learning*, *35*(2), 178-187. doi:10.1111/jcal.12319

Knowles, M. (1975). *Self-directed learning: A guide for learners and teachers*. New York: Association Press.

Kolb, A. Y., & Kolb, D. A. (2005). Learning styles and learning spaces: Enhancing experiential learning in higher education. *Academy of management learning & education*, *4*(2), 193-212.

Kostakis, V., Niaros, V., & Giotitsas, C. (2015). Open source 3D printing as a means of learning: An educational experiment in two high schools in Greece. *Telematics and informatics*, *32*(1), 118-128. http://dx.doi.org/10.1016/j.tele.2014.05.001

Lave, J. & Wenger, E. (1991). *Situated learning. Legitimate peripheral participation*. Cambridge, England: Cambridge University Press.

Loy, J. (2014). eLearning and eMaking: 3D Printing Blurring the Digital and the Physical. *Education Sciences*, *4*(1), 108-121. doi:10.3390/educsci4010108

Papert, S. (1972a). Teaching children thinking. *Programmed Learning and Educational Technology, 9,* 245-255. doi:10.1080/1355800720990503

Papert, S. (1972b). Teaching children to be mathematicians versus teaching about mathematics. *International Journal of Mathematical Education in Science and Technology, 3*, 249-262. doi:10.1080/0020739700030306

Papert, S., & Harel, I. (1991). Situating constructionism. *Constructionism*, *36*(2), 1-11.

Ratto, M. (2011). Critical making: Conceptual and material studies in technology and social life. *The information society*, *27*(4), 252-260. https://doi.org/10.1080/01972243.2011.583819

Ratto, M., & Ree, R. (2012). Materializing information: 3D printing and social change. *First Monday*. Retrieved from: https://journals.uic.edu/ojs/index.php/fm/article/view/3968/3273

Sun, Y., & Li, Q. (2018, April). The application of 3D printing in STEM education. In *2018 IEEE international conference on applied system invention (ICASI)* (pp. 1115-1118). IEEE.

Wright, L., Shaw, D., Gaidos, K., Lyman, G., & Sorey, T. (2018). 3D pit stop printing. *Science and Children*, *55*(7), 55-63.

Trust, T., & Maloy, R. W. (2017). Why 3D print? The 21st-century skills students develop while engaging in 3D printing projects. *Computers in the Schools*, *34*(4), 253-266. doi:10.1080/07380569.2017.1384684

Maloy, R. W., & Edwards, S. (2018). Learning through making: Emerging and expanding designs for college classes. *TechTrends*, *62*(1), 19-28.

Turner, H., Resch, G., Southwick, D., McEwen, R., Dubé, A. K., & Record, I. (2017). Using 3D printing to enhance understanding and engagement with young audiences: lessons from workshops in a museum. *Curator: The Museum Journal*, *60*(3), 311-333.

Fostering self-regulated learning in the classroom

Costanza Piccolo
Department of Mathematics, University of British Columbia
costanza@math.ubc.ca

We present a pilot project aimed at incorporating classroom activities in a Calculus 1 course where students actively engaged in self-regulation, including reflecting on their own understanding of the material and developing deliberate strategies to adapt their work to achieve success.

Successful learners often display effective self-regulation skills (Zimmerman, 1989, 2002): they are able to take deliberate, intentional control of their learning, monitoring their progress and adjusting to achieve their goals. These are skills we assume our students develop as they learn course material, but we rarely explicitly discuss these skills in the classroom or ask students to actively engage with them.

In this presentation, we will describe a pilot project that targeted active engagement of students with self-regulation skills in the context of a first-year Differential Calculus course for Arts students. In weekly problem-solving workshops, students engaged in individual and group activities where they self-monitored their own understanding of the material, developed strategies to work in an adaptive way, set goals and made plans for improvement. We will report preliminary results and discuss challenges and lessons learned when implementing these kinds of activities.

References:

Zimmerman, B.J., "A social cognitive view of self-regulated academic learning", Journal of Education Psychology 81 (30), 329 (1989)

Zimmerman, B.J., "Becoming a self-regulated learner: An overivew", Theory into Practice 41 (2), 64-70 (2002)

Results of an action-research with flipped classrooms in 6 institutions: Lessons learned and implications for practice

Bruno Poellhuber, Université de Montréal, bruno.poellhuber@umontreal.ca
Normand Roy, Université de Montréal, normand.roy@umontreal.ca
Vincent Laberge, Université de Montréal, vincent.laberge@umontreal.ca

In the context of the growing concern for student success, active learning pedagogies (Freeman et al., 2014) and flipped classroom approach seem very promising. A design-based action-research-training was carried out by researchers, teachers and educational developers from 6 post-secondary educational institutions. After an overview of the conceptual frameworks used on professional development (Clarke and Hollingworth, 2002) and motivation (Pintrich, 2003), we will describe the training and support system designed and applied by researchers and educational advisers, as well as the projects' objectives and its methodology.

First, we draw a portrait of flipped classroom practices based on the analysis of individual interviews with 25 teachers already experienced with flipped classroom. The integration of flipped classroom into teaching practice takes place following a trigger event that leads to a long-term professional development process. These triggers are mainly long term pedagogical training, observation of engagement and motivation problems or a desire to innovate. Most teachers initially conceive flipped classroom as a technological approach focused on video listening at home in between courses, but gradually, all teachers come to enrich these activities by quizzes or exercises and by active learning activities in the class. However, teacher-centered activities at key moments remain important. The pedagogical practices mobilized by the teachers gradually become quite varied, and rely as well on student-centered approaches (active learning) as on teacher-centered activities (e.g. lectures). Classroom management and learning assessment practices mobilized by teachers are also varied, but they are mainly associated with the interactionist style in Glickman and Tamashiro's model (1980), where control is shared between a teacher and his students.

In this project, we developed or translated and validated different scales targeted at measuring student's motivation and engagement regarding flipped classroom activities proposed to them, and we did the same for different aspects of teachers pedagogical preferences or practices, as well as for different dimensions of teacher's self-efficacy. We treated data with cluster analysis procedure, which revealed different profiles for students and for teachers.

Students can be classified within 3 motivation and engagement profiles. Student motivation, engagement and learning scales are high on average with a very notable exception: interactions with the teacher outside the classroom, which quotes really low. A key difference is that the students belonging to the least motivated profile invest little outside of the course sessions. It turns out that these are often quite vocal about the requirements of the flipped clasroom approach. However, teachers think that this regular involvement with course material is the precise aspect that may lead them to success.

We ran different multinomial multilevel logistic regressions in order to explore the links between teachers variables and students' motivation and engagement. Teachers' self-efficacy was present in the first models, but disappeared when we integrated gender, a result that suggests that teacher's gender and self-efficacy might be highly correlated. This analysis demonstrated a significant effect of time and experience acquired in the project, thus in flipped classroom practices, and by extension, is an indicator of the efficiency of the training and support system developed. Qualitative analysis results converge with this observation.

In line with Kennedy (2014), our most important conclusion is that to effectively transform teachers' pedagogical practices, the training and support system must include certain essential characteristics: 1) be flexible; 2) alternate between training and experimentation periods; 3) offer local support tailored to teachers' needs (ideally through a pedagogical advisor); 4) rely on collaborative problem solving within communities of practices; 5) introduce formal feedback from students; 6) encourage a process of teachers' reflection on their practice.

References:

Clarke, D. et Hollingsworth, H. (2002). Elaborating a Model of Teacher Professional Growth. *Teaching and Teacher Education*, *18*(8), 947-67.

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H. et Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences*, *111*(23), 8410–8415.

Kennedy, A. (2014). Understanding continuing professional development : The need for theory to impact on policy and practice. *Professional Development in Education*, *40*(5), 688-697. https://doi.org/10.1080/19415257.2014.955122
Miles, M. B. et Huberman, A. M. (2003). *Analyse des données qualitatives* (2e édition). Paris : De Boeck Université.
Pintrich, P. R. (2003). A Motivational Science Perspective on the Role of Student Motivation in Learning and Teaching Contexts. Journal of Educational Psychology, 95(4), 667–686. https://doi.org/10.1037/0022-0663.95.4.667

Acknowledgement:

This research has been made possible by a research grant from Actions concertées persévérance et réussite, from the FRQSC.

Misconceptions in University Physics: Example-based Content Promotes the Strongest Conceptual Change

Thomas Rademaker, McGill University, thomas.rademaker@mail.mcgill.ca
Ben Dringoli, McGill University, benjamin.dringoli@mail.mcgill.ca
Juliann Wray, McGill University, juliann.wray@mail.mcgill.ca
Michael Hilke, McGill, Ksenia Kolosova

Students enter the physics classroom with various (correct and incorrect) mental models of physical concepts. For example, in a question showing a diagram of a resting charge in the presence of a non-uniform magnetic field (question 27 of the Conceptual Survey of Electricity and Magnetism (Maloney et al., 2001)), some students believed that when there is a charge in the presence of a magnetic field, there must be a force along the field lines. Others thought that the force was perpendicular to the field, or they confused electric and magnetic fields all together, which led to a wrong answer in all cases. Yet, when provided with the mathematical expression of the magnetic force, they were more likely to come to the correct conclusion than when provided with a similar worked-out example. In contrast, for a question where the students had to rank the force strength of a charge moving perpendicularly, diagonally, or in parallel to the magnetic field lines (question 25 of (Maloney et al., 2001)), the students learned better with an example-based approach. Why did "theory" work better in the first case but "example" worked better in the second case? To explore this in a university STEM setting, we adapted the online learning platform McLEAP (Dringoli et al., 2019) to study misconceptions in a large first-year Electromagnetism & Optics class. With MisMcLEAP, a misconception-focused version of the McLEAP platform, we measured how effectively "example", "concept", and "theory"-based content types resolved misconceptions using 10 different questions and topics. We find that "example" content enhances conceptual understanding more robustly than "theory" or "concept" content. This is not as counterintuitive as one would think, as through example-based learning students self-reflect on the correct solution and compare it to their own thought process (Renkl, 2016). This is advantageous for initial skill acquisition, such as the dismantling of misconceptions.

References:

Dringoli, B. J., Kolosova, K., Rademaker, T. J., Wray, J., Choquette, J., & Hilke, M. (2019). Content Sequencing and its Impact on Student Learning in Electromagnetism: Theory and Experiment. *arXiv preprint arXiv:1910.00145*.

Maloney, D. P., O'Kuma, T. L., Hieggelke, C. J., & Van Heuvelen, A. (2001). Surveying students' conceptual knowledge of electricity and magnetism. *American Journal of Physics*, *69*(S1), S12-S23.

Renkl, A. (2016). Instruction based on examples. In *Handbook of research on learning and instruction* (pp. 341-364). Routledge.

Learning and teaching English vocabulary with clickers

Anne-Marie Sénécal, Concordia University, anne-marie.senecal@concordia.ca
Vanessa Mezzaluna, Concordia University, vanessamezza@gmail.com
Walcir Cardoso, Concordia University, walcir.cardoso@concordia.ca

"Learner Response Systems (LRS) are devices or applications that allow students to respond to and receive feedback on multiple-choice questions displayed on a screen. Previous studies suggest that the use of LRSs may contribute to learning (Bruff, 2009) and that they are positively perceived by students in general education (Wang, 2015) and in second language (L2) contexts (Cardoso, 2011). The pedagogical use of LRSs has been associated with the following affordances: user anonymity to increase students' willingness to share answers (Caldwell, 2007); immediate feedback to assist understanding (Hattie et al., 2007); and opportunities for peer instruction to promote active learning (Mazur, 1997). However, as most related studies tend to be in the context of large classrooms (e.g., universities, training programs) and with adult participants (Cardoso, 2011), LRS studies are still scarce in K-12 contexts of L2 education. The Make Words Click! project examines the effects of LRSs on the acquisition of English vocabulary in an L2 context, as well as teacher and student perceptions of the technology and associated pedagogy. The participants consisted of 61 secondary 2 students learning English as a second language in Montréal and constituted two intact groups (Clicker Group, n = 31; Non-Clicker Group, n = 30). Using a mixed-methods approach, the study included one pretest and two posttests to assess the amount of words learned and retained over the eight-week experiment. Students' and their teacher's perceptions were assessed via survey questionnaires and individual open-ended oral interviews related to the following themes: content learning, self-evaluation, engagement, and interactivity. The results revealed that: (1) an LRS-enhanced pedagogy benefits many students; and (2) while the teacher had neutral to negative perceptions, the positive perceptions in the Clicker Group surpassed those in the Control Group on most of the themes."

References:

Bruff, D. (2009). Teaching with classroom response systems: Creating active learning environments. John Wiley & Sons.

Caldwell, J. E. (2007). Clickers in the large classroom: Current research and best-practice tips. CBE—Life Sciences Education, 6(1), 9-20.

Cardoso, W. (2011). Learning a foreign language with a learner response system: the student's perspective. Computer Assisted Language Learning, 24, 393–417.

Hattie, J., & Timperley, H. (2007). The power of feedback. Review of Educational Research, 77(1), 81–112.

Mazur, E. (1997). Peer instruction: A user's manual. Upper Saddle River, NJ: Prentice Hall.

Wang, A. (2015). The wear out effect of a game-based student response system. Computers & Education, 82, 217–227.

Acknowledgements:

We would like to thank Turning Point Canada as well as the participants from Collège Sainte-Anne for their contribution to this study. Funding for this study was provided by the Social Sciences and Humanities Research Council (SSHRC) and the Concordia Undergraduate Students Research Award (CUSRA).

The discussion method in physics classrooms: Overcoming pitfalls to elaborate and lead efficient discussions

Louis Trudel, University of Ottawa, ltrudel@uottawa.ca
Abdeljalil Métioui, Université du Québec à Montréal, metioui.abdeljalil@uqam.ca

Discussion as a method of teaching is rarely used in physics classrooms. As such, many difficulties may prevent teachers from using this method: differences in status and knowledge between the participants (and teachers), time of discussion monopolized by some, etc. (Dillon, 1995) The purpose of this study is to identify the conditions under which an efficient discussion may be elaborated to guide students while they are investigating properties of physics phenomena. To answer our research question, we investigated the implementation of a discussion method in different school contexts (four classrooms) of a physics introductory course in grade 12. Qualitative methods were used such as a research diary where we noted our observations on the flow of events, the critical details about the introduction of the discussion method, and the links that we made between our observations and our theoretical framework (Miles et al., 2014) . Moreover, we taped the interviews with teachers in order to identify the various strategies they used while leading the discussion. Our results showed that, despite the complexities of the science classroom, some simple rules can be followed by teachers that are very effective to elaborate and lead efficient discussions.

The first rule concerns the preparedness of the teacher in managing a discussion, especially with the experimental apparatus. We have seen that being unprepared may expose the teacher to students' questions he would have difficulty answering right away. Even when prepared, the teacher had to consider the quality of the interactions with the students, and among the students themselves. If the relationship between the teacher and the students is strained or if there are tensions or antagonisms among students, the climate of the classroom may not be conducive to a good discussion. A good way to enhance sharing of ideas between students is to set up a structure that assigns roles to students and to set up a procedure to allocate speaking priority. In regular classrooms, the students should be gathered in small groups of five students while one of them is chosen as the spokesperson. A third rule related to the way the teacher interacted with the students. We observed in our research how it is difficult for teachers to avoid a pattern of recitation and to maintain a pattern of discussion. Some simple instructions to teachers have shown to be effective in decreasing the time he interacts individually with students and increasing the time students interact among themselves: 1) whenever a student asks a question, the teacher redirected the question to another student; 2) if the teacher started with a question (the teacher was the one who leaded the discussion), he tried to choose different students to answer and, when those students answered, he asked for comments from other students about the answers (Dillon, 1995). Finally, the use of the blackboard had been successful in promoting good classroom discussion. Indeed, it helped students keep track of the many ideas expressed to compare and evaluate them (Brown & Campione, 1990).

References:

Brown, A.L. & J.C. Campione, J.C. (1990). Interactive Learning Environments and the Teaching of Science and Mathematics. In Gardner, M., Greeno, J.G., Reif, F., Schoenfeld, A.H., diSessa, A. & E. Stage, E. (eds), *Toward a Scientific Practice of Science Education*, pp. 111-139. Mahwah (NJ): Lawrence Erlbaum Associates.

Dillon, J.T. (1995). Discussion. In Anderson, L.W. (ed.). *International Encyclopedia of Teaching and Teacher Education*, 2nd ed., pp. 251-255. Pergamon Press.

Miles, M.B., Huberman, A. M. & Saldaña, J. (2014). Qualitative data analysis: a methods sourcebook, 3rd ed. Thousand Oaks, Califorinia : SAGE Publications, Inc.

OCLaRE — A platform for scaffolding student lab report writing. Update on development

Petra Turkewitsch, Cégep de la Gaspésie et des Îles, pturkewitsch@cegepgim.ca
Michael Dugdale, John Abbott College, michael.dugdale@johnabbott.qc.ca
Murray Bronet, John Abbott College, murray.bronet@johnabbott.qc.ca
Eric Waldman, Mitchell Babin, Knealand Yates

Although a critical element of science education, introductory-level laboratory work has been criticized as impeding students' epistemological and conceptual growth (Holmes et al., 2017). The overly structured nature of many lab activities at this level mean students are largely passive actors. There is insufficient time for students to engage in meaningful writing activities given the number of labs, the time available for lab work, and the small ponderation allocated to lab report writing. OCLaRE, which is an interdisciplinary partnership between Physics and Chemistry departments at Cégep de la Gaspésie et des Îles and John Abbott College, was designed to address these issues. OCLaRE employs a scaffolding approach (Reiser & Tabak, 2014) to a writing-to-learn pedagogy (Rivard, 1994) wherein students participate in producing lab reports more reflective of the culture and community of science (Brown et al., 1989). Students interact with partially written templates to complete professionally formatted laboratory reports. OCLaRE helps mitigate the limited ponderation available for report writing by automating selected tasks — performing tedious computations, producing graphs, and formatting — that are inessential to a given evaluation. This frees students to focus on their scientific writing and their critical analysis. It also shifts the focus from managing data and formatting to developing critical thinking, judgment, and reflection skills.

We will report on the latest developments of this free online platform, including work in progress: collaborative grading between language and science teachers and a neural network based writing coach to highlight student-written sentences that are least reflective of professional scientific writing.

References:

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated Cognition and the Culture of Learning. *Educational Researcher, 18*(1), 32–42. doi:10.3102/0013189x018001032

Holmes, N. G., Olsen, J., Thomas, J. L., & Wieman, C. E. (2017). Value added or misattributed? A multi-institution study on the educational benefit of labs for reinforcing physics content. *Physical Review Physics Education Research, 13*(1), 010129. doi:10.1103/PhysRevPhysEducRes.13.010129

Reiser, B. J., & Tabak, I. (2014). Scaffolding. *In R. K. Sawyer (Ed.), The Cambridge Handbook of the Learning Sciences (2 ed., pp. 44–62)*. Cambridge: Cambridge University Press.

Rivard, L. P. (1994). A review of writing to learn in science: Implications for practice and research. *Journal of Research in Science Teaching, 31*(9), 969–983. doi:10.1002/tea.3660310910

Acknowledgements:

The authors would like to thank Entente Canada-Québec for funding this project, as well as our stagiaires Nathan Jasiukajc, Mitchell Babin, and Kneeland Yates.

WebWork Interface implementation in advanced engineering courses

David Urman, McGill University, david.urman@mail.mcgill.ca
Maria Orjuela-Laverde, McGill University, maria.orjuela-laverde@mcgill.ca
Mathias Legrand, McGill University, mathias.legrand@mcgill.ca

In university-level engineering courses, assignment problems commonly describe a physical or an engineering situation involving a set of given numerical parameters. This type of problems consists of application (i.e. implement solution procedures demonstrated in class) and analysis (i.e. recognizing the required tools and methods to solve a problem). The purpose of assignment problems is to allow students to test their acquired knowledge in a "controlled" environment where the solution and the tools required by problems are definite and cannot be contested. Thus, these problems will often be formulated for the solution to require an exclusive set of tools and will generate a unique solution. Almost in any course, to minimize the amount of work by the instructor/grader, all students will be given the same assignment to be done, outside of class. In practice, students may wish to minimize their workload as well by sharing answers, for example. Due to the formulation of assignments (exclusive methods and unique solutions), communal work and sharing answers implies some students' work is done by "blind" copying; thus, diminishing the educational value of the assignments. For this reason, they have been repeatedly rejected by instructors in advanced engineering courses as an educational tool. Still, the value of graded assignment in scaffolding students' knowledge in STEM fields has been directly correlated with student success in courses (Yang et al., 2016, Galyo et al., 2016). It is noticeable that the prominent weakness of assignments is in their lack of diversity. Constructing individual assignments to every student implies creating and grading of hundreds of distinct problems and will be obviously considered impractical. To mitigate this weakness, there exists an interface, widely used for fundamental mathematics courses, that answers this issue: WebWork (http://webwork.maa.org). WebWork is an interface where problems can be programmed as templates with arbitrary numerical parameters. This template format allows WebWork to distribute the same assignments but with different parameters to each student. Thus, each assignment can include different answers and different solution techniques. In effect, WebWork requires the same amount of work in creation as traditional assignments but, due to its randomizing in parameters, its output is equivalent to creating as many distinct assignments as there are students in the class. Thus, using this interface, peer-aided work does not imply sharing the workload of solving the assignment, but as a peer-to-peer learning where students help each other understand the assignment. Moreover, WebWork allows students to check the validity of their solutions and, naturally, records their answers. Hence, the interface allows for more indicators for the effectiveness of teaching tools and offers more precise evaluation of students' learning. In the present study, the WebWork interface has been implemented in a third-year mechanical engineering course in McGill University and has been received positively by the students. Student data from past versions of the course (where WebWork was not implemented) were used to measure the impact of the WebWork interface on student satisfaction and learning progress.

References:

Young, N., Dollman, A., & Angel, N. F. (2016). Does Homework Really Matter for College Students in Quantitatively-Based Courses?. Journal of Learning in Higher Education, 12(1), 19-26.

Galyon, C. E., Blondin, C. A., Forbes, B. E., & Williams, R. L. (2013). Does Homework Matter? A Comparison of Homework With Established Predictors of Exam Performance in Large College Classes. Journal on Excellence in College Teaching, 24(4).

Theoretical Perspectives on Active Learning

Joel Wiebe, OISE, University of Toronto, joel.wiebe@mail.utoronto.ca
Rubaina Khan, OISE, University of Toronto, rubaina.khan@mail.utoronto.ca
Renato Carvalho, OISE, University of Toronto, renatoscarvalho@gmail.com
Preeti Raman, OISE, University of Toronto
Garrick Burron, OISE, University of Toronto
Ju (Rebecca) Jeong, OISE, University of Toronto
Allison Van Beek, University of Toronto
Susan McCahan, University of Toronto
Olivier St-Cyr, University of Toronto
James D. Slotta, OISE, University of Toronto

Active learning has expanded into mainstream education, in Canada and internationally. However, there remains a lack of theoretical accounts and formal design frameworks. This symposium presents a set of theoretical perspectives: (1) defining active learning and its relationship with learning community pedagogy, (2) pedagogical approaches for active learning, (3) scripting and orchestration of complex curricular designs, (4) assessing the impacts of active learning on students and teachers, and (5) observation protocols for in-class active learning.

"Exploring the Intersections between Active Learning and Learning Communities: A Preliminary Review of Definitions and their Relationships" addresses the ambiguous definition of "active learning" and its relationship with the perspective of learning communities. This unfolding scoping review aims to explore various questions: What characteristics of learning can constitute *active learning*? What makes students a *learning community*? What are their distinguishing characteristics? This presentation negotiates preliminary shared definitions of these terms toward establishing a common vocabulary and through understanding their relationships aims to more clearly guide future curriculum designs and implementations.

"Pedagogy matters: Critical Pedagogy and Knowledge Building as Theoretical Backgrounds for Active Learning" will hypothesize that active learning and different pedagogical perspectives are compatible, complementary, and mutually contributive. This presentation will discuss how the theoretical frameworks of Knowledge Building (Hmelo-Silver & Barrows, 2008) and Critical Pedagogy (Freire, 2000) can provide relevant conceptual support to educators that adopt the active learning approach. Conversely, we will also discuss some active learning strategies that might facilitate and expand the possibilities for design and implementation of curricula grounded on Knowledge Building and Critical Pedagogy.

"Towards Co-orchestration: Technologies supporting teachers in active learning classrooms" will address the challenges of designing, monitoring, and intervening in an active learning environment. With growing evidence suggesting better learning outcomes through increased collaboration, many educators are encouraged to use active learning strategies in their classrooms (Blasco-Arcas et al., 2013; Bonwell & Eison, 1991). In this work, we outline some of the challenges of active learning and investigate ways in which scripting and orchestration could alleviate these challenges and support complex pedagogical designs of inquiry.

"Exploring Data Collection Instruments to Evaluate Active Learning Classrooms," will present a TEAL classroom constructed as a Design Studio in 2019 at the University of Toronto and discuss methods to examine the impacts of active learning classrooms on students. A new survey instrument, collated from five research studies of comprehensive instruments and five reports of data collection assessment questions, serves as a prelude to a promising study of measuring how students evaluate active learning classrooms based on their perception (Gebre et al., 2014; Office of Information Technology, 2009).

"Review of In-Class Active Learning Observation Protocols" will review existing classroom observation tools and present on how merging the Teaching Dimensions Observation Protocol (TDOP) and the Active Learning Classroom Observation Tool (ALCOT) can be used to capture the intersection of space, technology and pedagogy in active learning classrooms.

Together these five presentations, each aim to address a different theoretical or methodological aspect of active learning research or practice.

References:

Blasco-Arcas, L., Buil, I., Hernández-Ortega, B., & Sese, F. J. (2013). Using clickers in class. The role of interactivity, active collaborative learning and engagement in learning performance. C*omputers & Education, 62*, 102–110.

Bonwell, C. C., & Eison, J. A. (1991). Active Learning: Creating Excitement in the Classroom. 1991 *ASHE-ERIC Higher Education Reports.* ERIC.

Freire, P. (2000). *Pedagogy of freedom: Ethics, democracy, and civic courage*. Rowman & Littlefield Publishers.

Gebre, E., Saroyan, A., & Bracewell, R. (2014). Students' engagement in technology rich classrooms and its relationship to professors' conceptions of effective teaching. *BJET, 45*, 83-96.

Hmelo-Silver, C. E., & Barrows, H. S. (2008). Facilitating collaborative knowledge building. *Cognition and instruction, 26*(1), 48-94.

Office of Information Technology. (2009). STSS research project: student survey [Pdf]. University of Minnesota. Retrieved from https://www.lsu.edu/it_services/serv_op/ecar_files/student/2016_ECAR_Student_survey.pdf

Acknowledgements

Olivier St-Cyr and Rebecca Jeong would like to express their sincere thanks to Dr. Steve Szigeti for his generous support, insights in editing and implementing the final survey.

New literacies, social practices and active learning in e-discussions

Lesley Wilton, University of Toronto, lesley.wilton@mail.utoronto.ca

The field of online learning has much to offer those who are interested in active learning design. Online learning has its own rich history of inquiry into designs that engage, connect, and promote rich collaborations around student contributed content (Slotta & Jorde, 2010). Indeed, many active learning designs include an online component, where students are engaged in interactions with peers through online discussions (Dengler, 2008; Miller et al., 2018; Wilson et al., 2007). The design of e-discussions can influence rich, interactive and collective learning experiences (Koohang et al., 2012). This paper reviews a study of an online learning design that promoted new forms of social literacies and an atmosphere of social presence (Garrison, 2009), which could usefully inform future active learning designs.

An interpretive perspective (Bhattacharya, 2008) influenced this study of 137 online learning participants' interactions and perceptions to address the overarching question: *What new literacies and social practices support active learning in online learning discussions.* A thematic analysis of survey data identified new literacies and social practices important to interaction in online discussions (Lankshear & Knobel, 2013; Wilton, 2019; Wise et al., 2013).

Sawyer (2008) argues that the "best learning takes place when learners articulate their unformed and still developing understanding, and continue to articulate it throughout the process of learning" (p. 6). Understanding the importance of reading and revisiting as social practices in e-discussions could help to build support for online learners who "say" less. More than one third of the participants in this study preferred to read and revisit entries but were not highly visible in the discussions. One participant explained that they were not required to respond right away as in a face-to-face discussion, but that the online environment provided the opportunity to take time to think and understand before thoughtfully responding.

Another social practice that can positively influence interaction is the design of subject lines to engage readers in online discussions. When a subset of the participants were asked to intentionally create informative subjects lines, they explained their strategies as being catchy, creative, controversial, purposeful, clarifying, leading, succinct, insightful and/or precise. When asked how a subject line might influence their engagement with an entry, some participants explained they preferred subjects that asked a question, were controversial or were leading with part of the response. Interestingly, Perkins and Newman (1996) and Duranti (1986) suggested a subject that included only part of a response was a sign of misunderstanding or a mistake.

Finally, social presence activities involving starter activities can contribute to building interpersonal relationships, trust and a sense of belonging (Garrison, et al., 2000). Examples of these could include inviting participants to share pictures of places they would like to visit, their favourite meals or an inspirational quote.

The importance of the reading and revisiting, subject lines and starter activities has implications for e-discussion course design to support active learning. These results suggest it is important to further study these best practices.

References:

Bhattacharya, H. (2008). Interpretive research. In Lisa M. Given (Ed.), *The Sage encyclopedia of qualitative research methods, 1*, 2, 465–468. Thousand Oaks, CA: Sage Publications.

Dengler, M. (2008). Classroom Active Learning Complemented by an Online Discussion Forum to Teach Sustainability. *Journal of Geography in Higher Education, 32*(3), 481-494.

Duranti, A. (1986). Framing discourse in a new medium: Openings in electronic mail. *The Quarterly Newsletter of the Laboratory of Comparative Human Cognition, 8*(2), 62-70.

Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education model. *The Internet and Higher Education, 2* (2-3), 87-105.

Koohang, A., Smith, T., Yerby, J., & Floyd, K. (2012). Active Learning in Online Courses: An Examination of Students' Learning Experience. *International Journal of Management, Knowledge and Learning, 1*(2), 205-216.

Lankshear, C., & Knobel, M. (2013). Introduction: Social and cultural studies of new literacies from an educational perspective. In C. Lankshear & M. Knobel (Eds.), *A new literacies reader: Educational perspectives,* 1-19. New York, NY: Peter Lang.

Miller, K., Lukoff, B., King, G., & Mazur, E. (2018). Use of a Social Annotation Platform for Pre-Class Reading Assignments in a Flipped Introductory Physics Class. *Frontiers in Education, 3*, 108-120.

Perkins, J., & Newman, K. (1996). Two archetypes in e-discourse: Lurkers and virtuosos. *International Journal of Educational Telecommunications, 2*, 155-170.

Sawyer, K. S. (2008). Optimizing learning: Implications of learning sciences research. Directorate for Education, Centre for Educational Research and Innovation (CERI) Governing Board. Available at http://www.oecd.org/education/ceri/40805146.Pdf

Slotta, J. D, & Jorde, D. (2010). Toward a Design Framework for International Peer Discussions: Taking Advantage of Disparate Perspectives on Socio-Scientific Issues. *Research and Practice in Technology Enhanced Learning, 5*(3), 161-184. doi: 10.1142/S179320681000089X

Wilson, B. M., Pollock, P. H., & Hamann, K. (2007). Does Active Learning Enhance Learner Outcomes? Evidence from Discussion Participation in Online Classes. *Journal of Political Science Education, 3*, 131-142. doi: 10.1080/15512160701338304

Wilton, L. (2019). Quiet Participation: Investigating non-posting activities in online learning. *Online Learning Journal, 22*(4). Available at https://olj.onlinelearningconsortium.org/index.php/olj/article/view/1518/429

Wise, A. F., Hausknecht, S., & Zhao, Y. (2013). Relationships between listening and speaking in online discussions: An empirical investigation. In N. Rummel, M. Kapur, M. Nathan, & S. Puntambekar (Eds.), *Proceedings of the 10th International Conference on Computer Supported Collaborative Learning, 1,* 534–541. Madison, WI.

Educational Technology

CRE-ate: Bringing Research Experience to Undergraduate Lab Courses

Véronique Brulé, McGill University, veronique.brule@mcgill.ca
Hugo Zheng, McGill University, hugo.zheng@mcgill.ca
Rodrigo Reyes-Lamothe, McGill University, rodrigo.reyes@mcgill.ca
Tamara Western
Paul Harrison

Research experience is a critical component of science education through which students develop skills required for careers in STEM (Science, Technology, Engineering and Mathematics) (Hernandez et al., 2018). Unfortunately, opportunities for students to engage in research are generally restricted to a limited number of laboratory internships. Course-based Research Experience (CRE) is an inclusive alternative to internships that integrates research directly into for-credit courses, affording a broader student population the opportunity to engage in open-ended research (Brownell & Kloser, 2015; Hernandez et al., 2018). Additionally, CREs have been shown to better facilitate the learning and development of practical scientific skills as compared to traditional laboratory course formats. Despite these advantages, large class sizes (>150 students) make integrating CRE at the post-secondary level difficult in terms of logistics and feasibility (Brownell & Kloser, 2015).

To provide a broader population of undergraduates with research experience, we have developed a CRE-based framework specifically for high enrolment laboratory courses. There are two key elements to our approach that we believe are integral to adapting CREs to high-enrolment courses:

1. Standardized workflow: To logistically accommodate a large class size, we have created a semester-long research workflow in which all student groups perform the same experimental techniques, but groups design the experimental conditions so that data are unique among group research projects.

2. Flipped classroom approach: To feasibly manage course material, we have moved theoretical content into pre-lab videos and readings so that the lecture periods associated with the lab can be used as working sessions during which students and instructors can discuss the research projects. This provides instructors with a more enriching teaching experience than traditional lecturing, and provides students with more personalized learning despite the large class size.

The CRE framework was piloted in an upper-year undergraduate laboratory course at McGill University during F2019-W2020, and a variety of tools were used to evaluate the impact of the framework on student learning and perceptions about research (Goodey & Talgar, 2016; Shortlidge & Brownell, 2016). These tools include the Colorado Learning Attitudes About Science (CLASS) Biology survey, the Science Laboratory Environment Inventory (SLEI), and qualitative data analysis of end-of-term student course evaluations to assess changes in student engagement and attitude toward learning in STEM, as well as the validated Biological Experimental Design Concept Inventory (BEDCI) to assess changes in student understanding of course material. Based on a preliminary analysis, the CRE framework was well received by students, who reported more positive gains than pre-pilot cohorts in terms of developing research-based skills (experimental design and analysis, scientific literacy and communication, and technical competency).

References:

Brownell, S. E., & Kloser, M. J. (2015). Toward a conceptual framework for measuring the effectiveness of course-based undergraduate research experiences in undergraduate biology. *Studies in Higher Education, 40*(3), 525-544.

Goodey, N. M., & Talgar, C. P. (2016). Guided inquiry in a biochemistry laboratory course improves experimental design ability. *Chemistry Education Research and Practice, 17*(4), 1127-1144.

Hernandez, P. R., Woodcock, A., Estrada, M., & Schultz, P. W. (2018). Undergraduate research experiences broaden diversity in the scientific workforce. *BioScience*, *68*(3), 204-211.

Shortlidge, E. E., & Brownell, S. E. (2016). How to assess your CURE: a practical guide for instructors of course-based undergraduate research experiences. *Journal of microbiology & biology education, 17*(3), 399.

Undergraduates can publish too!
Biology writing assignments leading to publication

Chiara Gamberi, Concordia University, chiara.gamberi@concordia.ca
Katharine Hall, Concordia University, katharine.hall@concordia.ca

Critical inquiry and writing skills are fundamental in science professions. Scientific writing has been introduced in the upper-level undergraduate curriculum (Colton et al. 2014; Glaser, 2014; Stanford et al., 2013; Walker et al., 2013), yet can be challenging to teach to classes with large enrollment, short semesters and programs with traditionally light written course work. The typical assignment is a critique or summary of a published article prepared for the sole audience of the teacher (Yore et al., 2003). As such, these papers may not fulfill the standards expected in peer-reviewed publication, may ineffectively prepare students for graduate studies and scholarly careers, and limit the teaching and practice of scientific discourse (Ford et al., 2006). Moreover, the science presented in textbooks appears more unchangeable than the dynamic reality of scientific progress (Yore et al., 2003). While such approach may offer a stable knowledge reference, it also limits capacity of relating to and interpreting debate effectively, which remains an essential capacity at any time, and especially in times of global crisis and profound intellectual fraction as traversed in the current COVID-19 pandemic.

Inspired by the write-to-learn tradition (Yore et al., 2003; Jang et al., 2017), a new scaffolded assignment was designed and implemented in several upper-level biology courses with 100+ students. Broadly applicable, this assignment splits the class into teams each contributing a section to a larger review paper for eventual publication. The assignment was designed to scaffold the experiential learning of effective scholarship and scientific practice (e.g., source selection, publication database navigation), promote behaviors conducive to scientific writing, and mitigate plagiarism (Gamberi et al., 2019).

Each team is provided with seed articles to use as a starting point to help define the scope of the final paper and act as a model for the students' work. Although seed article selection is more labour intensive for the professor, it ensures the assignment pedagogical value providing both exemplary quality sources and guaranteeing consultation of a minimum of appropriate source content. Students are taught how to conduct their own bibliographic searches and expected to apply learned skills to find additional sources to complete their assignment.

A collaboration between professor and librarian was instrumental in teaching how to search scientific literature on contemporary course-relevant topics, discuss critically and connect with course objectives. Moreover, students were taught how to properly paraphrase and correctly cite sources to recognize and minimize plagiarism.

At course completion, several students volunteered as editors and were mentored through compilation of the final manuscript to submit for publication. The only incentive for such student editors was to gain scientific editorial skills and experience with the publication cycle. These students became the lead authors on the published reviews in acknowledgement of their greater contributions. To model an exemplary process of publication, the entire class was kept informed of the developments in real time. Open access journals were prioritized as publication venues as we wished the final publications to remain accessible and shareable by all contributors.

Stemming from this pedagogy, two articles have already been peer-reviewed and published to date (Selber-Hnatiw et al., 2020; Selber-Hnatiw et al., 2017) and others are in preparation. Student feedback from this assignment has been outstandingly positive.

References:

Colton, J. S., & Surasinghe, T. D. (2014). Using collaboration between English and biology to teach scientific writing and communication. *Journal of College Science Teaching, 44*(2), 31-39. https://www.jstor.org/stable/43631953

Glaser, R. E. (2014). Design and assessment of an assignment-based curriculum to teach scientific writing and scientific peer review. *Journal of Learning Design, 7*(2), 85-104. https://www.jld.edu.au/article/view/202.html

Stanford, J. S., & Duwel, L. E. (2013). Engaging biology undergraduates in the scientific process through writing a theoretical research proposal. *Bioscene: Journal of College Biology Teaching, 39*(2), 17-24. https://eric.ed.gov/?id=EJ1020511

Walker, J. P., & Sampson, V. (2013). Argument-driven inquiry: Using the laboratory to improve undergraduates' science writing skills through meaningful science writing, peer-review, and revision. *Journal of Chemical Education, 90*(10), 1269-1274. https://doi.org/10.1021/ed300656p

Yore, L. D., Bisanz, G. L., & Hand, B. M. (2003). Examining the literacy component of science literacy: 25 years of language arts and science research. *International Journal of Science Education, 25*(6), 689-725. https://doi.org/10.1080/09500690305018

Ford, M. J., & Foreman, E. A. (2006). Redefining disciplinary learning in classroom contexts. *Review of Research in Education, 30*(1), 1-32. https://www.jstor.org/stable/4129768

Jang, J-Y., & Hand, B. (2017). Examining the value of a scaffolded critique framework to promote argumentative and explanatory writings within an argument-based inquiry approach. *Research in Science Education, 47*(6), 1213-1231. https://doi.org/10.1007/s11165-016-9542-x

Gamberi, C., & Hall, K. (2019). Undergraduates can publish too! A case of scientific team writing assignment leading to publication. *International Journal of Science Education, 41*(1), 48-63. https://doi.org/10.1080/09500693.2018.1531439

Selber-Hnatiw, S., Sultana T., Tse W., Abdollahi, N., Abdullah, S., … & Gamberi, C. [93 authors]. (2020). Metabolic networks of the human microbiota. *Microbiology, 166*(2), 96-119. https://doi.org/10.1099/mic.0.000853

Selber-Hnatiw, S., Rukundo B., Ahmadi, M., Akoubi, H., Al-Bizri, H., … & Gamberi, C. [103 authors] (2017). Human gut microbiota: Toward an ecology of disease. *Frontiers in Microbiology*, *8*, 1265-84. https://doi.org/10.3389/fmicb.2017.01265.

Acknowledgements

We would like to thank Dr. Patrick Gulick, Dubravka Kapa, Dr. William D. Lubell and Dr. Madoka Gray-Mitsumune for the initial discussion and opinions on assignment design. CG is the recipient of a Professional Development Award from CUPFA (www.cupfa.org) and a Mitacs Accelerate research grant (IT10214).

Corriger avec un cellulaire pour orienter la réussite étudiante en arts visuels

Stéphanie Granger, Cégep Saint-Jean-Sur-Richelieu, stephanie.granger@cstjean.qc.ca
Jules Massé, Cégep Saint-Jean-Sur-Richelieu, jules.masse@cstjean.qc.ca

[Démo à regarder avant la lecture du texte (2 min) : *Le questionnaire en ligne pour enseigner et évaluer* https://youtu.be/7W9iqnnFy0k]

L'enseignante souhaitait améliorer l'ergonomie de sa tâche d'évaluation et de rétroaction par une approche créative. Elle voulait également que l'étudiant au DEC en Arts visuels (510.A0) puisse retrouver tous les documents pertinents de son cours de dessin d'observation au même endroit. C'est avec la collaboration du conseiller pédagogique TIC qu'elle a pu automatiser une partie du travail à l'aide d'applications accessibles et populaires retrouvées dans les plateformes Office 365, Moodle ou G-Suite éducation.

Orienter la réussite de l'étudiant au moyen de rétroactions visuelles rapides et efficaces

Plusieurs recherches sur la rétroaction efficace ont montré que les étudiants apprennent mieux et maintiennent leur motivation lorsqu'ils reçoivent une rétroaction de qualité. Celle-ci doit être personnalisée, orientée et fréquente (Hattie & Timperley, 2007 , p. 104; Leibold & Schwarz, 2015, p. 43; Schute, 2008 p. 154). Les étudiants sont alors plus enclins à maintenir leurs efforts, car les buts d'apprentissages sont clairs, le dialogue pédagogique est rassurant et stimulant. L'engagement est aussi augmenté par des attentes élevées et clairement exprimées.

Dans le cours de l'enseignante, les travaux évalués et les rétroactions sont compilés automatiquement dans une grille critériée. Le dispositif comporte un formulaire lié à un tableur (Google Sheets) automatisant l'archivage des données. De son côté, l'étudiant en arts visuels reçoit cette grille d'évaluation critériée qui lui permet de saisir visuellement, grâce à un code couleur, si sa performance répond aux exigences du cours et lui offre des pistes d'amélioration. Enfin, le formulaire d'évaluation facilite le travail de l'enseignante, car les données statistiques permettent d'ajuster la matière enseignée afin de répondre aux besoins communs de la classe.

Dans sa pratique, Stéphanie Granger utilise aussi les formulaires pour enseigner à distance (classe inversée), suivre les projets en automatisant la collecte de travaux visuels et aider pédagogiquement l'apprenant à organiser sa réflexion artistique. Corriger avec un cellulaire est efficace, car ce dispositif simplifie sa tâche tout en lui permettant d'offrir une rétroaction significative à l'étudiant désirant progresser. Parce que le temps gagné est réinvesti en accompagnement individuel, elle peut ainsi leur offrir un meilleur suivi personnalisé. C'est moins le produit final qui est évalué, mais plutôt le processus d'apprentissage qui y mène.

Cette innovation numérique faisant l'usage d'un formulaire de collecte de données permet à l'enseignante d'être:

1. Mobile et organisée dans la correction, automatisant l'archivage dans un environnement infonuagique et transmettant des fiches aux étudiants;
2. Constructive et visuelle dans les rétroactions;
3. Écoresponsable (pas de papier).

Vous souhaitez expérimenter cette méthode novatrice et comprendre les étapes pour la réaliser? Stéphanie Granger vous invite à visiter son récit publié dans Profweb.

References:

Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of educational research*, *77*(1), 81-112. DOI: 10.3102/003465430298487

Leibold, N., & Schwarz, L. M. (2015). The art of giving online feedback. *Journal of Effective Teaching*, *15*(1), 34-46.

Shute, V. J. (2008). Focus on formative feedback. *Review of educational research*, *78*(1), 153-189. DOI: 10.3102/0034654307313795

Acknowledgements

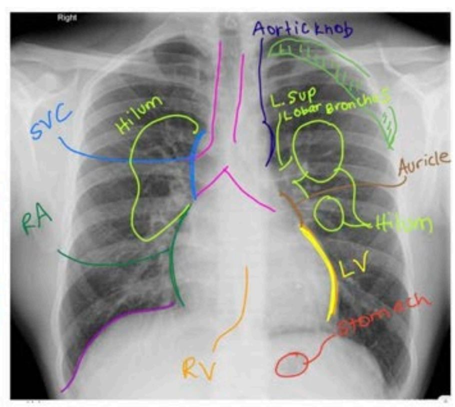
Jules Massé, conseiller pédagogique TIC, Cégep Saint-Jean-sur-Richelieu
Marc Landry, conseiller pédagogique, Cégep Saint-Jean-sur-Richelieu

Using Collaboration Technology to Transform Anatomy Education for Health Professionals

Krista Johansen, Tufts University School of Medicine, Krista.Johansen@tufts.edu
Leslie Schneider, Dr., leslie.schneid@gmail.com
Ellie Glasgow, Tufts University School of Medicine, Ellie.glasgow@tufts.edu

This project re-imagines an approach to teaching radiologic anatomy that contrasts with the approach of didactic lectures and self-directed learning modules. Current approaches in health professions education favor active, applied and clinical learning methodologies. Using a collaborative learning workshop format along with Visual Classrooms, an online computer supported collaborative learning (CSCL) platform, we created an active learning environment with opportunities for learners to undertake activities that allow them to apply basic knowledge and skills in practice – with immediate feedback from peers and the faculty facilitator. Four 2-hour collaborative learning workshops were designed and held for each region of the body taught in the course. Through Visual Classrooms, the groups annotated the images, including outlining key organs and vessels and answered questions regarding the cases (see image for example). Using this collaboration workspace, groups could review, discuss and provide feedback on each other's work. At the conclusion of the workshop, the instructor reviewed the cases with the entire class using students' ideas rather than providing a faculty answer key. This method was predominantly synchronous but provided opportunities for asynchronous discussion and feedback. An initial pilot test of this technology-supported workshop format was carried out in May 2018 with 50 first-semester PA students. A multiple-choice pre-test of radiologic identifications was given prior to the workshop and an identical post-test given the week after. A paired t-test was conducted and demonstrated a significant difference in the scores for the pre-test (M=5.08, SD 2.64) and post-test (M9.23, SD 1.15); $p<.001$. In addition, there was higher scoring on radiologic anatomy mid-term and final exam questions for the 2019 cohort when compared to the 2018 cohort who only received didactic lectures. Course evaluation data demonstrated that the 2019 cohort found radiologic anatomy the most relevant component of the course. This format was perceived as meaningful and favorable by students. Further studies will attempt to specifically evaluate higher-level learning outcomes, investigate longitudinal effects in clinical practice and apply the methodology to other specialties.

Above: CSCL workshop
Middle: Visual Classrooms platform
Right: Example of a group post



References:

Bell, P., & Winn, W. (2000). Distributed cognitions, by nature and by design. Theoretical foundations of learning environments, 123-145.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. Educational researcher, 18(1), 32-42.

Cooke, M., Irby, D. M., & O'Brien, B. C. (2010). Educating physicians: a call for reform of medical school and residency. San Francisco, CA, Jossey-Bass.

Hegmannn, T. (2013). Snapshot of anatomy teaching in physician assistant education. J Physician Assist Educ, 24(4), 19-21.

Means, B., Shear, L., & Roschelle, J. (2015). Using technology and evidence to promote cultures of educational innovation: The example of science and mathematics education. Menlo Park, CA: SRI International.

Phillips, A. W., S. G. Smith, C. F. Ross, and C. M. Straus. 2012. 'Improved understanding of human anatomy through self-guided radiologic anatomy modules', Acad Radiol, 19: 902-7.

Pizzimenti, Marc A., and Rick D. Axelson. 2015. 'Assessing student engagement and self-regulated learning in a medical gross anatomy course', Anat Sci Educ, 8: 104-10.

Scardamalia, M & Bereiter, C. (1994) Computer support for knowledge-building communities. The Journal of the Learning Sciences, 3(3), 265-2984.

Strijbos, J. W., Kirschner, P. A., & Martens, R. L. (2004). What we know about CSCL. In What we know about CSCL (pp. 245-259). Springer, Dordrecht.

Small changes to shift classroom learning culture

Tamara Kelly, York University, tljkelly@yorku.ca
Paula Wilson, York University, pjwilson@yorku.ca

Many post-secondary educators are becoming increasingly aware of the need to teach students more than just disciplinary content, especially during the first-year transition. In addition to strong foundational knowledge in their discipline, many students also need guidance and support to improve study and attention skills and develop a more wholistic approach to learning. Over the past decade, in our large first and second-year biology courses, we have gradually implemented several evidence-based strategies to help students improve their study and metacognitive skills and address course-related anxiety. Strategies include, Just-in-Time-Teaching questions (Marrs & Novak, 2004); reflection—in formative and summative assessments, as well as post-midterm reflections ("exam wrappers") (Tanner, 2012; Nilson, 2013); meditation; and the introduction of learning skills (McGuire & McGuire, 2015; Nilson, 2013;) into the curriculum. Regarding the latter, metacognition and other elements of effective learning are presented in mini-lectures during regular class time, and are assessed via reflection questions on weekly reading quizzes and questions about learning strategies on term tests. Additional resources supporting each mini-lecture were rolled out week by week via a "Learning Strategies Hub" on the course LMS, and developing effective learning skills is a course learning outcome included in the syllabus. Emotions (e.g., anxiety) and cognitive focus are tightly linked (Powietrzynska & Tobin, 2015). To help students manage their stress, improve the quality of their attention, and transition into class time, we have introduced a three-minute meditation at the beginning of each class and a one-minute breathing exercise prior to each test (Hart, 2004). We find that not only did it help students transition into class time, but it also helps instructors reduce stress and focus on the class at hand. In our session we will discuss these varied strategies and their implementation, and provide lessons learned and tips for other educators. Evidence to evaluate the effectiveness of these strategies was collected from course evaluations, surveys, concept inventory scores, and test/course grades. Together with our adoption of active learning approaches, each of these has had an impact on our classroom culture, helped us to better understand and address common points of confusion around core concepts, and encouraged students to be more reflective and proactive in their learning. Cumulatively, they have helped open up an important dialogue with our students regarding their own role in their academic success. This session will provide an opportunity to engage with other interested instructors to share best practices and share feedback on our experiences.

References:

Hart, T. (2004). Opening the contemplative mind in the classroom. *Journal of transformative education*, *2*(1), 28-46.

Marrs, K. A., & Novak, G. (2004). Just-in-time teaching in biology: Creating an active learner classroom using the internet. *Cell Biology Education*, *3*(1), 49-61.

McGuire, S. Y. (2015). *Teach students how to learn: Strategies you can incorporate into any course to improve student metacognition, study skills, and motivation*. Stylus Publishing, LLC.

Nilson, L. (2013). Creating Self-Regulated Learners: Strategies to Strengthen Students. *Self-Awareness and Learning Skills. Herndon, VA: Stylus Publishing, LLC*.

Powietrzynska, M., & Tobin, K. (2015). Mindfulness and science education. *Encyclopedia of science education*, 642-647.

Tanner, K. D. (2012). Promoting student metacognition. *CBE—Life Sciences Education*, *11*(2), 113-120.

Why this app? How educators choose a good educational app

Armaghan Montazami, McGill University, armaghan.montazami@mail.mcgill.ca
Heather Pearson, McGill University, heather.pearson@mail.mcgill.ca
Adam Dubé, McGill University, adam.dube@mcgill.ca

With currently over 75,000 educational apps in the App Store (Apple, 2019), it is valuable to understand what indicates a quality educational app that enhances learning. As apps have become a growing tool for education (Shuler, 2012), teachers will be required to evaluate and use apps effectively in their classrooms (Cherner, Dix, & Lee, 2014). Images and text descriptions are the only information provided to customers in the App Store (Vaala, Ly, & Levine, 2015); thus, it is crucial to know how educators make informed decisions based on this information. Prior research has identified five benchmarks as being indicative of educational quality. These include scaffolding, feedback (Callaghan & Reich, 2018), being based on a guiding curriculum, developed and tested by an interdisciplinary development team (Vaala et al., 2015), and based on a learning theory (Kebritchi & Hirumi, 2008). In the present study, participants were presented with 10 artificial math apps that replicate the App Store presentation while having their gaze recorded using an eye tracker; five contained one key educational benchmark and five contained one educational buzzword (interactive, hands-on, engaging, multi-media, personalized). Participants were 57, English-speaking elementary education pre-service teachers (n=50) and currently working elementary teachers (n=7) (51 female, 6 male) with a mean age of 22.74 years (range: 19 to 43 years). Immediately following each app, participants provided a value judgement by stating whether they would download the app or not, rating them on a 5-point-scale, stating how much they would be willing to pay, and explaining why they chose to download the app or not. Finally, participants ranked the apps in order from best to worst. Using the gaze data, we investigated what characteristics of the templates capture participants' attention (images vs. text) and contribute to participants' value judgements. Paired-sample t-tests across the four measures (i.e., average download, cost, rate, and rank data) revealed that educators are valuing educational benchmarks over buzzwords; they would be more willing to download them, pay more for the apps, rate them higher, and rank them above buzzwords. Repeated-measures within-subjects ANOVAs of the benchmark app evaluations determined that participants are valuing apps that feature development teams, scaffolding, and curriculum more than those with learning theory and feedback. Paired-sample t-tests of gaze duration identified that text descriptions are being viewed more frequently than images; however, educators spend more time looking at images featuring educational benchmarks than buzzwords. These findings suggest that educators are identifying and valuing research supported features when looking for apps to use in their classrooms. Thus, information on the five educational benchmarks should be clearly provided in the app descriptions of popular App Stores. Additionally, these findings support the need for professional development to make educators aware of the importance of all five educational benchmarks.

References:

Apple (2019). App store. Retrieved from https://www.apple.com/ca/education/ipad/apps-books-and-more/
Callaghan, M. N. & Reich, S. M. (2018). Are educational preschool apps designed to teach? An analysis of the app market. Learning, Media, and Technology, 43, 280-293. Doi:10.1080/17439884.2018.1498355
Cherner, T., Dix, J., & Lee, C. (2014). Cleaning up that mess: A framework for classifying educational apps. Contemporary Issues in Technology and Teacher Education, 14, 158-193.
Kebritchi, M. & Hirumi, A. (2008). Examining the pedagogical foundations of modern educational computer games. Computers & Education, 51, 1729- 1743. doi:10.1016/j.compedu.2008.05.004
Shuler, C., Levine, Z., & Ree, J. (2012). iLearn II: An analysis of the education category of Apple's app store. New York, NY: The Joan Ganz Cooney Center at Sesame Workshop.
Vaala, S., Ly, A., & Levine, M. H. (2015). Getting a read on the app stores: A market scan and analysis of children's literacy apps. New York, NY: The Joan Ganz Cooney Center at Sesame Workshop.

Acknowledgements:

We would like to acknowledge members of the Technology, Learning, and Cognition Lab for their work on the project.

Warp Zones for Higher Education: Designing Teaching and Learning in Flexible Spaces

Nadia Naffi, Université Laval, Nadia.Naffi@fse.ulaval.ca
Ann-Louise Davidson, Concordia University, ann-louise.davidson@concordia.ca
Ndèye Rokhy Diongue, Université Laval, ndeye-rokhy.diongue.1@ulaval.ca

Digital transformation for organizations has become inevitable (Fitzpatrick et al., 2020). To keep up with these rapid technological advancements we need to ground scholarship in the 21st century competencies that will be essential in this coming AI dominated era. We can no longer be satisfied with traditional models. Many innovative practices include flipping classrooms, or integrating experiential learning activities. However, these innovations rarely allow mixing it up between defined learning spaces and mode of delivery. We usually end up either exclusively online or exclusively face-to-face, and exclusively synchronous or asynchronous, even in hybrid designs. To bridge this gap, we imagined warp zones that enable real-world authentic learning experiences for graduate students in higher education. Warp zones exist in video games and are "secret passages that bring two or more worlds together" (Fuller & Jenkins, 1995) by allowing for "a much quicker movement through space than is generally possible within the real world" (Gazzard, 2009, p. 1).

We used an agile quick-prototyping method to design learning experiences that exploited the metaphor of warp zones in education. We iterated through various cycles of innovation that took in consideration the following trouble areas: context, learners, objectives, technology, environmental constraints and institutional agendas.

Two examples were a graduate course designed with the Hybrid-Flexible model (HyFlex), a model that allows students to choose whether to attend classes face-to-face or online, synchronously or asynchronously (Academic Senate - San Francisco State University, s. d., Beatty, 2019, Gobeil-Proulx, 2019), and a collaborative action-research group in education that had to develop high level expertise grounded in scholarship and pragmatism.

Similar to warp zones, the HyFlex model offers flexibility in time and space to students and supports student-directed learning with flexible approaches to participation and flexible learning paths. In the design of our graduate course and for the research group we broke the barriers between spaces and brought students together, regardless of where they were in space.

In the graduate course, we engaged online students as if they were in the physical class and brought the in-class students online to work with the online groups. Further, asynchronous discussions were triggered and facilitated organically by students from the three modalities. The students valued the three zones options and the flexibility they offered. They also appreciated their interactions with groups of students from other zones or modalities and observed that a larger number of students were able to follow the classes and to be engaged every step of the way.

As for the research group, it allowed us to package research interactions and iterations in various warps to create experiences which could all reach similar goals and answer similar research questions. Students appreciated the warp zones because it increased their network and pool of expertise.

In both cases, students were able to develop technological and social skills to collaborate and exchange with colleagues simultaneously in face-to-face and distance learning environments, synchronously and asynchronously. Mastering these skills is essential to compete in a world going through an accelerated digital transformation. Most of all, students felt that when the COVID-19 pandemic erupted, they were able to switch paths and complete their course with success.

References

Academic Senate - San Francisco State University. (s. d.). Online Education Policy (CURRENT) | Academic Senate. Retrieved from https://senate.sfsu.edu/policy/online-education-policy-1

Beatty, B. J. (2019). Beginnings: Where Does Hybrid-Flexible Come From?. In B. J. Beatty, *Hybrid-Flexible Course Design: Implementing student-directed hybrid classes*. EdTech Books. Retrieved from https://edtechbooks.org/hyflex/book_intro

Fitzpatrick, M., Libarikian, A., Smaje, K., & Zemmel, R. (2020, april 20). The digital-led recovery from COVID-19: Five questions for CEOs. Retrieved from https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/the-digital-led-recovery-from-covid-19-five-questions-for-ceos

Fuller, M. and H. Jenkins (1995). "Nintendo and New World Travel Writing: A Dialogue". *Sage Publications: Thousand Oaks*. Retrieved from http://web.stanford.edu/class/history34q/readings/Cyberspace/FullerJenkins_Nintendo.html

Gazzard, A. (2009). Teleporters, Tunnels & Time: Understanding Warp Devices in Videogames. Retrieved from https://uhra.herts.ac.uk/bitstream/handle/2299/7116/906040.pdf?sequence=1

Gobeil-Proulx, J. (2019). La perspective étudiante sur la formation comodale, ou hybride flexible. *Revue internationale des technologies en pédagogie universitaire*, *16*(1), 56. https://doi.org/10.18162/ritpu-2019-v16n1-04

Fostering Intercultural Competences for International Virtual Engineering Student Teams (InVEST): A Knowledge Community and Inquiry (KCI) Approach

Anuli Ndubuisi, University of Toronto, anuli.ndubuisi@mail.utoronto.ca
Rubaina Khan, University of Toronto, rubaina.khan@mail.utoronto.ca
Anuli Ndubuisi, University of Toronto, anuli.ndubuisi@mail.utoronto.ca

To meet the demands of the 21st century, engineering students need more than technical learning. They also require intercultural learning, a global competence concept, necessary for engineers to work in complex global projects, immigrate to find work, collaborate and compete with multicultural colleagues, and work for international companies (OECD/Asia Society, 2018; Downey et al, 2006). Higher education institutions are exploring how to help students develop intercultural competences; however, engineering studies are limited. Traditional study-abroad approaches have been adversely impacted by global events such as safety issues, health concerns, natural disasters, political instability as well as students' financial and time constraints (Opendoors, 2017). This has been illustrated by the recent COVID-19 pandemic. A survey of over 230 U.S. higher education institutions on the effects of COVID-19 on international students and study abroad programs revealed that 94% of respondents whose students were scheduled to go on study abroad programs in China had postponed or cancelled those programs, with 76 percent canceled outright or postponed indefinitely (Martel, 2020). For international students, 76% of institutions reported an impact on their outreach or recruiting events in China while 84% were exploring remote study, online or distance learning options for the students by leveraging virtual communications and webinars (Martel, 2020). Hence, it is imperative for higher education institutions to understand effective ways of teaching and assessing intercultural competence learning in their curriculum to address globalization challenges.

Furthermore, existing studies on intercultural learning in engineering revealed a 'perception' gap across instructors, students and employers that a "more active interpretation of intercultural communication (a demonstration, a practice) is not something students view as teachable in a classroom" (Rico-García & Burns, 2019, p17). A study on large companies found that while 59.9% valued the efforts of engineering institutions to prepare students for success in a global environment, only 27% of respondents felt that universities were successful in this mission (Warnick, 2011). In response, engineering programs are exploring how to harness modern information and communication technologies to satisfy academic and labor market needs in a scalable manner by allowing geographically dispersed students to work together in meaningful projects.

This study introduces the use of the Knowledge Community and Inquiry (KCI) pedagogical model developed by Slotta (2013) to design an inter-cultural learning course for the International Virtual Engineering Student Team (InVEST) participants through a blend of online, social and collaborative experiential learning with synchronous video meetings. InVEST is a pilot project aimed at bringing globally dispersed instructors and their engineering students to engage in cross-institutional and collaborative project-based learning via an online learning environment. The initiative facilitates students' online collaborative intercultural learning around technical engineering projects while promoting international exposure and global awareness. This study explores the intercultural competencies that engineering students could learn as part of their undergraduate experience through an interactive course. The course is designed to assist engineering students to gain an appreciation of diverse cultures, articulate their intercultural learning, reflect on their experiences, and work together on a project to co-construct new cross-cultural understanding.

References:

Downey, G. L., Lucena, J. C., Moskal, B. M., Parkhurst, R., Bigley, T., Hays, C., ... & Lehr, J. L. (2006). The globally competent engineer: Working effectively with people who define problems differently. Journal of Engineering Education, 95(2), 107-122. doi:10.1002/j.2168-9830.2006.tb00883.x

Martel, M. (2020). COVID-19 Effects on US Higher Education Campuses: Academic Student Mobility to and from China. *The Institute of International Education (IIE)*, Retrieved from https://www.iie.org/en/Research-and-Insights/Publications/COVID-19-Effects-on-US-Higher-Education-Campuses

OECD/Asia Society (2018). Teaching for Global Competence in a Rapidly Changing World. Center for Global Education, Retrieved from https://asiasociety.org/sites/default/files/inline-files/teaching-for-global-competence-in-a-rapidly-changing-world-edu.pdf

Opendoors (2017). Report on International Educational Exchange. *Institute of International Education*, https://www.iie.org/en/Research-and-Insights/Publications/Open-Doors-2017

Rico-García, M., & Fielden Burns, L. V. (2019). Intercultural communication in engineering studies: a key competence in global labour markets. European Journal of Engineering Education, 1-21, https://doi.org/10.1080/03043797.2019.1654980

Slotta, J. D. (2013). Knowledge community and inquiry: New opportunities for scripting and orchestration. OISE-University of Toronto, 1-15.

Warnick, G. M. (2011). AC 2011-350: Global Competence: Its Importance for Engi–Neers Working a Global Environment. In American Society for Engineering Education. Retrieved from https://www.asee.org/file_server/papers/attachment/file/0001/0775/Global_Competence_-_Its_importance_for_Engineers_Working_in_a_Global_Environment_-_Final.pdf

Acknowledgements

I would like to acknowledge Assistant Professor Elham Marzi, Director of the International Virtual Engineering Student Teams (InVEST) project at Institute for Studies in Transdisciplinary Engineering Education and Practice (ISTEP) for her support and dedication during this research. Many thanks to the InVEST project and Encore lab teams for their valuable feedback and insights.

My sincere thanks to Professor James Slotta, PhD, President's Chair in Education and Knowledge Technologies at Ontario Institute for Studies in Education (OISE) for his guidance on the theoretical underpinnings and his advice, encouragement, mentorship throughout the study.

“Group First” - New methods of two-stage exams implementation in organic chemistry

Laura Pavelka
McGill University, Department of Chemistry
laura.pavelka@mcgill.ca

A two-stage exam is an assessment method that occurs in two discrete stages: the individual stage and the group stage. This style of exam is gaining traction in the active learning community because the group stage gives students a rare opportunity for meaningful discussion with their peers and seems to lower exam anxiety. Normally, a two-stage exam begins with the individual exam followed by the group exam, in which students “redo” some of the individual exam questions together. Although there are many benefits of a two-stage exam run in this fashion, there are also some drawbacks. Many students prefer not to discuss an exam after it is written and there can be some increased anxiety as a student realizes they did the “redo” questions incorrectly during the individual stage. In addition, this approach is limited to questions the students have already seen. My approach turns this around; the group portion comes first and examines different questions from the individual exam, all of which are short-answer questions. I have run two-stage midterm exams in this fashion for the past year in my Organic Chemistry I and II courses, both of which are very large classes (100-600 students). The group portion can count for 20% of the midterm grade, but only if it helps. Overall, the group exam averages have been very similar to the individual exam averages, which means the biggest nominal support goes to the struggling student. Although, student feedback is very positive across the grade point ranges, indicating that the good students are also benefiting from the experience. The “group first” approach allows the exam to cover broader, conceptual or integrated topics during the group exam, which would be difficult to incorporate into an exam otherwise. I have found that these types of group questions can help clarify ideas for students prior to writing the individual exam, lowering anxiety, and really encourage meaningful debate and discussion.

References:

Wieman, C. E., Rieger, G. W., & Heiner, C. E. (2014). Physics exams that promote collaborative learning. The Physics Teacher, 52(1), 51-53.

Martin, A. P. (2018). A Quantitative Framework for the Analysis of Two-Stage Exams. International Journal of Higher Education, 7(4), 33-54.

Acknowledgements

Primarily, a big thank you to my students, for always rolling with new learning activities with grace and optimism. To my colleagues in the chemistry department at McGill, but especially Pallavi Sirjoosingh and Danielle Vlaho. Lastly, to the Salitse community and the S4 chemistry group for all the support during my foray into two-stage exams.

La prise de décisions pédagogiques appuyée sur les données locales de sources multiples : analyse réflexive sur l'implantation d'une pratique professionnelle en communauté d'apprentissage professionnelle (CAP)

André Villeneuve, Université Laval, andre.villeneuve.2@ulaval.ca
Yamina Bouchamma, Université Laval, Yamina.Bouchamma@fse.ulaval.ca

La prise de décisions appuyée sur les données se définit comme un processus qui consiste à effectuer de façon systématique la collecte et l'organisation de l'information sur un aspect concernant le monde scolaire (Lai et al., 2013). La conduite du processus de la prise de décisions appuyée sur les données est considérée comme une pratique professionnelle efficace pour améliorer l'enseignement et l'apprentissage (Mandinach et al., 2016; Schildkamp, 2019). Or, la littérature fait état de la difficulté pour les acteurs éducatifs d'analyser de manière efficace les données disponibles et produites dans leur milieu pour prendre des décisions pédagogiques (Kippers et al., 2018).

Inspiré des travaux de Ikemoto & Marsh (2007) et de Mandinach, Honey, Light, & Brunner (2008), le praticien-chercheur a développé un processus de la prise de décisions pédagogiques appuyée sur ce qu'il nomme les données locales de sources multiples, soit les données accessibles et produites dans l'établissement scolaire. Ce processus de la prise de décisions pédagogiques fonctionne selon une démarche itérative et structurée en six étapes : 1) établir un objectif (ou une question que l'on cherche à répondre); 2) collecter des données; 3) analyser et interpréter les données; 4) décider (élaborer un plan d'action); 5) mettre en œuvre la décision; et 6) évaluer/rétroagir. Le processus réserve une place centrale à l'apport des outils technologiques (informatiques), considérés comme des aides à la prise de décisions pédagogiques capables de collecter, structurer et analyser les données ainsi que de fournir les résultats de façon interactive (Sauter, 2011).

L'implantation de ce processus s'est effectuée dans le cadre d'une communauté d'apprentissage professionnelle (CAP) dans une visée d'amélioration de l'enseignement et de l'apprentissage des élèves. Précisons qu'une CAP renvoie à une modalité de travail collaboratif à l'intérieure de laquelle des acteurs éducatifs (ex. : directions, enseignants) entreprennent collectivement des actions et des réflexions dans le but d'améliorer de manière continue le rendement scolaire des élèves (Roy et al., 2006).

Les analyses en mode écriture et thématique (Paillé et al., 2016b, 2016a) du corpus, issu des rencontres en CAP, ont permis d'identifier sept thèmes qui décrivent le processus d'implantation du processus de la prise de décisions pédagogiques, soit : 1) la mobilisation des acteurs autour d'un objectif commun, 2) l'acquisition d'un langage commun, 3) les compétences en relations interpersonnelles, 4) l'autoformation des participants, 5) la mise en œuvre différenciée de la décision, 6) le retour réflexif et 7) le rapport paradoxal que les participants entretiennent avec les outils technologiques.

Durant les deux années du fonctionnement de l'équipe en CAP, les fonctionnalités d'analyse avancée d'Excel ont été utilisées, mais jugées insatisfaisantes pour répondre aux besoins des praticiens en matière de prise de décisions pédagogiques. La communauté s'affaire actuellement à concevoir un système d'aide à la décision, soit un outil informatique valorisant les données locales afin, d'une part, de décrire, expliquer et prédire les résultats scolaires et sociaux des élèves et, d'autre part, de prescrire aux intervenants des pratiques prometteuses pour répondre aux besoins des élèves.

References:

Albarello, L. (2004). *Devenir praticien-chercheur : comment réconcilier la recherche et la pratique sociale*. Bruxelles, Belgique: De Boeck.

Ikemoto, G. S., & Marsh, J. A. (2007). Cutting through the" Data-Driven" Mantra: Different Conceptions of Data-Driven Decision Making. Reprints. RAND Corporation.

Kippers, W. B., Poortman, C. L., Schildkamp, K., & Visscher, A. J. (2018). Data literacy: What do educators learn and struggle with during a data use intervention?. Studies in educational evaluation, 56, 21-31.

Lai, M. K., & Schildkamp, K. (2013). Data-based decision making: An overview. In Data-based decision making in education (pp. 9-21). Springer, Dordrecht. https://doi.org/10.1007/978-94-007-4816-3_2

Leitch, R., & Day, C. (2000). Action research and reflective practice: Towards a holistic view. Educational action research, 8(1), 179-193.

Mandinach, E. B., Honey, M., Light, D., & Brunner, C. (2008). A conceptual framework for data-driven decision making. Data-driven school improvement: Linking data and learning, 13-31.
Mandinach, E. B., & Honey, M. (Eds.). (2008). Data-driven school improvement: Linking data and learning. Teachers College Press.
Mandinach, E. B., & Jimerson, J. B. (2016). Teachers learning how to use data: A synthesis of the issues and what is known. Teaching and Teacher Education, 60, 452-457.
Paillé, P., & Mucchielli, A. (2016a). Chapitre 11. L'analyse thématique. In L'analyse qualitative en sciences humaines et sociales. Armand Colin, (pp. 235–312).
Paillé, P., & Mucchielli, A. (2016b). Chapitre 9. L'analyse en mode écriture. In L'analyse qualitative en sciences humaines et sociales. Armand Colin, (pp. 187–208).
Roy, P., & Hord, S. M. (2006). It's everywhere, but what is it? Professional learning communities. Journal of School Leadership, 16(5), 490-504.
Sauter, V. L. (2011). Decision Support Systems for Business Intelligence: Second Edition. https://doi.org/10.1002/9780470634431
Schildkamp, K. (2019). Data-based decision-making for school improvement: Research insights and gaps. Educational research, 61(3), 257-273.

Active Learning Designs for Calculus: Approach, patterns and impact

Xinli Wang, University of Toronto, xinliw.wang@utoronto.ca,
Yanhong, University of Munich, Yanhong.Li@psy.lmu.de
Jim Slotta, University of Toronto, jslotta@gmail.com
Dai Jinjun, Central China Normal University

In order to help fresh university students develop deep conceptual understandings of mathematics topics in Calculus and keep them engaged, we redesigned a first-year Calculus course at a public teachers' university in central China. Guided by Knowledge, Community and Inquiry (KCI) model (Slotta & Peters, 2008), in which individual student serves as a knowledge source, which in turn benefits the whole community in subsequent learning activities. This paper will present three new collective patterns for in-class activities: CSW (Community Supported Worksheets), CPC (Community Problem Creation) and PPP (Participatory Problems or Patterns). 308 students participated over two semesters which covered differential calculus and integral calculus. The curriculum was designed for a unique setting that includes 7 interconnected "smart classrooms", with a single professor and a TA for each room. The professor switches to a new room each day and our patterns are designed to engage the entire community of students (i.e., all 7 classrooms) in coherent activities that benefit from their collective participation.

After comparing the data from pre- and post-course surveys, we found that students' epistemological beliefs are significantly impacted by an active learning approach (Bielaczyc & Collins, 1999). The learning community pedagogy deepens students' commitment to mathematics learning, and student's interactions with peers and TAs after classes become an important part of student's learning which strengthens the whole learning community. Some challenges we face include how to help students develop a growth mindset where they don't focus on exam performance and grades too much. We are also developing new technology supports for sustaining our calculus learning community asynchronously (i.e., for homework and ongoing social support) - to allow students to collaborate on a wider range of tasks. Finally, we will present a new technology environment being developed to support such complex forms of student interaction.

References:

Bielaczyc, K., & Collins, A. (1999). Learning Communities in classrooms: a reconceptualization of educational pratice. *Instructional-design theories and models: a new paradigm of instructional theory*, 269-292.

Slotta, J., & Peters, V. (2008). A blended model for knowledge communities: Embedding scaffolded inquiry. *Proceedings of the 8th International Conference on International Conference for the Learning Sciences*, (pp. 343-350). Utrecht, The Netherlands.

Engaging the Learner

Improving students' understanding of the Nature of Science and supporting STEM identity development in a Grade 11 Biology class: A learning community approach

Elena Boldyreva, University of Toronto, elena.boldyreva@mail.utoronto.ca
James Slotta, University of Toronto, jim.slotta@utoronto.ca

The Grade 11 Biology Curriculum in Ontario includes five units: genetics, evolution, biodiversity, plants, and animal systems. We designed a curriculum that would integrate those units by adding a cross-cutting theme of diet and nutrition. For each unit, we provided students with interesting evidence "cases" and inquiry activities that were designed to engage students around ideas, connections, and data analysis. In the KCI Model, students work collectively as a knowledge community, creating a knowledge base that is further used as a resource for students' ongoing inquiry (Slotta, Quintana, & Moher, 2018). Students' exploration of NOS is effectuated through such activities as developing scientific arguments, reflecting on beliefs about science, and critically interpreting evidence, which includes data reasoning, student-contributed evidence, and discussions. According to research, students make sense of scientific concepts during inquiry projects where they work in groups, analyze data and come to conclusions through explanations and evidence-based argumentation (Driver, Newton, & Osborne, 2000; Kuhn, 2010). In our study, students address such aspects of NOS as: (1) the distinction between observation and inference, (2) the distinction between scientific laws, theories, hypotheses, principles and facts, (3) the understanding of how scientific knowledge is never absolute or certain, and (4) the exploration of scientific controversies. A final inquiry project that we planned for this school year would draw connections to each unit by posing the question "What diet/food is ideal (for you, for your family, community, and our planet)?"

Students would use the ideas and resources from the knowledge base they have co-created during the school year, reflecting on how science is important when making a food/diet choice, and connecting to other disciplines, technology, and careers. Because of the COVID-19 situation and transition to online teaching, we had to adjust our curriculum and develop culminating activities around a case study exploring two types of diets. Students worked in groups and individually to critically evaluate resources, experimental data and make their predictions. In each unit during the school year, students also contributed to the Class Career Journal where they recorded and built shared descriptions of careers they came across in their readings or discussions. Individually, students posed questions related to various careers and their STEM identity, which were addressed in small group and whole class discussions. This paper will present our designs and outcomes of our analysis regarding students' understanding of NOS and their STEM identity.

References:

Driver, R., Newton, P., & Osborne, J. (2000). Establishing the norms of scientific argumentation in classrooms. *Science Education, 84*(3), 287-312.

Kuhn, D. (2010). Teaching and learning science as argument. *Science Education, 94*(5), 810-824.

Slotta, J., Quintana, R., & Moher, T. (2018). Collective Inquiry in Communities of Learners. In the International Handbook of the Learning Sciences. (F. Fischer, C. Hmelo-Silver, P. Reimann, & S. Goldman, Eds.). Routledge.

Better learning of calculus concepts through more active learning: Details of a teaching methods comparison study

Warren Code, Science Centre for Learning and Teaching (Skylight), warcode@science.ubc.ca,
Costanza Piccolo, Mathematics, University of British Columbia, costanza@math.ubc.ca

We compared teaching methods in large (100-150 student) sections of introductory calculus: each of two sections of the same Calculus 1 course were subject to an "intervention" week where a less-experienced instructor encouraged a much higher level of student engagement by design. These instructional choices encouraged active learning (answering "clicker" questions, small-group discussions, worksheets) during a significant amount of class time, building on assigned pre-class tasks. The lesson content and analysis of the assessments were informed by existing research on student learning of mathematics. Our research questions were: Compared to a primarily lecture-based instruction with more limited active elements (some use of "clicker" questions), will students demonstrate more sophisticated reasoning on an immediate test of learning at the end of a week-long topic (2-3 hours of class time)? And will any effects persist to later, standard tests of learning in the course?

Our study was inspired by a similar week-long intervention approach in a physics course (Deslauriers et al., 2011), though with improvements in the design: our interventions were on two separate, week-long topics (related rates and linear approximation) where the intervention instructor taught one section for each topic; this "crossover" design provided a within-student (repeated measures) comparison, as all students were tested on both topics but each sections had the intervention instructor for only one of the topics. We quantified the extent of interactive engagement versus more passive approaches using a structured observation instrument (Hora et al., 2013). Further, the immediate tests of learning were developed separately from instruction, and all student names and sections were masked for the purposes of coding/scoring.

We report improved student performance, on conceptual items in particular, from each section when it had the higher engagement format. For example, students in the first intervention were more likely to sketch a sensible diagram and correctly solve a "growing sand pile" related rates problem, and those in the second intervention were more likely to correctly sketch an approximating tangent line. These trends were observed on the tests of learning at the end of the topic weeks, though to only a limited extent on later tests. Details are available in our paper, whose supplement includes the instructional materials and assessments we used (Code et al., 2014). This presentation will discuss lessons learned from both the results and the process of undertaking this study. This study could be considered a contribution to the call from Freeman and colleagues for "second-generation research" around active learning (Freeman et al., 2014), as the comparison sections both had some active learning components, but one much more intense.

References:

Code, W., Piccolo, C., Kohler, D., & MacLean, M. (2014). Teaching methods comparison in a large calculus class. *ZDM*, *46*(4), 589-601. https://doi.org/10.1007/s11858-014-0582-2.

Deslauriers, L., Schelew, E., & Wieman, C. (2011). Improved learning in a large-enrollment physics class. *science*, *332*(6031), 862-864. https://doi.org/10.1126/science.1201783.

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences*, *111*(23), 8410-8415.

Hora, M. T., Oleson, A., & Ferrare, J. J. (2013). Teaching dimensions observation protocol (TDOP) user's manual. *Madison: Wisconsin Center for Education Research*. http://tdop.wceruw.org/Document/TDOP-Users-Guide.pdf.

Acknowledgements:

This work was funded by the Carl Wieman Science Education Initiative at the University of British Columbia, including a generous donation from Professor David Cheriton (Stanford University).

Going beyond maker fundamentals to unleash innovation in higher education

Ann-Louise Davidson, Concordia University, annlouise.davidson@gmail.com
Nadia Naffi, Université Laval, nadianaffi@gmail.com
Nathalie Duponsel, Concordia University, nwduponsel@gmail.com
Houda Jawhar
Ivan Ruby
Farnaz Gholami
Aniklet Zefi
Clarissa Verish
Bojana Krsmanovich
Abe Kamel

Education Makers (www.educationmakers.ca) is a group that was created under the larger umbrella of the Concordia University Research Chair in Maker Culture. It groups international scholars, graduate and undergraduate students, community members and technicians who are interested in the maker movement in education. Maker culture refers to the revolutionary third wave of internet-enabled do-it-yourselfers that were preceded by subsistence DIY (subsistence farming) and industrial DIY (buying and building kits) (Fox, 2014). Makers use DIY tinkering using disruptive technologies (3D printers, vinyl cutters, laser cutters), emergent technologies (tiny and affordable open-source microcomputers, electronics) and recycled items to further sustainability, equity, social innovation, and democratization of innovation and community building (Andersson, 2015; Davidson et al., 2018; Dougherty, 2012; Dougherty, 2014; Hatch, 2014; Kurti et al., 2014; et al., 2017). In its broadest context, maker culture is the subculture of do-it-yourself enthusiasts (Kuznetsov et al., 2010), which meshes diverse social, cultural and technological imperatives. To some extent, the maker movement has been capable of keeping the idealist contribution of grassroots citizen-led innovation and the more corporate neoliberal vision of the Fourth Industrial Revolution, while also having a direct impact on the economy, education, accessibility to technology, and cultural policy. Maker culture, in this sense, is a complex context for a mix of practices, discourses, politics and values that are defining our contemporary experience with technology, education and social innovation.

Within that context, Education Makers have been focussing on developing communities of practice and makerspaces to engage individuals in persistent problem-solving and to imagine alternative ways of thinking about our life with technology. Education Makers operate with this mission, in iterative steps that allow them to navigate through the complexities of grassroots initiatives along with the demands of different institutions. As such, 2016-2017 was a year dedicated to documenting makerspaces, maker projects and maker narratives. 2017-2018 was dedicated to the creation of two makerspaces: #MilieuxMake and Chalet Kent Makerspace. 2018-2019 was focussed on the creation of more refined workshops, but also on identifying the maker fundamentals, which refers to the fundamental knowledge necessary to engage in maker activities autonomously and collaboratively. They found that maker fundamentals are essential to further skills such as creativity, problem-solving, critical thinking, intellectual risk-taking and resourcefulness, but they require curated workshops to unleash innovation. 2019-2020 was a year where they pushed the boundaries of previously identified maker fundamentals. They created workshops that tackle techno-creativity and provide opportunities to be resourceful and to stick with the trouble while exploiting fundamental knowledge of a variety of disciplines including textiles and materiality, bio-hacking, collaborative music and inclusive gaming.

Through constant comparison of various types of data, including interviews, collaborative discussion techniques, pictures, videos and tweets Education Makers have identified a cluster of skills that are essential to create or innovate with emergent and disruptive technologies, namely problem-solving, risk-taking and sticking with the trouble, but also computational thinking, creativity, and collaboration. They have also identified several needs that are the *sine qua non* of the maker movement in education: 1) going beyond disciplines and even going beyond STEAM; 2) going beyond the buzzword of making and; 3) getting everybody's hands dirty.

References:

Andersson, P. (2015). Digital fabrication and open concepts: An emergent paradigm of consumer electronics production. Retrieved from http://www.diva-portal.org/smash/get/diva2:822484/FULLTEXT02

Davidson, A. L., & Price, D. W. (2017). Does your school have the maker fever? An experiential learning approach to developing maker competencies. LEARNing Landscapes, 11(1), 103-120.
Dougherty, D. (2012). The maker movement. Innovations: Technology, governance, globalization, 7(3), 11-14.
Dougherty, D. (2016, July 26). Making it: The hands-on movement that impacts our economy, education and culture. *Vox*. Retrieved from https://www.vox.com/2016/7/26/12275036/makers-movement-children-education-technology-stem
Fox, S. (2014). Third Wave Do-It-Yourself (DIY): Potential for prosumption, innovation, and entrepreneurship by local populations in regions without industrial manufacturing infrastructure. Technology in Society, 39, 18-30. https://doi.org/10.1016/j.techsoc.2014.07.001
Hatch, M. (2013). The maker movement manifesto: Rules for innovation in the new world of crafters, hackers, and tinkerers. McGraw Hill Professional.
Kurti, R. S., Kurti, D. L., & Fleming, L. (2014). The philosophy of educational makerspaces part 1 of making an educational makerspace. Teacher Librarian, 41(5), 8.
Kuznetsov, S., & Paulos, E. (2010, October). Rise of the expert amateur: DIY projects, communities, and cultures. In Proceedings of the 6th Nordic Conference on Human-Computer Interaction: Extending Boundaries (pp. 295-304). https://doi.org/10.1145/2451116.2451133
Lindtner, S., & Lin, C. (2017). Making and its promises. CoDesign, 13(2), 70-82. https://doi.org/10.1080/15710882.2017.1308518

Embodying your learning journey, from an inside-out perspective

Geneviève Emond, MUZA - Creative Educational Solutions, emondgenev@gmail.com
Sonia Di Maulo, Harvest Performance, sonia@harvestperformance.ca

Most students want to thrive and enhance engagement in their studies and in their future. To help them achieve their goals and dreams, we are invited to transform our universities, and employment market alike, by adding to it an inside-out perspective. By renewing how people connect to themselves, their values, identities, and life missions, and how they successfully create links with their actions in their environment, we build a more sustainable university, work market and society for all. It creates a place where people are better able «to land» (Cooper Albright, 2019) and hopefully then, to flourish, individually and collectively.

In order to find such fulfilment and to contribute to their best, most people need help and most of all, they need others. To support university and post-secondary students, we created an innovative holistic pilot-project for students, bringing together Sonia Di Maulo's *model of growth for emerging leaders*, including how to reflect on student's learning legacies and journeys (2014); and Geneviève Emond's tools fleshing relational and social embodiment, creative reflection and internal-external coherence (2018, 2015). Sonia and Geneviève already use many of these tools in the courses they teach. The pilot-project enables to study how students eventually engage themselves better in their studies and develop resilience when supported. It will be launched in the Fall 2020 at *Concordia University* as an online voluntary program (COVID version) for students. During the entire semester, students will learn the *model of growth*, and share their learnings with peers in order to strengthen, and ground their learning in meaning and purpose.

In this session we will briefly present our respective theoretical tools while giving you time to experience exercises, including body movement (somatic education) and reflection on self-practices. We will finally have a discussion among peers on where and how they could be used.

References

Cooper Albright, A. (2019). *How to Land: Finding Ground in an Unstable World.* Oxford University Press.

Di Maulo, S. (2014). *Model of Growth for Emerging Leaders*.

Emond, G. (2018). *L'apprentissage de la conscience de la corporéité chez des enseignantes et formatrices et ses influences sur la cohérence interne-externe de la leur pratique*. [Embodiment consciousness learning processes for teachers and adult educators and their perceived influences on internal/external coherence of their practice.] Thèse de doctorat. Université du Québec à Montréal.

Emond, G (2015). *Enseigner avec son corps. Étude exploratoire sur le corp vécu d'enseignantes du primaire en contexte de stage.* [Teaching with our bodies: Exploratory study on the lived body of elementary school student-teachers while in practicum.] Mémoire de maîtrise en danse. Université du Québec à Montréal.

Keys to the Multimedia City: Leveraging open educational resources (OER) to produce affordable, flexible and interactive course materials for students

Chloe Lei, Concordia University, chloe.lei@concordia.ca
Cristina Sanza, Concordia University, cristina.sanza@concordia.ca

The modularity, multimedia, and interactive elements of Open Educational Resources (OER) are perfectly suited to journalism education and innovation. Journalism, as a discipline and practice, faces the enormous challenge of a profession that changes rapidly; monthly to yearly (Lee-Wright et al., 2012). To our knowledge, other journalism schools across Canada have yet to engage with OER as a solution to the constant changes the industry undergoes and journalism educators must face. In fact, in general, OER in journalism is limited (BCcampus, 2020).

OER in journalism is fertile ground for innovation (Klinger, 2013). OER allows educators to customize openly-licensed materials (e.g. open textbooks) to fit their courses, which enable huge cost savings for students (Hilton III et al., 2020). Concordia University has been offering grants since 2019 to encourage the use of OER in various courses (Concordia University Library, 2020). One grant was awarded to a journalism capstone course whereby students work in a digital newsroom environment to produce the department's multimedia digital magazine, The City. In this course, students gain an understanding of the requirements that go into creating a multimedia digital magazine, including best practices for multimedia storytelling and production, as well as how to promote their story online.

The open textbook being created by a team of journalism faculty and staff will serve as a hands-on, interactive resource and teaching tool on the fundamentals of multimedia journalism skills, such as writing, video, audio, photography, infographics and social media. It will engage users and stimulate learning through video components and interactive activities that will be embedded throughout its pages. It aims to not only serve the students in the digital magazine class, but be a go-to resource that can be used throughout Concordia's undergraduate and graduate journalism programs. Its structure will enable professors and students in any class to pick and choose chapters relevant to their courses, build new chapters, and envision dynamic experimental material to help promote OER throughout the Canadian journalism school network. The textbook is designed with the idea that it will be routinely edited and updated as the field changes. This will facilitate up-to-date, dynamic instruction and learning.

References:

BCcampus (2020). *Find open textbooks*. BCcampus OpenEd. Retrieved June 4, 2020, from https://open.bccampus.ca/browse-our-collection/find-open-textbooks/?subject=Media

Concordia University Library (2020). *Concordia University OER grants*. Open Educational Resources. https://www.concordia.ca/library/guides/oer/oergrants.html

Hilton III, J., Mason, S., & Clinton, V. (n.d.). *The review project*. Open Education Group. http://openedgroup.org/review

Klinger, L. (2013). *Journalism textbooks have seen their future and it is digital.* Poynter Institute. Retrieved June 8, 2020, from https://www.poynter.org/reporting-editing/2013/journalism-textbooks-have-seen-their-future-and-it-is-digital/

Lee-Wright, P., Phillips, A., & Witschge, T. (2012). *Changing journalism*. Taylor & Francis Ltd.

Acknowledgement:

We would like to thank Concordia University Library and Concordia's Digital Strategy Team for supporting open educational resources via the OER grants.

Can we engage students by letting them use Cellphones in Class: Yes or No?

Madona Moukhachen, Université de Montréal, madona.moukhachen@umontreal.ca
Bruno Poellhuber, Université de Montréal, bruno.poellhuber@umontreal.ca

Nowadays, cell phones prevail in post-secondary classrooms: the majority of students have their cellphones in class (Fichten et al., 2018). Although the use of cell phones in the classroom entails risks of distraction (Karsenti, 2013), plagiarism (Campbell, 2006) and inequality among students (Baker et al., 2012); it allows students to have access to information at all times (Thornton & Houser, 2004) and develop 21st-century skills (Lowe, 2017). By adopting practices for managing the use of cell phones in the classroom and promoting appropriate classroom behaviors, phones can be used to promote engagement and success (Wu et al., 2012). In post-secondary education, managing class activities does not mean keeping order and discipline inside the class (Al-Hamdan, 2007), but rather leading students to self-regulate and engage in course activities (Lowe, 2017). To explore post-secondary students' and teachers' perceptions on the use of cell phones in the classroom and management of classroom activities, a mixed study (surveys and interviews) was carried out in 2019 in two cégeps of Montreal. Results of this study will be presented in this talk. The talk will highlight teachers' practices in post-secondary education and the most promising ones for student learning and success. Student success is an important subject of concern in post-secondary education, the challenges posed by cell phones in the classroom like distraction and plagiarism add to this concern. The talk will suggest concrete courses of action to dissipate these concerns and promote the applicability of the results in the participants' educational establishments.

References :

Al-Hamdan, J. (2007). Higher education classroom management: Kuwait university students' views. *College Student Journal*, *41*, 572.

Baker, W. M., Lusk, E. J., & Neuhauser, K. L. (2012). On the use of cell phones and other Electronic devices in the classroom: Evidence from a survey of faculty and students. *Journal of Education for Business*. https://doi.org/10.1080/08832323.2011.622814

Campbell, S. W. (2006). Perceptions of mobile phones in college classrooms: Ringing, cheating, and classroom policies. *Communication Education*. https://doi.org/10.1080/03634520600748573

Fichten, C., Jorgensen, M., Havel, A., King, L., Lussier, A., Asuncion, J., … Amsel, R. (2018). Journal of education and training studies. *Journal of Education and Training Studies*, *6*(9), 1-12.

Karsenti, T. (2013). Usages des technologies en éducation: analyse des enjeux socioculturels.

Lowe, T. (2017). Utilizing cell phones as a learning tool in the classroom: Preventing distractions while increasing student engagement.

Thornton, P., & Houser, C. (2004). Using mobile phones in education. *The 2nd IEEE International Workshop on Wireless and Mobile Technologies in Education, 2004. Proceedings.* https://doi.org/10.1109/WMTE.2004.1281326

Wu, W. H., Jim Wu, Y. C., Chen, C. Y., Kao, H. Y., Lin, C. H., & Huang, S. H. (2012). Review of trends from mobile learning studies: A meta-analysis. *Computers and Education*, *59*(2), 817-827. https://doi.org/10.1016/j.compedu.2012.03.016

Analyse des données et apprentissage automatique : nouvelles orientations à la suite de l'EDUsummIT 2019

Severine Parent, UQAR, severine_parent@uqar.ca
Michelle Deschenes, Université Laval, michelle.deschenes.1@ulaval.ca

À l'automne 2019 avait lieu l'EDUsummIT, un rassemblement international de 150 chercheurs et intervenants pédagogiques qui soutiennent l'intégration des technologies de l'information et de la communication en éducation. Les discussions et les négociations dans les groupes de travail, et aussi entre les groupes de travail, ont permis d'identifier des tendances concernant les apprenants et les contextes d'apprentissage à l'ère du numérique. La réflexion collective a mené à l'écriture collaborative du livre électronique Learners and learning contexts : New alignments for the digital age (Fisser & Phillips, 2020). Deux chercheuses qui ont participé aux discussions partagent quelques recommandations et les implications pour l'éducation liées à leur intégration, notamment pour les groupes de travail sur l'analyse de l'apprentissage et sur l'apprentissage automatique.

L'analyse de l'apprentissage (learning analytics)

L'analyse de l'apprentissage est la mesure, la collecte, l'analyse et la communication de données sur les apprenants et leurs contextes, afin de comprendre et d'optimiser l'apprentissage et les environnements dans lesquels il se produit (Siemens, 2010). L'un des objectifs du groupe de travail sur l'analyse de l'apprentissage visait à promouvoir l'adoption de l'analyse de l'apprentissage, notamment en élaborant des normes, des principes et des politiques afin d'aider les parties prenantes à intégrer et utiliser l'analyse de l'apprentissage. La place de l'analyse d'apprentissage dans la conception pédagogique et le rôle des fournisseurs de services de données, un rôle qui semble varier selon les contextes éducatifs, ont notamment suscité des discussions. De plus, de nombreuses opportunités ont été nommées et quelques défis listés, dont l'interopérabilité des données ainsi que l'acquisition des niveaux de connaissances pertinentes à l'analyse de l'apprentissage, notamment par la graphicacy (Balchin, 1972).

L'apprentissage automatique (machine learning)

L'apprentissage automatique correspond à une branche de l'intelligence artificielle qui étudie les façons dont les ordinateurs peuvent tirer des apprentissages à partir des données (Bengio & Lodi, 2017). Il s'agit en quelque sorte d'une inférence statistique qui permet de trouver des modèles à partir de données (Touretzky et al., 2019). En éducation, les applications de l'apprentissage automatique sont nombreuses : rétroactions automatiques, identification des difficultés d'apprentissage, recommandations de ressources d'apprentissages, etc. Ce qui a retenu l'attention du groupe de travail est l'identification des notions que devraient comprendre tous les élèves, pas seulement ceux qui étudient dans les domaines technologiques. Le groupe a retenu la nécessité d'une approche interdisciplinaire permettant le développement d'une culture algorithmique, notamment pour agir en tant que citoyen responsable en envisageant les questions éthiques que l'apprentissage automatique soulève.

L'éthique et les données

Les discussions ont parfois suscité davantage de questions que de réponses, notamment concernant l'éthique, la confidentialité et l'utilisation des données. Si plusieurs questions demeurent sans réponse, c'est qu'elles doivent être abordées dans les institutions, notamment avec les étudiants. C'est pourquoi, en matière d'analyse de l'apprentissage et d'apprentissage automatique, il est encouragé à d'aborder le sujet en tenant compte de votre contexte pour que les décisions prises servent véritablement la réussite scolaire et éducative.

References:

Balchin, W. G. V. (1972). Graphicacy. *Journal of the Geographical Association, 57*(3), 185-195.

Bengio, Y., & Lodi, A. (2017). Les données au service du savoir. *Gestion, 42*(1), 68-70.

Fisser, P., & Phillips, M. (2020). Learners and learning contexts : New alignments for the digital age. https://edusummit2019.fse.ulaval.ca/files/edusummit2019_ebook.pdf

Siemens, G. (2010). About. First International Conference on Learning Analytics and Knowledge 2011. https://tekri.athabascau.ca/analytics/.

Touretzky, D., Gardner-McCune, C., Martin, F., & Seehorn, D. (2019, juillet). Envisioning AI for K-12: What Should Every Child Know about AI?. *Dans Proceedings of the AAAI Conference on Artificial Intelligence, 33*, 9795-9799. https://www.aaai.org/ojs/index.php/AAAI/article/download/5053/4926

Advancing Creativity in Postsecondary STEM Contexts: Students' Understandings and Experiences of Creativity and Risk in Science Learning

Claire Paton, University of Calgary, claire.paton@ucalgary.ca
Jennifer Adams, University of Calgary, jennifer.adams1@ucalgary.ca
Kristal Turner, University of Calgary, kllumsde@ucalgary.ca

Creativity is becoming an increasingly important aspect of STEM teaching and learning (Kind & Kind, 2007). Research points to active and cooperative learning as providing the context that supports student creativity in learning (Freeman et al., 2014). However, students are resistant to engage in active learning and activities that could foster creativity (Tharayil et al., 2018). This may be due to a perception of risk. In order for students to feel supported in their learning and comfortable in taking creativity advancing risks, educators must have a knowledge of students' perceptions of risks and work to mitigate these concerns. Research has been conducted on creating supportive classroom environments and ways to increase the creative capacity of learners through alternative teaching and learning activities (McWilliam, 2007). However, the student perspective on risk and creativity in learning is missing. The goal of this research project is to bring student perspectives on risk and creativity to light. The research questions for this study are:

1. How do students' definitions of scientific creativity correlate to students' descriptions of risk?
2. In what ways do undergraduate students experience risk in their STEM classes?
3. When do undergraduate students in STEM feel comfortable taking risks in classroom environments?

This independent research study is in collaboration with a larger ongoing faculty Community of Practice (CoP) aimed at integrating creativity in science teaching and learning. The goals of this ongoing research project are to increase the creative capacities of learners in postsecondary science education settings, identify evidence of learning that demonstrate creative practices and growth in a creative capacity, and assess faculty engagement in a collaborative design context. As risk-taking is both a necessary component of creativity and engaging in learning activities that could foster creativity, this study will research student perspectives on risk in science learning.

This study describes data collected from undergraduate STEM students through voluntary surveys and interviews. The data collected was both qualitatively and quantitatively analyzed to identify common themes in student perspectives about scientific creativity and risk in STEM courses and ways to create safer classroom environments to take risks. Initial analysis identified that undergraduate STEM students generally define scientific creativity into the following categories: trying something new or different, presenting knowledge to others, engaging in activities, expansive thinking, and pursuing passions or interests. The risks students take in classroom settings were also found to fall within the following categories: stepping outside of comfort zone, participating in active learning activities, publicly asking and answering questions, and the pressure to achieve grades. Table 1 presents a summary of students' suggestions about how educators can engage students successfully in active learning practises and mitigate this fear of risk-taking. Society must not only recognize that creativity is the key to generating new ideas and creating a more knowledgeable world but must also encourage STEM students to embrace creativity and allow it to flourish.

Category	**Definition**
Student-Teacher Relationships	Open communication between professors and students. Professors that display approachable, personable, and understandable attitudes allow students to feel safer, more supported, and more comfortable taking risks.
Clear Expectations	Receiving straightforward and outlined expectations and guidelines from professors for learning assessments or activities in order for students to assess the opportunities and consequences of risk taking.
Balance of Guidance and Choice	Receiving enough support and guidance to execute experiments and learning assessments successfully but given enough freedom and choice to pursue passions and not feel constrained or limited.

Table 1. Categories and definitions of ways to create safer classroom environments.

References:

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences, 111*(23), 8410-8415.

Kind, P., & Kind, V. (2007). Creativity in science education: Perspectives and challenges for developing school science. *Studies in Science Education, 43,* 1-37.

McWilliam, E. L. (2007). Is creativity teachable? Conceptualising the creativity/pedagogy relationship in higher education. *Proceedings 30th HERDSA Annual Conference: Enhancing Higher Education, Theory and Scholarship,* 1-14.

Tharayil, S., Borrego, M., Prince, M., Nguyen, K. A., Shekhar, P., Finelli, C. J., & Waters, C. (2018). Strategies to mitigate student resistance to active learning. *International Journal of STEM Education, 5*(1), 7.

Acknowledgement:

We wish to thank all of the people whose assistance was a milestone in the completion of this research study and express our deepest gratitude to the Faculty Community of Practise group.

Perimeter Institute: Process of Science and Tools for Teaching Science

Laura Pankratz, Perimeter Institute for Theoretical Physics, lpankratz@perimeterinstitute.ca
Nanouk Paré, John Abbott College, nanouk.pare@johnabbbott.qc.ca

Science has changed our world. Scientific discoveries have led to the eradication of diseases, understanding of matter, development of technology and exploration of space. The ability of science to explore, explain, and modify our world will be even more important as we move ahead to the challenges facing us in the future. An essential part of preparing students for the future is ensuring that they are scientifically literate. One of Perimeter Institute's resources, *Process of Science*, has a series of hands-on activities that explore scientists are curious, collaborators, questioners, and model makers and modifiers.

But how can we help students become better learners? Across many different papers on Physics Education Research, one essential finding emerges: *Methods of instruction that use interactive engagement (active learning) produce higher levels of students learning than traditional methods of instruction (lectures)* [e.g., Hakes, 1998]. More recent research, for example, Deslauriers, et al, 2019, shows that students who are required to be active learners learn better, deeper, and longer lasting, but do not value that process.

The Perimeter Institute's newest resource, *Tools for Teaching Science*, helps teachers blend intuition about teaching and learning with intention about pedagogy to help produce active learners. The resource is following a framework based on four aspects of teaching/learning: activating prior knowledge, establishing a foundation (introductory learning), deepening understanding (going further with learning) and reflecting on (metacognition) or reviewing learning - all while students are demonstrating thinking. The inventory of tools is divided in subsections for each tool: Description, Teacher Actions, Demonstrating, Strengths/Cautions, Differentiation and Framework. The *Description* defines the tool and links it with other complementary tools that can be used. The *Teacher Actions* defines the role played by the teacher while using the tool. Some actions require the teacher to be more active while in others, the teacher observes and guide the students. The *Demonstrating* defines what the students will be doing to demonstrate their understanding. This demonstration is continuous and on-going, and an excellent source of information for teachers. The *Strengths/Cautions* highlight the inherent advantages and restrictions. The *Differentiation* is fundamentally different than the classroom management necessary to mitigate the tool's cautions. Finally, the Framework presents the aspects that the tool most easily accomplishes. Moreover, the resource, *Tools for Teaching Science*, includes illustrations and visual examples of how the tool can be used in a science classroom. An easily missed but highly relevant aspect of the resource is the presentation of several Indigenous pedagogy which emphasises respect for shared knowledge, people and nature.

Perimeter Institute for Theoretical Physics, located in Waterloo, ON, is a center for scientific research, training, and educational outreach. One of Perimeter's mission is the training of the next generation of physicists and to share the excitement and wonder of science with students, teachers and the general public. The classroom resources developed by Perimeter Institute are centred around the process of science, the habits of mind practiced by scientists, and use classical or modern physics to help students analyze what's happening in physics right now. The resources are free, in English and French, and can be downloaded at resources.perimeterinstitute.ca.

References:

Hake, Richard. *Interactive-engagement Versus Traditional Methods: A Six-Thousand-Student Survey of Mechanics Test Data for Introductory Physics Courses.* American Journal of Physics 66. no. 1 (January 1998): 64–74.

Deslauriers, Louis, Logan S. McCarty, Kelly Miller, Kristina Callaghan, and Greg Kestin. *Measuring Actual Learning Versus Feeling of Learning in Response to Being Actively Engaged in the Classroom.* Proceedings of the National Academy of Sciences of the United States of America 116. no. 39 (2019): 19251–257; first published September 4, 2019, https://doi.org/10.1073/pnas.1821936116

Professional Development

Supporting faculty supervisors to foster the reflective practice of student teachers

Eva Mary Bures, l'Université Bishop's, ebures@ubishops.ca
Avril Aitken, l'Université Bishop's, aaitken@ubishops.ca

This project focuses on supporting faculty supervisors to support the reflective practice of student teachers. Research suggests that electronic portfolios and reflections could be effectively used during integrated field-based semesters that combine course-work and practicums to support reflective practice (Reeves, 2006). Having multiple players in the community of practice view the same work makes the activity more authentic (Rocco, 2010; Herrington et al., 2014).

<u>Intervention</u>: This study follows a design-based research methodology involving participatory action research and relying largely on qualitative data (Amiel & Reeves, 2008). Technology is viewed as a process; the key goal is to improve practice and develop design principles and models in an iterative cycle of implementation and evaluation. We created an intervention to support our faculty supervisors in supporting our student teachers' reflective practice during practicum. This represents our first iteration. Data comes from volunteer participants amongst the faculty supervisors (n=21). The 21 faculty supervisors supervised 43 students. Two course instructors, two facilitators (acting teachers and graduates of the same teacher education program), and the Practice Teaching Director are also engaged in the project. The first author was the instructor of the elementary students and the second author was the Practice Teaching Director and a faculty supervisor. Both worked with the faculty supervisors during professional development days.

Faculty supervisors engaged in two half days of professional development focused on reflective practice. Subsequently, student teachers during their six-week practicum posted weekly critical reflections into an online environment for their faculty supervisors and for course purposes. Faculty supervisors could view their student teachers' reflections and comments made by the course instructor, a facilitator, and peers. We designed a customized wordpress environment which allowed faculty supervisors to view only their own students' reflections, at the same time as allow students in small groups to view each other's reflections.

Following this reflective online activity and the practicum, faculty supervisors engaged in one full-day of synthesis and further support in fostering reflective practice.

<u>Data</u>: Data includes supervisor activity online, an anonymous survey including 10 Likert-scale questions, and five open-ended questions. Other important data sources include one-on-one informal discussions and interviews as well as discussions with the entire group of faculty supervisors.

<u>Results & Discussion</u>: Twenty-one faculty supervisors had access to their student teachers' reflections. Four were quite actively engaged in responding to their students comments on a frequent basis. Six logged on a few times and left at least two comments. Eight read posts but did not write comments. Three never logged in. The faculty supervisors were enthusiastic about being able to read the critical reflections. They found reading instructor and facilitator comments somewhat effective, but were less positive about reading peers' comments. Most considered writing comments to be less useful. Benefits included increased insight by supervisors of student experiences, faculty expectations, and the development of competencies related to reflective practice; increased communication amongst various partners in the practicum experiences; and support for students' developing critical reflection. Drawbacks included increased workload for faculty supervisors.

References:

Amiel, T., & Reeves, T. C. (2008). Design-Based Research and Educational Technology: Rethinking Technology and the Research Agenda. *Educational Technology & Society, 11*(4), 29–40.

Herrington, J., Parker, J. & Boase-Jelinek, D. (2014). Connected authentic learning: Reflection and intentional learning. *Australian Journal of Education, 58*(1), 23-35.

Reeves, T. (2006). Design research from a technology perspective. In J. V. D. Akker, K. Gravemeijer, S. McKenney & N. Nieveen (Eds.), *Educational design research* (pp. 52–66). New York: Routledge.

Rocco, S. (2010). Making reflection public: Using interactive online discussion board *to* enhance student learning, *Reflective Practice*, *11(3): 307–317*.

Acknowledgements:

We acknowledge funding from l'Entente Canada-Quebec (ECQ).
We also acknowledge contributions of Tony Bures (customization of online community of practice), Wendy King (instructor and supervisor), Douglas Cote and David Hopps (teachers serving as online mediators)

Eliciting and Responding: Shifts in novice teachers' noticing of teaching practice in math

Vandana Chandrasekhar, McGill University, vandana.chandrasekhar@mail.mcgill.ca

An increasing number of teacher education programs are implementing practice-based approaches to support novice teacher (NT) learning (Lampert et al., 2013). Such approaches support NTs to learn to teach a limited number of teaching practices called *high-leverage teaching practices* whose successful implementation are likely to influence student's learning (Lampert & Graziani, 2009). This encourages NTs to adopt a responsive approach to teaching by paying close attention to students' thinking in order to engage students in deeper learning (NCTM, 2000). In particular, teachers must learn to *elicit* students' thinking by asking open- ended questions and *respond* with further probing questions.

A critical aspect of learning to appropriate these practices entails noticing how they are enacted (Sherin & van Es, 2009). Noticing discourse moves, such as eliciting and responding (E&R), can allow teachers to reflect on and improve how they enact these moves (Mason, 1991). One goal of NTs education is to develop noticing. Yet, there has been little work on understanding how NTs' noticing of E&R develops over the course of their program. In this paper, I describe a study in which I investigated how elementary NTs noticing of the practice of E&R of their own math teaching changed at earlier and later points in their teacher education training.

Accordingly, five elementary NTs participated in two noticing interviews. These interviews occurred four semesters apart – each during an elementary mathematics methods course in which NTs engaged in identifying, discussing and enacting E&R. In both interviews, NTs viewed video-recordings of the same math lesson and identified moments in the video where they elicited or responded to students' thinking and described the purpose of the move. Results revealed that there was not a large difference in the number of E&R moments attended by NTs across the interviews, but there were differences in their interpretations. These results can provide insight to modify future teaching methods courses.

References:

Lampert, M., Franke, M. L., Kazemi, E., Ghousseini, H., Turrou, A. C., Beasley, H., . & Crowe, K. (2013). Keeping it complex: Using rehearsals to support novice teacher learning of ambitious teaching. Journal of Teacher Education, 64(3), 226-243. https://doi.org/10.1177/0022487112473837

Lampert, M., & Graziani, F. (2009). Instructional activities as a tool for teachers' and teacher educators' learning. The Elementary School Journal, 109(5), 491-509. https://doi.org/10.1086/596998

Mason, J. (1991). Epistemological foundations for frameworks which stimulate noticing. In G. U. Robert (Ed.), Psychology of mathematics education (Vol. 2, pp. 36-42). Blacksburg, VA: Division of Curriculum & Instruction, VPI & SU.

National Council of Teachers of Mathematics. (2000). Principles and standards for school mathematics. Reston, VA: Author

Sherin, M. G., & van Es, E. A. (2009). Effects of video club participation on teachers' professional vision. Journal of Teacher Education, 60(1), 20-37. doi:10.1177/0022487108328155

Quick Last-Minute Fixes: Making Your Word and PowerPoint Documents Accessible

Catherine Fichten, Dawson College, cfichten@dawsoncollege.qc.ca
Mary Jorgensen, Adaptech Research Network, MJORGENSEN07@ubishops.ca
Alice Havel, Dawson College, Adaptech Research Network, ahavel@dawsoncollege.qc.ca
Christine Vo

Making Office365 Word and PowerPoint documents accessible to all our students, including those who have disabilities, is vital. Accessibility means that a document can be accessed by any user regardless of the device (e.g. browser, screen reader, mobile device) they are using and regardless of their disabilities. This is vital because it provides educational opportunities to all students. For example, a map or an image that has alternative text is of benefit not only to students with a visual impairment. It also benefits students who learn better from verbal than from visual material. "Plus, when it comes to accessibility, it is better to be proactive than reactive as you may be required to redesign major parts of ... the assignment to make it accessible to students with disabilities" (University of Nebraska-Lincoln, 2020).

It is important to make your documents accessible because of the diversity of Canadian post-secondary student populations, the variety of different technologies used by faculty, and the large number of post-secondary students with disabilities. Well over 11% of the American and Canadian undergraduate population have a disability (Fichten et al., 2018; Snyder, et al., 2016). According to an extensive American study of freshmen enrolled in 184 different universities, 21.9% of students self-reported a disability (Eagan et al., 2017). A recent study of two-year Canadian college social science students (Fichten et al., 2019) found that 26% self-reported a disability.

Luckily, it has become easier for instructors to create accessible Word and PowerPoint documents, since needed information can now be accessed anywhere and anytime through short, just-in-time training videos. We understand that knowing how to create an accessible document may become vital the night before you have to upload your documents to your course management system, such as Moodle. So just-in-time help is often what faculty need.

In this presentation we will highlight the importance of the accessibility of Microsoft Office documents and we will show you two brief (< 6 minute), up-to-date videos on how to make Office365 Word and PowerPoint documents accessible. We will also provide the URLs so that you can view these videos, or portions of them, whenever you need to. The videos are part of a Coursera course (Basics of Inclusive Design). You can view the videos for free (Word https://www.coursera.org/learn/inclusive-design/lecture/DGB3g/creating-accessible-microsoft-word-documents ; PowerPoint https://www.coursera.org/learn/inclusive-design/lecture/hNF8m/creating-accessible-microsoft-powerpoint-documents) any time you wish. You can pause or rewind as needed. If you are interested, you can view the entire Coursera (2019) MOOC on making accessible documents for free.

References

Coursera. (2019). *Basics of inclusive design for online education*. Retrieved from https://www.coursera.org/learn/inclusive-design

Eagan, M. K., Stolzenberg, E. B., Zimmerman, H. B., Aragon, M. C., Whang Sayson, H., & Rios-Aguilar, C. (2017). *The American freshman: National norms fall 2016*. Los Angeles: Higher Education Research Institute, UCLA. Retrieved from https://www.heri.ucla.edu/monographs/TheAmericanFreshman2016.pdf

Fichten, C. S., Havel, A., King, L., Jorgensen, M., Budd, J., Asuncion, J., … Marcil, E. (2018). Are you in or out? Canadian students who register for disability-related services in junior/community colleges versus those who do not. *Journal of Education and Human Development, 7*(1), 166-175. https://doi.org/10.15640/jehd.v7n1a19

Fichten, C. S., Jorgensen, M., Havel, A., King, L., Harvison, M., Lussier, A., & Libman, E. (2019). More than meets the eye: A Canadian comparative study on PowerPoint use among post-secondary students with and without disabilities. International Research in *Higher Education, 4*(2), 25-36. https://doi.org/10.5430/irhe.v4n2p25

Fichten, C., Olenik-Shemesh, D., Asuncion, J., Jorgensen, M., & Colwell, C. (2020). Higher education, information and communication technologies, and students with disabilities: The good and the bad. In J. Seale (Ed.), *Improving accessible digital practices in higher education – Challenges and new practices for inclusion* (pp. 21-44). Palgrave Macmillan. https://doi.org/10.1007/978-3-030-37125-8

Snyder, T. D., de Brey, C., & Dillow, S. A. (2016). *Digest of education statistics 2015* (51st ed.) (NCES 2016-014). Washington, DC: National Center for Education Statistics, U.S. Department of Education. Retrieved from https://files.eric.ed.gov/fulltext/ED570993.pdf

Thomson, R., Fichten, C., Budd, J., Havel, A., & Asuncion, J. (2015). Blending universal design, e-learning, and information and communication technologies. In S. E. Burgstahler (Ed.), *Universal design in higher education: From principles to practice* (2nd ed., pp. 275-284). Harvard Education Press.

University of Nebraska-Lincoln. (2020). *Why is accessibility important? Designing Accessible Online Courses*. Retrieved from https://canvas.unl.edu/courses/27068/pages/why-is-accessibility-important?module_item_id=318716

Exploring the Role of Post-Secondary Instructors in Promoting Student Mental Health

Kira Smith, McGill University, kira.smith@mail.mcgill.ca

The prevalence of post-secondary student mental health concerns has led Canadian post-secondary institutions to identify student mental health as an urgent crisis, which demands immediate, institution-wide action (CHMA & CACUSS, 2013; Kessler, 2005; Charter, 2015). Post-secondary institutions have established that instructors are uniquely situated to promote student mental health – they are the only human contact that students are guaranteed (Di Placito-De Rango, 2018). Yet, no research has directly studied how instructors can effectively engage in this work (Lane et al., 2018). Conducted this February, my master's research explores post-secondary instructors' experiences with respect to their engagement in student mental health promotion, and, ultimately, will produce a body of knowledge that informs institutional approaches to providing support for instructors. Specifically, my research asks: 1) What are post-secondary instructors currently doing to promote student mental health and how do they understand this work? 2) What support does/would enable or hinder instructors' promotion of student mental health? 3) What must universities do to empower and facilitate instructors' efforts to promote student mental health?

During this presentation, I will situate my research within the context of work done by Canadian post-secondary institutions to engage instructors in mental health promotion, and also share the results of my research, which will be completed in May. The results will be connected to actionable next steps that attendees can take to play a role in promoting student mental health. Highlighting the conference theme, this presentation will emphasize the potential for "small", sustainable strategies to radically transform the experiences of post-secondary students in and out of the classroom.

References:

Charter, O. (2015). An international charter for health promoting universities and colleges.(2015). In *An outcome of the 2015 International Conference on Health Promoting Universities and Colleges/VII International Congress* (pp. 1-12).

CMHA & CACUSS. Post-Secondary Student Mental Health: Guide to a Systemic Approach (2013, June). Retrieved from https://healthycampuses.ca/wp-content/uploads/2014/09/The-National-Guide.pdf

Di Placito-De Rango, M.L. (2018). Situating the Post-Secondary Instructor in a Supportive Role for the Mental Health and Well-Being of Students. *International Journal Mental Health Addiction. 16*:284. https://doi.org/10.1007/s11469-017-9740-4

Kessler, R. C., Berglund, P., Demler, O., Jin R., Merikangas, K.R., & Walters, E.E. (2005). Lifetime Prevalence and Age-of-Onset Distributions of DSM-IV Disorders in the National Comorbidity Survey Replication. *Archives of General* Psychiatry. 62(6):593–602. doi:10.1001/archpsyc.62.6.593

Lane, K., Teng, M. Y., Barnes, S. J., Moore, K., Smith, K., & Lee, M. (2018). Using appreciative inquiry to understand the role of teaching practices in student well-being at a research-intensive university. *The Canadian Journal for the Scholarship of Teaching and Learning, 9*(2).

Acknowledgement:

This research was supported by the Social Sciences and Humanities Research Council of Canada.

PolyTeam : quand l'intelligence artificielle s'invite dans le processus de formation d'équipes

Lévis Thériault, Polytechnique Montréal, levis.theriault@polymtl.ca
Olivier Gendreau, Polytechnique Montréal, olivier.gendreau@polymtl.ca
François Guibault, Polytechnique Montréal, francois.guibault@polymtl.ca

L'apprentissage par projet offre aux étudiants en ingénierie une excellente occasion d'apprendre le travail d'équipe collaboratif (Totten et al., 1991; Johnson & Johnson, 1986) et d'améliorer leurs compétences en matière de gestion des conflits (Somkror, 2020; Martins & Eduarda, 2016). Il a été démontré que le choix des membres de l'équipe pour un projet spécifique n'est pas anodin (Galaleldin et al., 2019), car la composition et la formation des équipes ont souvent un impact sur les résultats des projets et la satisfaction des étudiants dans le cours (Felder et al., 2002). Bien qu'il existe différentes méthodes pour former des équipes d'étudiants en ingénierie, elles sont loin d'être parfaites (Shen et al., 2007) et il n'y a pas de consensus dans la littérature sur la meilleure approche pour former des équipes d'étudiants (Takai & Esterman, 2017). Si un professeur choisi de créer des équipes d'étudiants ayant des styles cognitifs différents (Montequín et al., 2013; Hastie, 2019; DuPont & Hoyle, 2015), l'un des défis est que les différences entre les modes cognitifs peuvent être trop subtiles pour être facilement détectées. En réponse à ce défi, Wilde (2008) a développé un questionnaire de vingt questions qui peut être utilisé pour former des équipes. Wilde a montré que les équipes ainsi formées produiront des résultats de meilleure qualité que les équipes qui sont auto-sélectionnées ou formées au hasard (Hastie, 2019; Wilde, 2008).

Le système logiciel PolyTeam fournit un ensemble de fonctionnalités s'adressant tant aux étudiants qui doivent former des équipes qu'aux professeurs qui veulent intégrer le travail en équipe dans leurs cours. L'originalité de ce système est l'intégration d'outils et de méthodes d'intelligence artificielle permettant de tenir compte des principaux facteurs clés de succès lors de la formation d'équipes.

Le système est composé de trois modules. Premièrement, le module-étudiant permet aux étudiants de créer leur profil d'utilisateur (préférences, intérêts, contraintes, attentes, etc.) et de compléter le test de personnalité MBTI (Myers Briggs Type Indicator) déterminant leur type psychologique. Deuxièmement, le module-professeur permet aux professeurs de créer leur profil d'utilisateur (disponibilités, contraintes, exigences, objectifs, etc.) et de configurer les contraintes de chacun de leurs cours (équipes de 4 étudiants, 2 étudiants en génie informatique et 2 étudiants en génie logiciel, etc.). Le professeur choisit parmi trois algorithmes de formation d'équipes. Le premier permet de former des équipes en utilisant l'outil MBTI d'évaluation psychologique. Le second permet de former des équipes en utilisant un algorithme de satisfaction de contraintes en fonction du profil du cours. Le troisième permet de former des équipes en utilisant un algorithme de recommandation collaborative fondée sur l'analyse du profil des utilisateurs. Finalement, le module-gestionnaire permet au responsable des services informatiques de créer et de configurer des environnements pour la gestion de chacun des cours.

PolyTeam est toujours en cours de développement. Un prototype est fonctionnel et sera utilisé pour former les équipes dans le cadre du projet intégrateur de 2e année en génie informatique et en génie logiciel (environ 150 étudiants) à la session d'automne 2020 à Polytechnique Montréal. Son utilisation devrait favoriser les apprentissages expérienciel et collaboratif, identifier les dominantes psychologiques des personnes afin d'améliorer les relations personnelles et professionnelles, augmenter la productivité et identifier les préférences en matière de leadership et de communication.

References:

DuPont, B., & Hoyle, C. (2015, June). Automation and optimization of engineering design team selection considering personality types and course-specific constraints. In ASEE Annual Conf. & Exposition, Seattle, WA.

Felder, R. M., Felder, G. N., & Dietz, E. J. (2002). The effects of personality type on engineering student performance and attitudes, *Journal of Engineering Education, 91*(1), 3-17. https://onlinelibrary.wiley.com/doi/abs/10.1002/j.2168-9830.2002.tb00667.x

Galaleldin, M., Boudreau, J., & Anis, H. (2019, June). Team formation in engineering design course. *Proceedings of the Canadian Engineering Education Association (CEEA-ACEG19) Conference, 66*, 1-8.

Hastie, M. (2019, June). Design team performance: A comparison between self-formed teams and teams with diverse cognitive modes. *Proceedings of the Canadian Engineering Education Association (CEEA-ACEG19) Conference*, 157, 1-8.

Johnson, R. T., & Johnson, D. W. (1986). Cooperative learning in the science classroom. *Science and children*, *24*(2), 31-32.

Martins, F., & Eduarda, P. F. (2016, June). Integrating CDIO skills by teamwork in a school of engineering. *Proceedings of the 12th International CDIO Conference*, 9-17.

Montequín, V. R., Fernández, J. M., Balsera, J. V., & Nieto, A. G. (2013). Using MBTI for the success assessment of engineering teams in project-based learning. *International journal of technology and design education*, *23*(4), 1127-1146. https://link.springer.com/article/10.1007/s1 0798-012-9229-1

Shen, S. T., Prior, S. D., White, A. S., & Karamanoglu, M. (2007). Using personality type differences to form engineering design teams. *Engineering education*, *2*(2), 54-66. https://www.tandfonline.com/doi/abs/10.11120/ened.2007.02020054

Somkror, B. (2020, June). Building team skill with Rube Goldberg Machine project. *Proceedings of the 16th International CDIO Conference,* Gothenburg, Sweden.

Takai, S., & Esterman, M. (2017, August). Towards a better design team formation: A review of team effectiveness models and possible measurements of design-team inputs, processes, and outputs. In *International Design Engineering Technical Conferences and Computers and Information in Engineering Conference* (Vol. 58158, p. V003T04A018). American Society of Mechanical Engineers.

Totten, S. S., Digby, T. A., & Russ, P.(1991). *Cooperative learning: A guide to research.* New York: Garland.

Wilde, D. J. (2008). *Teamology: the construction and organization of effective teams*. Springer Science & Business Media.

Acknowledgements:

Ce travail est subventionné par le département de génie informatique et génie logiciel de Polytechnique Montréal.

Learning Analytics - AI

Les environnements immersifs au service des apprenants : un partenariat innovant pour la réussite scolaire des élèves ayant des difficultés d'apprentissage

Mariève Blanchet, Université du Québec à Montréal, blanchet.marieve@uqam.ca
Philippe Chaubet, Université du Québec à Montréal, chaubet.philippe@uqam.ca
Fabienne Venant, Université du Québec à Montréal, venant.fabienne@uqam.ca
Véronique Carbonneau
Stéphane Villeneuve
Geneviève Cadoret

De plus en plus d'évidences montrent que l'expérience corporelle des apprenants, par le biais de leurs mouvements, de leurs positions et de leurs sensations, influence positivement leur cognition et leurs apprentissages scolaires (Bara & Tricot, 2017; Barsalou, et al., 2003). Des recherches montrent aussi que l'utilisation de technologies immersives entraîne des bénéfices d'apprentissage pour les élèves, notamment en sciences et mathématiques (Lindgren & Johnson-Glenberg, 2013; Lindgren et al., 2016). Ces bénéfices s'expliqueraient par une interaction optimisée entre l'expérience corporelle de l'élève et l'environnement dans lequel il est immergé. Au-delà de leur caractère enrichi et ludique, les jeux immersifs offrent une dimension multi sensorielle et collective. Combinés à l'engagement corporel, ces jeux soutiendraient les apprentissages de l'élève. Les bénéfices observés jusqu'à présent dans la littérature l'ont surtout été pour des enfants au développement typique. Cependant, cette recherche a comme hypothèse que tous les élèves, quels que soient leurs besoins, sont susceptibles d'en profiter à condition que les environnements immersifs soient judicieusement créés pour répondre au niveau d'engagement et de compréhension des élèves (Lindgren et al., 2016). C'est cette adaptation qui a été testée dans cette recherche avec la plateforme LÜ pour les apprentissages du plan cartésien. LÜ est un environnement spatial intelligent québécois qui comprend et réagit aux comportements et aux interactions des joueurs en temps réel. Grâce à l'information issue des caméras 3D, LÜ dirige les jeux en projetant différents éléments interactifs sur les murs. Les systèmes d'éclairage et de son synchronisés en temps réel offrent une immersion totale. Cette recherche, conduite en partenariat avec la compagnie de jeux LÜ, l'école Lucien-Guilbault et Cadre 21, a tout d'abord permis l'adaptation de jeux immersifs sur la plateforme LÜ pour des élèves ayant des troubles graves d'apprentissage et des troubles moteurs associés. Une approche de construction avec tous les membres de l'équipe (enseignants, créateurs de jeux, chercheurs, etc) a été appliquée pour effectuer l'adaptation des outils et la conception des jeux. Des prétests avec certains enfants ont été effectués et l'équipe a pris en compte leurs commentaires pour adapter LÜ. Par la suite, les élèves issus de 5 classes (n=70) âgés entre 8 et 14 ans ont débuté leur participation à la recherche qui est actuellement en cours. Les habiletés visuo-spatiales des enfants (test de Corsi), leur équilibre, leur capacité d'endurance et leur connaissance du plan cartésien ont été évalués en pré-test et seront à nouveau évalués en post-test. Dans le protocole, les élèves joueront pendant 6 semaines, à raison de 2 fois par semaine aux jeux LÜ. Après la session de jeu, la motivation des enfants sera évaluée (auto-évaluation). La moitié des élèves jouera aux jeux immersifs, tandis que l'autre moitié jouera aux mêmes jeux à l'ordinateur. Jusqu'à présent, nous avons observé la faisabilité d'inclure cette approche dans l'horaire scolaire et l'intérêt des enfants à jouer aux jeux éducatifs immersifs. Nos résultats montreront les effets de l'utilisation des jeux immersifs sur la participation des enfants ayant des troubles graves d'apprentissage avec des limitations motrices associées, sur leur apprentissage du plan cartésien et sur leur mémoire visuo-spatiale.

References:

Bara, F., & Tricot, A. (2017). Le rôle du corps dans les apprentissages symboliques : apports des théories de la cognition incarnée et de la charge cognitive. *Recherches sur la philosophie et le langage*.

Barsalou, L. W., Simmons, W. K., Barbey, A. K., & Wilson, C. D. (2003). Grounding conceptual knowledge in modality-specific systems. *Trends in cognitive sciences*, *7*(2), 84-91.

Lindgren, R., & Johnson-Glenberg, M. (2013). Emboldened by embodiment: Six precepts for research on embodied learning and mixed reality. *Educational Researcher*, *42*(8), 445-452.

Lindgren R, Tscholl M, Wang S, & Johnson E. (2016). Enhancing learning and engagement through embodied interaction within a mixed reality simulation. Computers & Education, 95 174-187.

Remerciements :

Nous aimerions remercier le CRSH ainsi que l'UQAM pour le financement de ce projet. Nous aimerions aussi remercier les participants de l'étude ainsi que nos précieux collaborateurs l'école Lucien-Guilbault, Cadre 21 et la compagnie de jeux LÜ.

L’apprentissage actif par le vécu moteur dans la classe : une stratégie pédagogique efficace pour les enseignants

Geneviève Cadoret, Université du Québec à Montréal, cadoret.genevieve@uqam.ca
Stéphanie Boyer, Université du Québec à Montréal, boyer1stephanie@gmail.com
Philippe Chaubet, Université du Québec à Montréal, chaubet.philippe@uqam.ca

Selon les théories de la cognition incarnée, la cognition humaine est profondément enracinée dans les interactions du corps avec son environnement (Chandler et Tricot, 2015; Kiefer et Trumpp, 2012). Les recherches récentes sur la cognition spatiale et l’apprentissage des mathématiques appuient ces théories et mettent en évidence le rôle essentiel que jouent les gestes des apprenants et des enseignants dans l’apprentissage et la cognition (Hurst et al., 2019). Ainsi, un enfant de 5 ans exprime mieux sa connaissance implicite du concept de parallélisme par des gestes que par des mots, ce qu’il continue de faire jusqu’à l’âge de 8 ans (Calero et al., 2019). Des élèves du 2e cycle du primaire améliorent leur capacité à estimer la taille d’angles et à dessiner des angles de mesures données grâce à des expériences motrices sur une plateforme Kinect (Smith et al., 2014). Toutefois, la place accordée aux gestes et aux mouvements dans les salles de classe est très restreinte et, au Québec, les enseignants intègrent peu les gestes de l’élève dans leurs stratégies pédagogiques. L’objectif de cette recherche était de former des enseignants du primaire afin qu’ils intègrent dans leurs stratégies pédagogiques une activité motrice de l’élève qui soit le plus possible en adéquation avec le contenu scolaire. L’objectif était également d’évaluer la perception des enseignants suite à cette formation. Celle-ci consistait à offrir aux enseignants des contenus théoriques sur l’éducation par la motricité, des exercices pratiques, un soutien via une plateforme interactive, et des outils pour co-construire des activités en classe pour les élèves. Une analyse préliminaire des formations et des entretiens montre que l’apprentissage par le vécu moteur suscite beaucoup d’intérêt de la part des enseignants. Le fait que la formation apporte des informations qui sont appuyées par la recherche rassure les enseignants et les encourage à utiliser davantage cette stratégie d’enseignement puisqu’ils comprennent qu’elle est bénéfique pour l’apprentissage de leurs élèves. Ils constatent qu’en utilisant la motricité intégrée au contenu d’apprentissage, le corps donne beaucoup d’indices complémentaires aux enfants qui apprennent la plupart du temps avec la vision et l’audition. Une fois formés et outillés, les enseignants sont motivés à créer des activités en lien avec les contenus disciplinaires, comme des activités en lien avec le calcul de l’aire et du périmètre en mathématiques. Cependant, les enseignants sont d’avis qu’un soutien et un accès à une banque d’idées permettraient davantage la bonne mise en œuvre de cette stratégie d’enseignement. Ces premiers résultats indiquent que l’apprentissage par le vécu moteur dans la classe est perçu comme étant une stratégie pédagogique efficace pour les enseignants.

References:

Calero, C.I., Shalom, D.E., Spelke, E.S. & Sigman, M. (2019). Language, gesture, and judgment. Children’s paths to abstract geometry, *Journal of Experimental Child Psychology*, *177*, 70–85.

Chandler, P. & Tricot, A. (2015). Mind your body: The essential role of body movements in children’s learning. *Educational Psychology Review*, *27*(3), 365-370. doi: 10.1007/s10648-015-9333-3

Hurst, M.A., Polinsky, N., Haden, C.A., Levine, S.C. & Uttal, D.H. (2019). Leveraging research on informal learning to inform policy on promoting early STEM, *Social Policy Report*, *Society for Research in Child Development, 32*, 3, 1-33.

Kiefer, M. & Trumpp, N. (2012). Embodiment theory and education: The foundations of cognition in perception and action. *Trends in Neuroscience and Education, 1*(1), 15-20. doi: 10.1016/j.tine.2012.07.002

Smith, C. P., King, B. & Hoyte, J. (2014). Learning angles through movement: Critical actions for developing understanding in an embodied activity. *The Journal of Mathematical Behavior*, *36*, 95-108. doi: 10.1016/j.jmathb.2014.09.001

Acknowledgements:

Nous remercions les enseignantes qui ont accepté de participer à cette recherche.

Weaving Maker Skills That Meet the Demands of the 21st Century

Houda Jawhar, Concordia University, houda.jawhar@concordia.ca
Ann-Louise Davidson, Concordia University, ann-louise.davidson@concordia.ca

How does one become a maker and why should education stakeholders spend time developing maker curricula? This is a complex question that can not be answered through simple projects. The maker movement in education is often limited to the consumption of maker kits that are commercial methods to build STEAM (science, technology, engineering, arts and math) knowledge and access to makerspaces where we get access to disruptive and emergent technologies (such as 3D printers, vinyl cutters and laser cutters, microcontrollers...), as well as traditional tools and materials (such as saws, hammers and screwdrivers) (Fleming, 2015; Hatch, 2017; Johnson, 2018). This is very interesting as a point of departure into the maker journey, but technologies only do not provide enough direction to develop the creative confidence to solve ill-defined problems and maker skills that meet the demands of the 21st century (Taylor, 2016; Trust et al., 2018).

In an attempt to bridge this gap, we decided to experiment with the creation of responsive embedded wearables through a project we titled “Fabric of #MilieuxMake” (#MilieuxMake is the makerspace we created at the Milieux Institute for Arts, Culture and Technology at Concordia University, in Montreal). We used different approaches to “making” which encompass multiple layers of skills and knowledge. It allowed us to think with and through the technologies to construct “powerful ideas” (Papert, 1980), build new connections across different concepts and disciplines (Bender, 2016; Kafai et al., 2013; Peppler & Glosson, 2013), and develop skills to compete in the 21st century.

Inspired by the work of Joyce Wieland (Sloan, 2014), “Fabric of #MilieuxMake” is an evolving project which combines various materials including knitted yarn, 3D printed fabric, embedded electronics and sensors. The building blocks of our project were the maker fundamentals, which included workshops such as basic electronics, Arduino 101, 3D modelling and robotics, as well as building our own 3D printer and learning how to control it and 3D print various objects. These workshops, delivered within the community of #MilieuxMake, were essential to develop basic maker knowledge and skills, and to establish connections within our local maker community. Various iterations of these workshops helped us plan ideas of what each piece within our fabric would look like, and what components it would incorporate to serve as the foundation of a maker curriculum that would help learners build advanced expertise.

Going through an iterative process of developing responsive embedded wearables required skills development that went beyond what was offered in the maker fundamentals workshops. The combination of concepts (textiles and materiality investigation, basic electronics and programming) and materials (such as regular and conductive yarn) and technologies (NeoPixels and various sensors) that were required to build one functional project piece, allowed us to further our knowledge and explore new disciplines that emerged from the intersection of the maker fundamentals. It also allowed us to apply and advance various skills including creativity, complex problem solving, persistence, collaboration, and sticking with the trouble, all of which are essential to meet the demands of the 21st century.

References:

Bender, S. (2016). Electronics meets textiles: Sewing the way to powerful new ideas about technology. In *Makeology* (pp. 139–158). Routledge.

Fleming, L. (2015). Worlds of making: Best practices for establishing a makerspace for your school. Corwin

Hatch, M. R. (2017). The maker revolution: Building a future on creativity and innovation in an exponential world. John Wiley & Sons.

Johnson, R. H. (2018). School-based and museum-based Makerspaces. (Masters dissertation, University of Wisconsin-Milwakee). Retrieved from https://dc.uwm.edu/etd/1838

Kafai, Y., Fields, D., & Searle, K. (2013). Making connections across disciplines in high school e-textile workshops. In L. Buechley, K. Peppler, M. Eisenberg, & Y. Kafai (Eds.), Textile messages: Dispatches from the world of e-textiles and education (pp. 85–93). Peter Lang Publishing, New York, NY.

Papert, S. (1980). Mindstorms: children, computers, and powerful ideas Basic Books. Inc. New York, NY.

Peppler, K., & Glosson, D. (2013). Learning about circuitry with e-textiles in after-school settings. In L. Buechley, K. Peppler, M. Eisenberg, & Y. Kafai (Eds.), Textile messages: Dispatches from the world of E-textiles and education.(pp. 71–83). Peter Lang Publishing, New York, NY.

Sloan, J. (2014). Joyce Wieland: Life & work. Art Canada Institute. https://aci-iac.ca/art-books/joyce-wieland/significance-and-critical-issues

Taylor, B. (2016). Evaluating the benefit of the maker movement in K-12 STEM education. Electronic International Journal of Education, Arts, and Science (EIJEAS), 2.

Trust, T., Maloy, R. W., & Edwards, S. (2018). Learning through making: Emerging and expanding designs for college classes. TechTrends, 62(1), 19–28. https://doi.org/10.1007/s11528-017-0214-0

Three computer programming scenarios and recommendations for practice in a makerspace setting

Ivan Ruby, Concordia University, ivan.ruby@mail.concordia.ca
Ann-Louise Davidson, Concordia University, ann-louise.davidson@concordia.ca

Learning computer programming is a common task and learning activity in makerspaces. Participants use programming skills in a wide array of activities ranging from the creation of computer animations and games, the control of electronic components in a robotics project, to the configuration of open-source tools (Komis, Romero, & Misirli, 2017; Resnick & Rosenbaum, 2013). Over the past three years, we have observed three computer programming scenarios through a variety of activities and events that take place at #MilieuxMake, the makerspace Education Makers (www.educationmakers.ca) have built: learning *about,* learning *with* and learning *through* computer programming. While these three common practices share a variety of elements, they ultimately have different goals with respect to the development of programing knowledge and skills.

The following three positional statements emerge from clusters of observations we have made organically through maker activities and projects at #MilieuxMake:

- When learning *about* computer programming in activities, such as learning how to program an Arduino microcontroller, learners view programming as an isolated skill, to be subsequently applied in future or existing projects. While this scenario prioritizes depth of programming knowledge, the frequent lack of a clear tangible project or task to accomplish often negatively impact the progress learners make.
- In learning *with* computer programming, we observed a learning process on which programming is used as a component of a project, frequently in STEAM integrated activities. In this case, the depth and breadth of the knowledge of computer programming are limited to the role of programming on the project.
- When learning *through* programming, learners are often immersed in environments with ill-defined problems on which programming plays a very limited role. This scenario often requires the usage of resources and tools that simplify the learning and implementation of programming as to favor progress in the overall activity.

For each of these scenarios, we offer the following recommendations for practice, to better support learners as well as facilitators.

When designing learning *about* programming:

1. Spend time developing strong foundations of the conceptual aspects of programming and the programming language/environment being used;
2. Present learners with progressively challenging projects with a reduced set of concepts;
3. Whenever a troubleshooting opportunity arises, spend time addressing it collaboratively, focusing on the conceptual aspects related to the issue.

When learning *with* programming:

1. Spend time developing an understanding of the role programming plays in the system;
2. Whenever possible, have pre-existing sample programs that can be used as guides in these activities, to reduce the overload in starting a program from scratch as well as the sources of errors;
3. Whenever an error arises, trace the behavior starting from the non-programming components of the project.

Lastly, when learning *through* programming:

1. Focus on isolated programming concepts with examples that can be used in the activity;
2. Whenever possible, have pre-existing sample programs that can be used as a guide;
3. Whenever an error arises, stimulate learners to attempt troubleshooting, but consider the idea of quickly transitioning to non-programming-based prototypes.

More developments on these aspects are forthcoming as we are currently collecting data with expanded communities of practice.

References:

Education Makers. www.educationmakers.ca

Komis, V., Romero, M., & Misirli, A. (2017). A scenario-based approach for designing educational robotics activities for co-creative problem solving. *Advances in Intelligent Systems and Computing*, *560*, 158–169. https://doi.org/10.1007/978-3-319-55553-9_12

Resnick, M., & Rosenbaum, E. (2013). Designing for tinkerability. In *Design, make, play: Growing the next generation of STEM innovators*, 163–181. Retrieved from http://web.media.mit.edu/~mres/papers/designing-for-tinkerability.pdf

Co-learning about Artificial Intelligence, digital citizenship and the ethics of technology in the classroom

Kate Arthur, Kids Code Jeunesse, hannah@kidscodejeunesse.org

Today's children are being born into a world already permeated by AI, and not knowing life has ever been different. They will be the first generation ever to grow up in a world influenced and manipulated by AI. As technology seamlessly integrates into our daily lives, children need analytical skills to understand how it impacts the environment around them - and the tools to take control of how their world works. But as educators, can we depend on our education systems to prepare the next generation for a future world that we can't even imagine yet?

Kids Code Jeunesse (KCJ) is a bilingual Canadian charity determined to give every Canadian child access to digital skills education, with a focus on girls and underserved communities. KCJ teaches kids and their educators about algorithm literacy, artificial intelligence, code, digital citizenship and how these integrate with the UN's Global Goals for Sustainable Development so that our kids have the confidence and creative tools they need to build a better future.

We do this through a blended approach, training educators and children in the classroom and through webinars; facilitating extracurricular workshops and coding camps that use topics like arts, science and sport to engage kids in coding; community events that celebrate national and international events; and supporting the Canadian network of volunteer-led Code Clubs.

By using kids interests and hobbies as paths to engage them in digital skills, and focusing on the skills of collaboration, communication, and creativity, we take a holistic and multifaceted approach to empower kids with the tools they need to engage with the world as digital citizens.

We recently launched the Algorithm Literacy Project: a national awareness campaign with CCUNESCO to educate Canadians about the role algorithms play in our online lives, and how we as digital citizens can actively influence their impact.

KCJ has already taught over 325,000 children and 10,000 educators, across every province and territory. With our #kids2030 initiative we're planning to reach a million kids by the UN's 2030 deadline for meeting the Sustainable Development Goals.

In conversation, Kate Arthur can share how KCJ is taking Artificial Intelligence, ethics and digital citizenship skills into schools, and creating educational experiences that have an impact that expands way beyond the classroom. She can show how a blended approach of teaching the teachers, and engaging children to learn through creating in turn creates creates communities of practice and digital skills - building on from her (2019) open letter calling for better education around AI, published in leading Francophone outlet La Presse and signed by Yoshua Bengio, Rémi Quirion, Lyse Langlois.

Kate speaks to our collective responsibility as adults to ensure that all children are receiving the best education and are prepared for the uncertainty surrounding our AI-enabled futures, whilst empowering children to build healthy relationships with the technology that is embedded in their world.

References:

Author (2019, April 6). Artificial Intelligence: The urgency to educate now. La Presse. http://plus.lapresse.ca/screens/507156e2-5874-4097-83f1-f2380889e033__7C___0.html

Assessment

Small but Mighty: Using Students' Smartphones in College Teaching

Anick Legault, Dawson College, aclegault@dawsoncollege.qc.ca
Mary Jorgensen, Adaptech Research Network, mjorgensen07@ubishops.ca
Laura King, Collège André-Laurendeau, laura.king@claurendeau.qc.ca
Alice Havel, Dawson College
Alex Lussier, Collège André-Laurendeau,
Meagan Harvison, Concordia University
Christine Vo, Adaptech.

A recent study showed that because of the abundance of learning tools, apps, digital books with interactive elements, visual content, cameras and browsers, students can engage in learning activities with fewer space and time restrictions using smartphones (Fichten et al., 2019). However, some consider smartphones to be a distraction to learning and teaching (Bennett, 2019). When used in a responsible, well informed, and timely manner during a lecture, the smartphone can be an efficient tool to increase and improve the inclusion of all students, whether they have a disability or not. Moreover, smartphones have been cited as a useful tool for remote learning during the Covid-19 pandemic (Blagg et al., 2020).

Since most students own a smartphone (Galanek et al., 2018), our initial thought was "Why not use this small tool in the classroom to make a big impact?" With this idea in mind, we conducted a series of focus groups where participants were students, teachers, and professionals. Group members co-created activities for using smartphones. We also developed an online survey to examine how students used smartphones in class and what pedagogical practices they find helpful. We found that teachers used students' smartphones to administer short quizzes, assess comprehension, make e-textbooks and library resources more readily available, poll students and allow students to practice concepts. We also found that teachers used smartphones to help students access class material, to Google information, and to work in small teams on shared documents.

Many free apps and websites offer the opportunity to use smartphones in class. Two of the popular sites mentioned by focus groups participants, Poll Everywhere and Kahoot, allow teachers to poll their students for ideas, opinions, comprehension, etc. in a confidential manner. Teachers can use the smartphone polling option in individual, collaborative and competitive formats.

References:

Bennett, P. W. (2019, March 21). *We should ban cell phones from classrooms. The research backs that up.* The Globe and Mail. Retrieved from https://www.theglobeandmail.com/opinion/article-we-should-ban-cellphones-from-classrooms-and-the-research-backs-that/

Blagg, K., Blom, E., Gallagher, M., & Rainer, M. (2020). Mapping Student Needs during COVID-19. Retrieved from https://vtechworks.lib.vt.edu/bitstream/handle/10919/98460/MappingStudentsNeeds.pdf?sequence=1&isAllowed=y

Fichten, C., Jorgensen, M., King, L., Havel, A., Heiman, T., Olenik-Shemesh, D., & Kaspi-Tsahor, D. Mobile Technologies That Help Post-Secondary Students Succeed: A Pilot Study of Canadian and Israeli Professionals and Students With Disabilities. https://doi.org/10.5430/irhe.v4n3p35

Galanek, J. D., Gierdowski, D. C., & Brooks, D. C. (2018). ECAR study of undergraduate students and information technology 2018. URL https://library.educause.edu/resources/2018/10/2018-students-and-technology-research-study

Acknowledgement:

We would like to thank Entente-Canada Quebec for funding this important project.

Assessment and Intervention in a Large Enrollment Course

Pallavi Sirjoosingh, McGill University, pallavi.sirjoosingh@mcgill.ca

General Chemistry 1 and 2 (Chem110 and 120) are large enrollment (>850 students) introductory level chemistry courses at McGill University. We undertook two major reforms that focused on two challenges associated with large enrollment classes: 1) providing detailed feedback on individual exams; and 2) providing effective learning resources for struggling students. In Fall 2019, we changed the midterm and final exam assessments from a multiple-choice format to a short answer format. Though multiple-choice exams can be graded efficiently, quickly, and objectively, students receive no individualized feedback. Individualized feedback can help students assess the fundamental concepts they may have misunderstood (Biggs, 2011) and provides a way to check-in with students, a difficult interaction to achieve in large enrollment courses. Crowdmark, a web-based application to evaluate and discuss individual exams, was utilized to administer, grade, and evaluate all exams in both the introductory courses. Crowdmark allows for pre-populating the platform with detailed rubric and comments for each question that an individual grader can add to a particular exam booklet. Grading using the comments is objective across multiple graders, but more importantly we can determine the most common mistakes based on the frequency of each comment used and align teaching strategies based on these results. Our second reform focused on providing learning resources to low performing students. Based on results from early assessments (midterms) students struggling with the material were surveyed, and organized into study groups. Prior research suggests there is value in collaborative learning (Bransford, Brown & Cocking, 2000) and that learning can be enhanced by helping students organize their learning styles (Ambrose, Bridges et al., 2010). At the end of the semester, a survey was conducted to evaluate the effectiveness of these study groups as perceived by the students. Results show a majority (~89%) of students completely agreed that the study groups were helpful in improving learning strategies, and ~85% completely agreed that being in the study group helped improve their learning outcomes (grades). Employing such small study groups can be an effective instructional intervention but there are associated issues such as sustainability of the study groups, assessing content understanding beyond exam performance, and group-to-group differences in effectiveness. Results related to the implementation of Crowdmark shows that the application can support instructors with an effective way to provide students with more individualized feedback on exams. While we did not survey students on whether or not this feedback was instrumental in their learning, we plan to examine its impact on improving learning.

References:

Ambrose, S. A., Bridges, M. W., DiPietro, M., Lovett, M. C., & Norman, M. K. (2010). *How learning works: Seven research-based principles for smart teaching. John Wiley & Sons.*

Biggs, J. B. (2011). *Teaching for quality learning at university: What the student does. McGraw-hill education* (UK).

Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). *How people learn* (Vol. 11). Washington, DC: National academy press.

Introducing Metacognitive Skills for Undergraduate Students in Engineering Courses

Armin Yazdani, McGill University, armin.yazdani@mcgill.ca
Alexander Liepins, McGill University, alexander.liepins@mcgill.ca
Maria Orjuela-Laverde, McGill University, maria.orjuela-laverde@mcgill.ca
Nathaniel Quitoriano, McGill University

This project was the recipient of a SALTISE mini grant and aimed to build the capacity of students to be active agents in their learning by following the model and process of Self-Regulated Learning (SRL). SRL encourages intentionality in students' approach to their learning by integrating preparation, goal-setting, and reflection into study behaviors with an overall emphasis on strategic outcomes. The aims of this project were two-fold. First, to foster students to become deep learners by using a metacognitive toolkit and application of learning strategies. Second, to provide instructors with accessible tools to teach metacognitive skills to their students. Therefore, metacognitive tools to enhance student learning were intentionally created with both instructors and students in mind to reinforce metacognitive learning skills. An upper-level engineering course was used to pilot the delivery of material and obtain feedback. The professor presented these metacognitive strategies in a 1.5-hour materials engineering course after the first assessment. Students participated in several activities and were engaged throughout the presentation. Two of the five modules were presented, and the feedback obtained was used to revise content in these two modules. Subsequently, three additional modules were developed that were not piloted in the course. A team consisting of a graduate student, an undergraduate student, educational developers, and faculty worked on revision of content as well as the development of a guide that faculty could use. A series of tools were compiled as an optional resource for instructors that may be interested in assessing the efficacy of the metacognitive toolkit. After a number of meetings, plans were developed for dissemination of this toolkit to other STEM professors and courses.

References:

Pintrich, P. R. (1995). Understanding self-regulated learning. New directions for teaching and learning, 1995(63), 3-12.

McGuire, S. Y. (2015). Teach students how to learn: Strategies you can incorporate into any course to improve student metacognition, study skills, and motivation. Stylus Publishing, LLC.

Bibliographic Anthology

The Foundations of Student Learning: Lessons from the Research Literature on Perennial Challenges of Pre-Class Work, Note-Taking, Interactivity, Prior Learning, and Assessment

Saul Carliner, Concordia University, saul.carliner@concordia.ca
Monica Lopez, Dawson College, mlopez@dawsoncollege.qc.ca
Nadine Bekkouche, Concordia University, nadine.bekkouche@mail.concordia.ca
David Jones, Concordia University, Wenbin Liu, Concordia University, Ezgi Ozyonum, Concordia University, Alexis Stylianou, Concordia University

Although institution-wide efforts to strengthen teaching in higher education tend to focus on innovation and the integration of technologies, instructors on the front-line continue to feel challenged by more basic and perennial issues, such as getting students to complete pre-class work, assisting students with taking effective notes, promoting interaction without classroom chaos, aligning course material to the knowledge levels of students, and fairly, yet meaningfully, assessing students, all while managing their teaching workload.

As part of a project to develop an easy-to-access online reference for faculty on everyday teaching matters, a research team from Concordia University and Marianopolis College conducted a series of systematic reviews of the research literature on these issues to bring research-validated insights to faculty.

The issues explored are based on questions arising in a needs assessment of faculty and that faculty development specialists commonly encounter. Those addressed in this session include:

- "Are my assignments and assessments fair?" (Topics: Assessment by Objective Tests; Assessment by Essay Tests)
- "How do I get students to complete their pre-class work?" (Topic: Pre-class preparation)
- "How can I use paired discussions and other interactive techniques without inviting pandemonium?" (Topics: Class Discussions; Interactivity)
- "How can I support students in taking notes from class?" (Topic: Note Taking)
- "How can I avoid problems of plagiarism and academic misconduct?" (Topic: Avoiding Plagiarism and Academic Misconduct)
- The reviews include general and discipline-specific advice geared towards faculty.

References:

On Assessment by Objective Tests

Bacon, D. R. (2003). Assessing learning outcomes: A comparison of multiple-choice and short-answer questions in a marketing context. *Journal of Marketing Education, 25*(1), 31-36.

Burton, R. F. (2001). Quantifying the effects of chance in multiple choice and true-false tests: Question selection and guess of answers. *Assessment & Evaluation in Higher Education, 26*(1), 41-50. doi: 10.1080/02602930020022273

Burton, R. F. (2006). Sampling knowledge and understanding: How long should a test be? *Assessment & Evaluation in Higher Education, 31*(5), 569-582. doi: 10.1080/02602930600679589

Butler, A. C., & Roediger, H. L. (2008). Feedback enhances the positive effects and reduces the negative effects of multiple-choice testing. *Memory & Cognition, 36*(3), 604-616.McCoubrie, P. (2004). Improving the fairness of multiple-choice questions: a literature review. *Medical Teacher, 26*(8), 709-712. doi: 10.1080/01421590400013495

DiBattista, D., Sinnige-Egger, J., & Fortuna, G. (2014). The "noun of the above" option in multiple-choice testing: An experimental study. *The Journal of Experimental Education, 82*(2), 168-183.

Downing, S. M., & Haladyna, T. M. (Eds.). (2006). Handbook of test development. Mahwah, Jew Jersey: Laurence Erlbaum Associates.

Haladyna, T. M. (2012). Developing and validating multiple-choice test items (3rd ed.). Mahwah, NJ: Lawrence Erlbaum Associates.

Kubinger, K. D., Holocher-Ertl, S., Reif, M., Hohensinn, C. & Frebort, M. (2010). On minimizing guessing effects on multiple-choice items: superiority of a two solutions and three distractors item format to a one solution and five distractors item format. *International Journal of Selection and Assessment, 18*(1), 111–115.

Kun, A. I. (2015). Does the repetitive use of the same test in consecutive examination sessions facilitate cheating? *Assessment & Evaluation in Higher Education, 40*(8), 1159-1181. doi: 10.1080/02602938.2014.977845

Lesage, E., Valcke, M., & Sabbe, E. (2013). Scoring methods for multiple choice assessment in higher education -- Is it still a matter of number right scoring or negative marking? *Studies in Educational Evaluation, 39*(3), 188-193. doi: 10.1016/j.stueduc.2013.07.00

Ng, A. W. Y., & Chan, A. H. S. (2012). Evaluation of three multiple-choice assessment methods in a human factors engineering course. *Journal of the Chinese Institute of Industrial Engineers, 29*(7), 466-476. doi: 10.1080/10170669.2012.727478

Nicol, D. (2007). E-assessment by design: Using multiple-choice tests to good effect. *Journal of Further and Higher Education, 31*(1), 53-64. doi: 10.1080/03098770601167922

Rodriguez, M. C. (2005). Three options are optimal for multiple-choice items: A meta-analysis of 80 years of research. *Educational Measurement: Issues and Practice, 24*(2), 3-13. doi: 10.1111/j.1745-3992.2005.00006.x

Roediger III, H. L., & Marsh, E. J. (2005). The positive and negative consequences of multiple-choice testing. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 31*(5), 1155-1159. doi: 10.1037/0278-7393.31.5.1155

Tasdemir, M. (2010). A comparison of multiple-choice tests and true-false tests used in evaluating student progress. *Journal of Instructional Psychology, 37*(3), 258-266.

Towns, M. H. (2014). Guide to developing high-quality, reliable, and valid multiple choice assessments. *Journal of Chemical Education, 91*, 1426-1431.

Ward, C. (1981). Preparing and using objective questions. London: Stanley Thornes.

Xu, X., Kauer, S., & Tupy, S. (2016). Multiple-choice questions: Tips for optimizing assessment in-seat and online. *Scholarship of Teaching and Learning in Psychology, 2*(2), 147-158. doi: 10.1037/stl0000062

Yaman, S. (2011). The optimal number of choices in multiple-choice tests: Some evidence for science and technology education. *New Educational Review, 23*(1), 227-241.

On Assessment by Essay Test

Assessment basics: Glossary. (2019). *Eberly Center, Carnegie Mellon University*. Retrieved from https://www.cmu.edu/teaching/assessment/basics/glossary.html

Balfour, S. P. (2013). Assessing writing in MOOCs: Automated Essay Scoring and Calibrated Peer Review™. *Research & Practice in Assessment, 8*, 40–48. Retrieved from https://eric.ed.gov/contentdelivery/servlet/ERICServlet?accno=EJ1062843

Campbell, C. E., & Nehm, R. H. (2013). A critical analysis of assessment quality in Genomics and Bioinformatics Education research. *CBE - Life Sciences Education, 12*(3), 530–541. http://dx.doi.org/10.1187/cbe.12-06-0073

Connelly, V., Dockrell, J. E., & Barnett, J. (2006). A pilot intervention to improve the structural quality of exam essay writing in UK undergraduate psychology students. *Psychology Teaching Review, 12*(1), 43–56. Retrieved from https://lib-ezproxy.concordia.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=EJ876469&site=ehost-live&scope=site

Creating exams. (2019). *Eberly Center, Carnegie Mellon University*. Retrieved from https://www.cmu.edu/teaching/assessment/assesslearning/creatingexams.html

Eder, D. (2004). General education assessment within the disciplines. *The Journal of General Education, 53*(2), 135-157. Retrieved from http://www.jstor.org/stable/27797983

Hughes, G., Smith, H. & Creese, B. (2015). Not seeing the wood for the trees: Developing a feedback analysis tool to explore feed forward in modularised programmes. *Assessment and Evaluation in Higher Education, 40*(8), 1079-1094. https://doi.org/10.1080/02602938.2014.969193

Jaidhev, R. & Chan, P. (2018). Embedding communication in the disciplines: a tale of two faculties. *Innovation in Language Teaching and Learning, 12*(3), 199-21. https://doi.org/10.1080/17501229.2016.1156685

Lea, M.R. & Street, B.V. (1998). Student writing in higher education: An academic literacies approach. *Studies in Higher Education, 23*(2), 157-172. https://doi.org/10.1080/03075079812331380364

Mansilla, V. B., & Duraising, E. D. (2007). Targeted assessment of students' interdisciplinary work: An empirically

grounded framework proposed. *Journal of Higher Education, 78*(2), 215–237. Retrieved from http://0-search.ebscohost.com.mercury.concordia.ca/login.aspx?direct=true&db=eric&AN=EJ754100&site=ehost-live&scope=site
McLeod, S.G., Brown, G.C., McDaniels, P.W., & Sledge, L. (2008). Improving writing with a PAL: Harnessing the power of Peer Assisted Learning with the Reader's Assessment Rubrics. *International Journal of Teaching and Learning in Higher Education, 20*(3), 488-502. Retrieved from https://files.eric.ed.gov/fulltext/EJ869333.pdf
Meyer, L. H., Davidson, S., McKenzie, L., Rees, M., Anderson, H., Fletcher, R., & Johnston, P. M. (2010). An investigation of tertiary assessment policy and practice: Alignment and contradictions. *Higher Education Quarterly, 64*(3), 331–350. http://dx.doi.org/10.1111/j.1468-2273.2010.00459.x
Mogey, N., Paterson, J., Burk, J., & Purcell, M. (2010). Typing compared with handwriting for essay examinations at university: Letting the students choose. *ALT-J: Research in Learning Technology, 18*(1), 29–47. Retrieved from https://lib-ezproxy.concordia.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=EJ880181&site=ehost-live&scope=site
Morante, E. (2003). *A Handbook on Outcomes Assessment for Two Year Colleges.* Palm Springs, CA: College of the Desert. Available from https://files.eric.ed.gov/fulltext/ED482595.pdf
Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.620.2863&rep=rep1&type=pdf
Mummalaneni, V. (2014). Reflective essay and e-portfolio to promote and assess student learning in a capstone marketing course. *Marketing Education Review, 24*(1), 43–46. http://dx.doi.org/10.2753/MER1052-8008240107
O'Donovan, N. (2005). There are no wrong answers: An investigation into the assessment of candidates' responses to essay-based examinations. *Oxford Review of Education, 31*(3), 395–422. Retrieved from https://lib-ezproxy.concordia.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=EJ717883&site=ehost-live&scope=site
Pereira, D., Flores, M. A., & Niklasson, L. (2016). Assessment revisited: A review of research in Assessment and Evaluation in Higher Education. *Assessment and Evaluation in Higher Education, 41*(7), 1008–1032. DOI: 10.1080/02602938.2015.1055233
Potential assessments. (2019). *Eberly Center, Carnegie Mellon University*. Retrieved from https://www.cmu.edu/teaching/designteach/design/assessments.html
Shi, L., & Dong, Y. (2015). Graduate writing assignments across faculties in a Canadian university. *Canadian Journal of Higher Education, 45*(4), 123–142. Retrieved from http://0-search.ebscohost.com.mercury.concordia.ca/login.aspx?direct=true&db=eric&AN=EJ1086918&site=ehost-live&scope=site
VandenBos, G. R. (2015). Subjective tests. *APA Dictionary of Psychology* (2nd ed.). Washington, DC: American Psychological Association.
Walvoord, B. E. & Anderson, V.J. (1998). *Effective Grading: A Tool for Learning and Assessment.* San Francisco: Jossey-Bass.
Wingate, U., & Tribble, C. (2012). The best of both worlds? Towards an English for Academic Purposes / Academic Literacies writing pedagogy. *Studies in Higher Education, 37*(4), 481–495. https://doi.org/10.1080/03075079.2010.525630

On Class Preparation

Ackerman, D.S., & DeShields, D.W. (2013). How ordering of assignments can influence beliefs about the self and how these beliefs can impact on student class performance. *Alberta Journal of Educational Research*, *59* (4), 553-568. Retrieved from http://ajer.synergiesprairies.ca
Arora, M.L., Rho, Y.J., & Masson, C. (2013). Longitudinal study of online statics homework as a method to improve learning. *Journal of STEM Education: Innovations and Research*, *14*(1), 36-44. Retrieved from https://www.jstem.org/jstem/index.php/JSTEM
Arthurs, L., & Templeton, A. (2009). Coupled collaborative in-class activities and individual follow-up homework promote interactive engagement and improve student learning outcomes in a college-level Environmental Geology course. *Journal of Geoscience Education, 57*(5), 356-371. DOI: 10.5408/1.3544287.
Averill, R., Roccabianca, S., & Recktenwald, G. (2019). A multi-instructor study of assessment techniques in engineering mechanics courses. *American Society for Engineering*

Education 126th Annual Conference & Exposition. Retrieved from https://peer.asee.org/a-multi-instructor-study-of-assessment-techniques-in-engineering-mechanics-courses

Babaali, P., & Gonzalez, L. (2015). A quantitative analysis of the relationship between an online homework system and student achievement in pre-calculus. *International Journal of Mathematical Education in Science and Technology*, *46* (5), 687-699, DOI: 10.1080/0020739X.2014.997318

Bailey, E.G., Baek, D., Meiling, J., Morris, C., Nelson, N., Rice, N.S., Rose, S., & Stockdale, P. (2018). Learning gains from a recurring "teach and question" homework assignment in a general biology course: using reciprocal peer tutoring outside class. *CBE Life Sciences Education, 17*(23), 1-10. DOI:10.1187/cbe.17-12-0259.

Chang, C.B., Wall, D., Tare, M., Golonka, E., & Vatz, K. (2014). Relationships of attitudes toward homework and time spent on homework to course outcomes: The case of foreign language learning. *Journal of Educational Psychology*, *7* (16), 1-17. DOI: 10.1037/a0036497

Chew, K.J., Chen, H.L., Rieken, B., Turpin, A., & Sheppard, S. (2016). Improving students' learning in statics skills: Using homework and exam wrappers to strengthen self-regulated learning. Paper presented at The American Society for Engineering Education 123rd Annual Conference & Exposition. Retrieved from https://www.asee.org/search/proceedings

Cutshall, R.C., Mollick, J.S., & Bland, E.M. (2012). Use of an e-textbook and web-based homework for an undergraduate business course: Students' perceptions. *Journal of the Academy of Business Education*, *13*, 1-11. Retrieved from https://www.researchgate.net/publication/242564663_Use_of_an_e-Textbook_and_WebBased_Homework_for_an_Undergraduate_Business_Course_Students'_Perceptions

Dabrowski, R., Leloup, J.W., & MacDonald, L. (2013). Effectiveness of computer-graded vs. instructor-graded homework assignments in an Elementary Spanish course: A comparative study at two undergraduate institutions. *IALLT Journal of Language Learning Technologies*, *43* (1), 78-100. Retrieved from https://journal.iallt.org › IALLT › article › download

Edgcomb, A., Vahid, F., Lysecky, R., & Lysecky, S. (2017). Getting students to earnestly do reading, studying, and homework in an introductory programming class. *Proceedings of the 2017 ACM SIGCSE Technical Symposium on Computer Science Education*, 171-176. Retrieved from http://dx.doi.org/10.1145/3017680.3017732

Fernandez, A., Saviz, C., & Burmeister, J.S. (2006). Homework as an outcome assessment: Relationships between homework and test performance. Paper presented at The American Society for Engineering Education Annual Conference & Exposition, 1-18. Retrieved fom https://peer.asee.org/41

Fish, L.A. (2013). A comparison of undergraduate versus graduate student perceptions and performance using online homework in introduction to operations management courses. *Business Education Innovation Journal*, *5*(1), 58-66. Retrieved from http://www.beijournal.com/home.html

Fish, L.A. (2015). Undergraduate students computer-managed homework versus in-class performance for different testing formats. *Business Education Innovation Journal*, *7* (1), 5-14. Retrieved from http://www.beijournal.com/

Folami, L.B., & Simons, K. (2012). Students' perceptions of online homework software in accounting courses. *International Journal of Education Research*, *7*(2), 56-72. Retrieved from https://www.journals.elsevier.com/international-journal-of-educational-research

Gleason, J. (2012). Using technology-assisted instruction and assessment to reduce the effect of class size on student outcomes in undergraduate mathematics courses. *College Teaching*, *60* (3), 87-94. DOI: 10.1080/87567555.2011.637249

Jackson, M.A., Tran, A., Wenderoth, M.P., & Doherty, J.H. (2018). Peer vs. self-grading of practice exams: Which is better? *CBE Life Sciences Education*, *17* (44), 1-8. DOI:10.1187/cbe.18-04-0052

Jones, C.G. (2008). Student perceptions of the impact of web-based homework on course interaction and learning in introductory accounting. *Issues in Information Systems, 9*(1), 223-232. https://www.iacis.org/iis/iis.php.

Kandra, K.L., Armour, J.L., & Eichler, F.A. (2011). The challenge of homework in the teaching and learning of social science statistics. *National Social Science Journal*, *37* (1), 60-66. Retrieved from https://nssa.us › journals

Kearsley, P.D., & Klein, A.G. (2016). Self-corrected homework for incentivizing metacognition. Paper presented at the American Society for Engineering Education Annual Conference & Exposition. Retrieved from https://www.asee.org/public/conferences/64/papers/16884/view

Kitsantas, A., & Zimmerman, B.J. (2009). College students' homework and academic achievement: The mediating role of self-regulatory beliefs. *Metacognition Learning*, *4*, 97-110. doi: 10.1007/s11409-008-9028-y

Kowalski, A., & Snow, C. (2018). Feasibility of graded, electronic homework assignments in a second year chemical engineering course. American Society for Engineering Education Zone IV Conference. Retrieved from https://peer.asee.org/collections/2018-asee-zone-iv-conference

Lambright, K. (2008). Lessons outside of the classroom: Examining the effectiveness of service learning projects at achieving learning objectives. *Journal of Public Affairs Education*, *14* (2), 205-217. DOI: 10.1080/15236803.2008.12001520

Lefcort, H., & Eiger, S. M. (2003). Preparatory versus practice homework. *Journal of College Science Teaching*, *33*(1), 16-18. Retrieved from https://www.nsta.org/college/

Leong, K.E., & Alexander, N. (2014). College students attitude and mathematics achievement using web based homework. *Eurasia Journal of Mathematics*, *Science & Technology Education*, *10*(6), 609-615. DOI: 10.12973/eurasia.2014.1220a

Lindquist, T.M., & Olsen, L.M. (2007). How much help, is too much help? An experimental investigation of the use of check figures and completed solutions in teaching intermediate accounting. *Journal of Accounting Education*, *25*, 103-117. DOI: 10.1016/j.jaccedu.2007.07.001

McVey, M., Luchies, C.W., Giraldo, C., & Sidener, L. (2019). Developing problem-solving skills in dynamics: Implementation of structured homework assignments. American Society for Engineering Education Annual Conference & Exposition. Retrieved from https://www.asee.org/public/conferences/140/papers/25713/view

Peng, J.C. (2009). Using an online homework system to submit accounting homework: Role of cognitive need, computer efficacy, and perception. *Journal of Education for Business*, *84* (5), 263-268. DOI: 10.3200/JOEB.84.5.263-268

Pierson, H. (2013). The large lecture conundrum: A case study in leveraging instructional resources to increase student learning. Proceedings of the 2013 ASEE North-Central Section Conference. Retrieved from http://people.cst.cmich.edu/yelam1k/asee/proceedings/2013/tech_program_2013.html

Planchard, M., Daniel, K.L., Maroo, J., Mishra, C., & McLean, T. (2015). Homework, motivation, and academic achievement in a college genetics course. *Bioscene: Journal of College Biology Teaching*, *41*(2), 11-18. Retrieved from https://www.acube.org/bioscene/

Radhakrishnan, P., Lam, D., & Ho, G. (2009). Giving university students incentives to do homework improves their performance. *Journal of Instructional Psychology*, *36* (3), 219-225. Retrieved from https://www.questia.com/library/p6137/journal-of-instructional-psychology/i2853375/vol-36-no-3-september

Richards-Babb, M., Drelick, J., Henry, Z., & Robertson-Honecker, J. (2011). Online homework, help or hindrance? What students think and how they perform. *Journal of College Science Teaching*, *40*(4), 81-93. Retrieved from https://www.nsta.org/college/

Ryan, C.S., & Hemmes, N.S. (2005). Effects of the contingency for homework submission on homework submission and quiz performance in a college course. *Journal of Applied Behavior Analysis*, *38* (1), 79-88. DOI: 10.1901/jaba.2005.123-03

On Class Discussions

Akcaoglu, M. & Lee, E. (2016). Increasing Social Presence in Online Learning through Small Group Discussions. *The International Review of Research in Open and Distributed Learning, 17*(3), 1-11.

Angera, J. & Latty, C. (2015). Structures and Technology Encouraging Discussion in Human Sexuality Courses: Strategies to Engage a Range of Students. *American Journal of Sexuality Education, 10*, 86–100.

Blings, S. & Maxey, S. (2017). Teaching Students to Engage with Evidence: An Evaluation of Structured Writing and Classroom Discussion Strategies, *Journal of Political Science Education*, 13:1, 15-32.

Bosman, L. & Fernhaber, S. (2019). Applying Authentic Learning through Cultivation of the Entrepreneurial Mindset in the Engineering Classroom. *Education Sciences*, v9 Article 7.

Brank, E. & Wylie, L. (August, 2013). Let's discuss: Teaching students about discussions. *Journal of the Scholarship of Teaching and Learning, 13*(3), 23- 32.

Breton, R., Doak, S., Foster, W., Lundström, D., McMaster, L., Miller, J., Rauch, U., Reid, M., Scott, W., Wang, T. & Wisenthal, J. (2005). Online Learning and Intellectual Liberty: A Mixed-Mode Experiment in the Humanities, *College Teaching*, 53:3, 102-109.

Bruss, K. (2009) Improving Classroom Discussion: A Rhetorical Approach. *The Journal of General Education, 58*(1), 28-46.

Cartolari, M., Carlino, P., & Colombo, L. M. (2013). Reading and Note Taking in Monological and Dialogical

Classes in the Social Sciences. *Australian Journal of Teacher Education*, 38(6).
Cline, K., Zullo, H., Duncan, J., Stewart, A. & Snipes, M. (2013). Creating discussions with classroom voting in linear algebra. *International Journal of Mathematical Education in Science and Technology, 44*(8), 1131-1142. DOI: 10.1080/0020739X.2012.742152
Darabi, A., Liang, X., Suryavanshi, R. & Yurekli, H. (2013). Effectiveness of Online Discussion Strategies: A Meta-Analysis. *American Journal of Distance Education, 27*(4), 228-241.
Duncan, L., Burkhardt, B., Benneyworth, L., Tasich, C. & Duncan, B. (Sep 2015). Getting the Most Out of Dual-Listed Courses: Involving Undergraduate Students in Discussion through Active Learning Techniques. *Journal of College Science Teaching, 45*(1), 24-31.
Ellis, R., Calvo, R. (Jan., 2006). Discontinuities in University Student Experiences of Learning through Discussion. *British Journal of Educational Technology, 37*(1), 55-68.
Finn, A. & Schrodt, P. (2016) Teacher discussion facilitation: a new measure and its associations with students' perceived understanding, interest, and engagement. *Communication Education, 65*(4), 445-462. DOI: 10.1080/03634523.2016.1202997
Francek, M. (Sept., 2006). Promoting Discussion in the Science Classroom Using Gallery Walks. *Journal of College Science Teaching, 36*(1), 27-31.
Freguia, S. (2017). Webcasts promote in-class active participation and learning in an engineering elective course, *European Journal of Engineering Education*. 42:5, 482-492.
Harton, H., Richardson, D., Barreras, R., Rockloff, M. & Latane, B. (2002). Focused Interactive Learning: A Tool for Active Class Discussion. *Teaching of Psychology, 29*(1), 10-15.
Johnson, C. (2016). Rethinking online discourse: Improving learning through discussions in the online classroom. *Educ Inf Technol 21*, 1483–1507. DOI 10.1007/s10639-015-9395-3
Khalid, A. (2013). Improving Student Interest in Engineering Curricula--Exciting Students about Their Classes. *Universal Journal of Educational Research*, v1 n1 p20-25.
Knight, J., Wise, S. & Southard, K. (Dec., 2013). Understanding Clicker Discussions: Student Reasoning and the Impact of Instructional Cues. *CBE - Life Sciences Education, 12*(4) 645-654.
Malkin, A., Rehfeldt, R. & Shayter, A. (Nov 15, 2016). An investigation of the efficacy of asynchronous discussion on students' performance in an online research method course. *Behavior Analysis in Practice*, 5pp.
Obenland, C., Kincaid, K. & Hutchinson, J. (2014). A General Chemistry Laboratory Course Designed for Student Discussion. *Journal of Chemical Education, 91*, 1446−1450.
Pence, L., Greene, E. & Pence, H. (March, 2010). Using a Google Jockey To Enhance Classroom Discussion. *Journal of Chemical Education, 87*(3), 254-255.
Rocca, K. (2010). Student Participation in the College Classroom: An Extended Multidisciplinary Literature Review. *Communication Education, 59*(2), 185-213.
Speer, N. & Wagner, J. (Nov., 2009). Knowledge Needed by a Teacher to Provide Analytic Scaffolding during Undergraduate Mathematics Classroom Discussions. *Journal for Research in Mathematics Education, 40*(5), 530-562.
To, J. & Carless, D. (2016) Making productive use of exemplars: Peer discussion and teacher guidance for positive transfer of strategies. *Journal of Further and Higher Education, 40*(6), 746-764. DOI: 10.1080/0309877X.2015.1014317
Tucker, S., R. (2018). Social Learning via Improved Daily Writing Assignments, Implementation of Study Groups, and Well-Structured Daily Class Discussions. *InSight: A Journal of Scholarly Teaching*, v13 p28-39 2018. 12 pp.
Westervelt, R. & Leonard, Z. (2011). Questioning = Thinking: Critical Curiosity as the Focus of an Interior Design Curriculum Redesign. *Design Principles and Practices: An International Journal, 5*(4), 35-40. Retrieved from http://www.Design-Journal.com, ISSN 1833-1874

On Interactivity in Class

Backer, D. I. (2017). The mass psychology of classroom discourse. Educational Theory, 67(1), 67-82.
Barbieri, F. (2015). Involvement in University Classroom Discourse: Register Variation and Interactivity. *Applied Linguistics, 36*(2), 151–173. https://doi.org/10.1093/applin/amt030
Blings, S., & Maxey, S. (2017). Teaching Students to Engage with Evidence: An Evaluation of Structured Writing and Classroom Discussion Strategies. *Journal of Political Science Education, 13*(1), 15–32. http://dx.doi.org/10.1080/15512169.2016.1168303.

Bolden III, E. C., Oestreich, T. M., Kenney, M. J., & Yuhnke Jr, B. T. (2017). Location, location, location: A comparison of student experience in a lecture hall to a small classroom using similar techniques. *Active Learning in Higher Education, 20*(2), 139-152. doi:10.1177/1469787417742018

Bruss, K. S. (2009). Improving Classroom Discussion: A Rhetorical Approach. *The Journal of General Education, 58*(1), 28-46.

Chen, O., Kalyuga, S. & Sweller, J. (2017). The Expertise Reversal Effect is a Variant of the More General Element Interactivity Effect. *Educational Psychology Review, 29*, 393-405. https://doi.org/10.1007/s10648-016-9359-1.

Dallimore, E. J., Hertenstein, J. H., Platt, M. B. (2006). Nonvoluntary class participation in graduate discussion courses: Effects of grading and cold calling. *Journal of Management Education, 30*(2), 354-377.

Gravett, E. O. (2018). Note-taking During Discussion: Using a Weekly Reflection Assignment to Motivate Students to Learn from Their Peers. *College Teaching, 66*(2), 75-83.

Hamann, K., Pollock, P. H., & Wilson, B. M. (2012). Assessing Student Perceptions of the Benefits of Discussions in Small-Group, Large-Class, and Online Learning Contexts. *College Teaching, 60*, 65-75. DOI: 10.1080/87567555.2011.633407Khalid, A. (2013). Improving Student Interest in Engineering Curricula--Exciting Students about Their Classes. *Universal Journal of Educational Research*, v1 n1 p20-25.

Nelson, M. A., And Others. (1971). *Discussion Paradigms*. Paper presented at annual meeting, AERA, NewYork

Roehling, P. V., Vander Kooi, T. L., Dykema, S., Quisenberry, B., & Vandlen, C. (2011). Engaging the Millennial Generation in Class Discussions. *College Teaching, 59*, 1–6. DOI: 10.1080/87567555.2010.484035

Schneider, G. (2010). Democratizing the Classroom: Sequencing Discussions and Assignments to Promote Student Ownership of the Course. *Review of Radical Political Economics, 42*(1), 101-107.

Tran, M. V., Weigel, E. G., & Ric, G. (2014). Analyzing Upper Level Undergraduate Knowledge of Evolutionary Processes: Can Class Discussions Help? *Research and Teaching, 43*(5), 87-97.

Windschitl, M. (1999). Using small-group discussions in science lectures. *College Teaching, 47*(1), 23-27.

On Note Taking

Aragón-Mendizábal, E., Delgado-Casas, C., Navarro-Guzmán, J. I., Menacho-Jiménez, I., & Romero-Oliva, M. F. (2016). A comparative study of handwriting and computer typing in note-taking by university students. *Comunicar, 24*(48), 101-107.

Blom, R. (2017). Guided note taking and student achievement in a media law course. *Journalism and Mass Communication Educator, 72*(4), 384–396.

Bonner, J. M., & Holliday, W. G. (2006). How college science students engage in notetaking strategies. *Journal of Research in Science Teaching, 43*(8), 786–818.

Cohn, E., Cohn, S., & Bradley, J., Jr. (1995). Notetaking, working memory, and learning in principles of economics. *Journal of Economic Education, 26*, 291–307.

Cornelius, T. L., & Owen-DeSchryver, J. (2008). Differential effects of full and partial notes on learning outcomes and attendance. *Teaching of Psychology, 35*(1), 6–12.

Crooks, S. M., White, D. R., & Barnard, L. (2007). Factors influencing the effectiveness of note taking on computer-based graphic organizers. *Journal of Educational Computing Research, 37*(4), 369–391.

Crooks, S. M., White, D. R., & Barnard, L. (2007). Factors influencing the effectiveness of note taking on computer-based graphic organizers. *Journal of Educational Computing Research, 37*(4), 369–391.

Hilton III, J., Sweat, A. R., & Plummer, K. (2015). Factors related to in-class spiritual experience: relationship between pre-class scripture reading, in-class notetaking, and perceived in-class spiritual experiences. *Journal of Research on Christian Education, 24*(3), 271–291.

Iannone, P., & Miller, D. (2019). Guided notes for university mathematics and their impact on students' notetaking behaviour. *Educational Studies in Mathematics, 101*(3), 387–404.

Igo, L. B., Kiewra, K. A., & Bruning, R. (2008). Individual differences and intervention flaws: a sequential explanatory study of college students' copy-and-paste note taking. *Journal of Mixed Methods Research, 2*(2), 149–168.

Jansen, R. S., Lakens, D., & IJsselsteijn, W. A. (2017). An integrative review of the cognitive costs and benefits of Notetaking. *Educational Research Review, 22,* 223–233.

Katayama, A. D., & Robinson, D. H. (2000). Getting students `partially' involved in notetaking using graphic organizers. *Journal of Experimental Education, 68*(2), 119.

Kiewra, K. A., DuBois, N. F., Christian, D., McShane, A., Meyerhoffer, M., & Roskelley, D. (1991). Note-taking

functions and techniques. *Journal of educational psychology, 83*(2), 240.
Kiewra, K. A., DuBois, N. F., Christian, D., McShane, A., Meyerhoffer, M., & Roskelley, D. (1991). Notetaking functions and techniques. *Journal of Educational Psychology, 83*(2), 240–245.
Kobayashi, K. (2005). What limits the encoding effect of notetaking? A meta-analytic examination. *Contemporary Educational Psychology*, *30*(2), 242–262.
Loughlin, C. (2018, November). The Impact of Lecture Recordings on HE Student Approaches to Learning. In *European Conference on e-Learning* (pp. 658-XVI). Academic Conferences International Limited.
Makany, T., Kemp, J., & Dror, I. E. (2009). Optimising the use of Notetaking as an external cognitive aid for increasing learning. *British Journal of Educational Technology, 40*(4), 619–635.
Morehead, K., Dunlosky, J., Rawson, K. A., Blasiman, R., & Hollis, R. B. (2019). Notetaking habits of 21st Century college students: implications for student learning, memory, and achievement. *Memory, 27*(6), 807–819.
Orndorff, H. N., III. (2015). Collaborative notetaking: the impact of cloud computing on classroom performance. *International Journal of Teaching and Learning in Higher Education, 27*(3), 340–351.
Peverly, S. T., Ramaswamy, V., & Brown, C. (2007). What predicts skill in lecture note taking? *Journal of Educational Psychology*, *99*(1), 167–180.
Piolat, A., Olive, T., & Kellogg, R. T. (2005). Cognitive effort during note taking. *Applied Cognitive Psychology, 19*(3), 291–312.
Reed, D. K., Rimel, H., & Hallett, A. (2016). Notetaking interventions for college students: A synthesis and meta-analysis of the literature. *Journal of Research on Educational Effectiveness, 9*(3), 307–333.
Ruffini, M. F. (1999). The impact of undergraduate preservice teachers' use of hypermedia to review lecture notes. *Journal of Research on Computing in Education, 31*(3), 292–304.
Stefanou, C., Hoffman, L., & Vielee, N. (2008). Note-taking in the college classroom as evidence of generative learning. *Learning Environments Research*, *11*(1), 1-17.
Thompson, K. N. ., & Lee, D. (1991). Developing effective notetaking guides for use in mass lecture sections. *Journal of Marketing Education, 13*(3), 40.
Waite, B. M., Lindberg, R., Ernst, B., Bowman, L. L., & Levine, L. E. (2018). Off-task multitasking, notetaking and lower- and higher-order classroom learning. *Computers & Education, 120*, 98–111.
Williams, R. L., & Eggert, A. C. (2002). Notetaking in college classes: student patterns and instructional strategies. *The Journal of General Education, 51*(3), 173–199.
Witherby, A. E., & Tauber, S. K. (2019). The current status of students' notetaking: why and how do students take notes? *Journal of Applied Research in Memory and Cognition, 8*(2), 139–153.

On Plagiarism and Academic Integrity

Babaii, E., & Nejadghanbar, H. (2017). Plagiarism among Iranian graduate students of language studies: perspectives and causes. *Ethics & behavior, 27*(3), 240-258.
Chen, Y., & Chou, C. (2017). Are we on the same page? College students' and faculty's perception of student plagiarism in Taiwan. *Ethics & Behavior, 27*(1), 53-73.
Flowerdew, J., & Li, Y. (2007). Plagiarism and second language writing in an electronic age. *Annual Review of Applied Linguistics, 27*, 161-183.
Ison, D. C. (2015). The influence of the Internet on plagiarism among doctoral dissertations: An empirical study. J*ournal of Academic Ethics, 13*(2), 151-166.
Gullifer, J. M., & Tyson, G. A. (2014). Who has read the policy on plagiarism? Unpacking students' understanding of plagiarism. *Studies in Higher Education, 39*(7), 1202-1218.
Jensen, L. B., Kyvik, K. O., Leth-Larsen, R., & Eriksen, M. B. (2018). Research integrity among PhD students within clinical research at the University of Southern Denmark. *Danish medical journal, 65*(4).
Jones, I. 2009. Cyber plagiarism: Different method – same song. J*ournal of Legal, Ethical and Regulatory Issues, 12*(1), 89–100.
Lancaster, T., & Culwin. F. (2007). Preserving academic integrity - fighting against non-originality agencies. *British Journal of Educational Technology. 38 (*1),153–157.
Lessig, L. (2004). *Free culture: How big media uses technology and the law to lock down culture and control creativity*. New York: The Penguin Press.
Jones, M., & Sheridan, L. (2015). Back translation: an emerging sophisticated cyber strategy to subvert advances in 'digital age' plagiarism detection and prevention. *Assessment & Evaluation in Higher Education, 40*(5), 712-724.

Khan, B. A. (2011). Plagiarism: An academic theft. *International journal of pharmaceutical investigation,* 1(4), 255.
Levine, J., & Pazdernik, V. (2018). Evaluation of a four-prong anti-plagiarism program and the incidence of plagiarism: a five-year retrospective study. *Assessment & Evaluation in Higher Education,* 1-12.
Michalak, R., Rysavy, M., Hunt, K., Smith, B., & Worden, J. (2018). Faculty Perceptions of Plagiarism: Insight for Librarians' Information Literacy Programs. *College & Research Libraries, 79*(6), 747.
Naik, R. R., Landge, M. B., & Mahender, C. N. (2015). A review on plagiarism detection tools. *International Journal of Computer Applications*, *125*(11).
ORI (1994). ORI's working definition of plagiarism. *ORI Newsletter*, 3(1).
Preciado Babb, A. P., Yeworiew, L., & Sabbaghan, S. (Eds.) (2017). *Selected Proceedings of the IDEAS Conference 2017: Leading Educational Change.* Calgary, Canada: Werklund School of Education, University of Calgary.
Sánchez-Vega, F., Villatoro-Tello, E., Montes-y-Gómez, M., Rosso, P., Stamatatos, E., & Villaseñor-Pineda, L. (2017). Paraphrase plagiarism identification with character-level features. *Pattern Analysis and Applications*, 1-13.
Singh, S., & Remenyi, D. (2016). Plagiarism and ghostwriting: The rise in academic misconduct. *South African Journal of Science, 112*(5-6), 1-7.
Sutherland-Smith, W. (2014). Legality, quality assurance and learning: Competing discourses of plagiarism management in higher education. *Journal of Higher Education Policy and Management, 36*(1), 29-42.
Tripathi, R., Tiwari, P., & Nithyanandam, K. (2015, January). Avoiding plagiarism in research through free online plagiarism tools. In *Emerging Trends and Technologies in Libraries and Information Services (ETTLIS), 2015 4th International Symposium* on (pp. 275-280). IEEE.
Vani, K., & Gupta, D. (2017). Detection of idea plagiarism using syntax–semantic concept extractions with genetic algorithm. *Expert Systems with Applications, 73*, 11-26.
Walker, C., & White, M. (2014). Police, design, plan and manage: developing a framework for integrating staff roles and institutional policies into a plagiarism prevention strategy. *Journal of Higher Education Policy and Management, 36*(6), 674-687.
Weber-Wulff, D., Möller, C., Touras, J., & Zincke, E. (2013). Plagiarism detection software test 2013. *Abgerufen am, 12,* 2014.
Wolverton, B. (2016). The new cheating economy. *Chronicle of Higher Education, 63* (1).

Acknowledgement:

This project was funded by Québec's ministère de l'Éducation et de l'Enseignement supérieur, through contributions from the Canada- Québec Agreement on Minority-Language Education and Second-Language Instruction.

Practitioner Reflections

Small Data: A humble inquiry into online learning behaviour of students through LMS logs

Eric Francoeur, École de technologie supérieure, eric.francoeur@etsmtl.ca

Beyond defining the course content itself, the creation of an online course (for blended learning or distance education) requires a multitude of implicit and explicit design decisions. These seek, among other things, to foster engagement on the part of the student, i.e. elicit a degree of attention, interest and effort in the learning process.Whether these choices actually work can be difficult to tell, creating uncertainty in if and how the course can be improved (at least as far as engagement is concerned). We propose here that LMS logs, which record student activities during the learning process, can help characterize the their online learning behaviour, which in turn help create insights in their actual engagement. Using the example of a blended learning course, we will show how patterns of behaviour can be identified through the log data and how these suggest potential improvements in the online course design.

From high-impact extra-curricular activity to the classroom: Challenges

Hélène Nadeau, Dawson College, hnadeau@dawsoncollege.qc.ca
Sylvia Cox, McGill University and Dawson College, sylvia.cox@mcgill.ca

We have conducted a very successful summer internship program in research in neuroscience over the past several years. This high-impact activity clearly engaged the learners. But as we are adapting this model to the classroom, we are faced with new challenges. Students who volunteer to participate in a high-impact extra-curricular activity are usually strongly motivated by the activity itself. Those who register for an option course may be genuinely interested by the course or may take it simply because it fits their schedule. This variety in intrinsic motivation and commitment among students will offer a challenge when applying a student-centered teaching approach that is based on participation in oral presentations, group discussions and team work. In this talk, we will discuss strategies to enhance engagement and participation of all students from the beginning, and to keep them on board throughout the course.

The first point to keep in mind is that the students will be willing to try something different as long as they have a clear view of what is expected of them and how they will be graded. Students will be warned that research involves solving unexpected problems and thus is not entirely predictable. Still, the outcomes they should deliver in the course of their project will be well-determined from the beginning: clear hypotheses supported by peer-reviewed literature, a proposal for ethics approval, a detailed description of the methods used, raw and anonymized data collection, data analyses, reflection on the results.

Second, involvement should start from the first class with meaningful and manageable tasks. Each student should be an active participant with responsibility toward the team and the class as a whole. Deliverables may be produced during or outside the classroom, individually or in teams, but should eventually be shared with the larger group. Emphasis should be put on collaborating with people of different backgrounds, and each student should have a specific role to play in the team.

Engagement should be maintained throughout the semester, so regular feedback is a must and spreading the evaluations over the term will help keep a good pace for the course and verify that all students are on board.

Third, the course aims to develop communication skills, critical thinking, self-efficiency, and ethical considerations while going through all the phases of an authentic research project. How to achieve all of this in the limited time allocation? It is important to have a very clear plan for the course with activities designed to develop the targeted skills. Expectations should be kept reasonable.

Finally, while no credit is given for the extra-curricular activity, a structured evaluation has to be designed for the course. Evaluating skills presents its own challenges. We suggest using strategies that combine self-, peer- and teacher-evaluation, based on simple and transparent grading rubrics. Evaluation criteria may focus on clarity and relevance at the beginning, and evolve towards a deeper understanding of the concepts at the end.

We would love to pursue the conversation with other teachers who developed strategies for similar situations.

Acknowledgements:

We thank the winter 2020 Learning Communities for their valuable support during the development of the course and Dawson College for believing in innovative teaching strategies.

A quantitative analysis of career path of PhD graduates from Canadian universities

Shanmugavalli Narayanan, McGill, shanmugavalli.narayanan@mail.mcgill.ca

This project aims to understand the career path of Canada-based PhD graduates in the humanities, social sciences, and fine arts. This project (TRaCE 2.0) expanded on the TRaCE pilot project by tracking 1,818 PhD graduates in the humanities, social sciences, and fine arts (also MFA graduates) from eight Canadian universities. The participating universities were: Carleton University, Concordia University, McGill University, Queen's University University of Guelph, University of Toronto, University of Waterloo and York University. Each participating university determined that a certain number of departments would take part in the study. Participating universities provided the TRaCE office with lists of PhD graduates—graduating cohorts from 2007 to 2017. These lists included graduates' names, year of graduation, and dissertation titles. Supplementary data was added to this list by the project's graduate student researchers, who used the basic lists supplied by the respective departments to search the Web and public electronic employment/professional sites (e.g., LinkedIn, academia.edu) and gather data on graduates' current occupation and geographic location. Student researchers were provided with a data collection template to facilitate and streamline data retrieval. Data analysis was undertaken at the TRaCE office. We assessed demographic characteristics of the dataset and conducted a series of basic descriptive analyses to explore associations between discipline/department, graduation year, gender, occupation, and location of employment. The TRaCE office was responsible for merging the institutional datasets, conducting the analyses, and presenting the findings. Our quantitative findings suggest that most go on to work in higher education while a minority find work in other, non-academic sectors.

Acknowledgment:

Trace McGill

Teaching the Social Considerations of Materials Engineering Through Podcasts

Michael Wood, McGill University, michael.wood3@mail.mcgill.ca
Anne-Marie Kietzig, McGill University, anne.kietzig@mcgill.ca
Maria Orjuela-Laverde, McGill University, maria.orjuela-laverde@mcgill.ca

Teaching in an accredited engineering program means that it's difficult to add new material beyond the mandated technical. Nonetheless, the social considerations of engineering are tremendously important concepts which warrant classroom discussion. A course revamp of CHEE 484 – Materials Engineering at McGill University allowed us to introduce some of these concepts by tasking students to record podcasts. The assigned subjects ranged from "Cradle-to-Cradle Design" to a "Waste-Free Lifestyle Self-Test", with an emphasis on how the topic relates to materials engineering professional practice.

Student groups were given personalized handouts listing the deliverables expected alongside 2-3 references to get them oriented with their research. Topics were left open-ended to encourage exploration and critical thinking by the students. Podcasts were recorded using software and style of their choosing. Submitted podcasts were shared with the entire class for personal listening, allowing for effective peer-teaching. Finally, tutorial time was devoted to classroom-based activities on the submitted recordings, allowing information recalling and a guided compare/contrast of the topics.

Overall the submitted podcasts were of high quality. The recordings offered these students a chance to explore their creative sides, with the fun some of the teams had being extremely evident in their submission. The open-ended nature of the assignment resulted in a variety of show styles being implemented; some groups acted as specific famous people, debated, hosted a relaxed conversation, or shared personal experiences. All the while the main goal of the assignment was well achieved with students debating the role of materials engineers in important issues. The recall exercises allowed a bigger view to be taken of the professional practice of materials engineering. The students were encouraged to bring together the concepts raised in the individual podcasts into larger ideas about engineering ethics.

An anonymous survey allowed us to gather feedback from the students on their views of the podcast assignment. When asked overall if they considered the social considerations podcasts a useful addition to the course's scope, nearly 70% of the class responded "Yes". Further, 75% of the students answered that they enjoyed the podcast format for the submission. Nonetheless, this project can no doubt be improved in future iterations by addressing some of the negative feedback received from the students. Specifically, students brought up the fact that a few of the podcasts were difficult to understand due to poor recording quality or because of the use of never before heard terms-of-art. Both issues could potentially be resolved by asking for a transcript to be submitted alongside the audio file.

In sum, we consider the project a success in terms of having introduced the students to some of the social considerations of materials engineering. The novel podcast medium we asked the students to work in will hopefully have made this assignment (and the topics discussed therein) have a lasting impact as they progress through their degrees and into industry. The success of this project in our own class leads us to believe that podcasts could be used to peer-teach concepts in a wide variety of classrooms.

The Future of STEM Education

Armin Yazdani, McGill University, Armin.yazdani@mcgill.ca
Brule Veronique, McGill University, veronique.brule@mcgill.ca
Anita Parmar, McGill University, anita.parmar@mcgill.ca
Joel Trudeau, Dawson College, Iris Guo, McGill UniversityRobert Cassidy, Concordia University

Student enrollment in STEM (Science, Technology, Engineering, Math) programs continues to increase. It is becoming evident that the traditional STEM educational models are no longer sufficient to meet the pace, complexity, and unpredictability of the changes the world is facing. The problems facing future STEM students such as climate change require novel, multi-disciplinary, and often unconventional approaches. Post-secondary institutions from across the globe are experimenting with various technological and philosophical models to better prepare STEM students for this rapid evolution. Identification of best practices are crucial to guide post-secondary institutions into integrating evidence-based change. To understand how STEM education is evolving, we will do a brief presentation to demonstrate how STEM focused teaching and learning units in North America are diverting their resources. Specifically, the presentation will identify (1) key areas of focus common to multiple institutions that are emerging and (2) briefly describe a few novel experiments that are unique to one or a few institutions that may potentially change the future of the STEM teaching and learning landscape. Following this initial presentation, five panelists from McGill University, Dawson College, and Concordia University will discuss (1) key skills and attitudes that students in STEM may need to adapt to a rapid pace of change (2) examples of inspirational change that is occurring in post-secondary institutions from across the globe and Canada to cultivate these skills and attitudes, and (3) initiatives that our respective institutions have developed or are developing to better prepare students in STEM. Following these rounds of discussion, the symposium will be open to the audience for questions and general discussion.

Kahoot une application ludique au service de la pédagogie, boosteur dénergie positive

Fethi Boutelaa, Ecole polytechnique de Tours

Problématique pédagogique: les élèves avaient des difficultés à consolider leurs connaissances, et vivaient les évaluations formatives classiques comme une contrainte. Ils ne se prêtaient pas au jeu et souvent ce sont les mêmes élèves qui participaient. Ainsi, les copies d'examen révélaient souvent des lacunes ou une maîtrise approximative du vocabulaire et des notions mobilisées par le sujet.

Il faut donc renforcer la maîtrise des notions propres à la discipline, pour mieux préparer les élèves à l'examen final.

Par ailleurs, l'évaluation est encore trop souvent vécue par les élèves comme un moment solennel, définitif (pas ou peu de possibilités de « deuxième chance »). Ceci peut induire une vision faussée de l'évaluation et dans certains cas extrêmes favoriser des stratégies de contournement voire de fuite (absences aux devoirs).

Il est donc nécessaire de changer la perception de l'évaluation et de lui redonner sa véritable place : celle d'une étape « naturelle » dans le processus d'apprentissage.

Mais aussi, il convient d'éviter le découragement des élèves qui fournissent des efforts mais qui, pour des raisons diverses (lacunes anciennes, troubles de l'apprentissage...), ne réussissent pas à produire des copies satisfaisantes. Ces élèves sont particulièrement sensibles à la reconnaissance des efforts fournis au travers de l'obtention d'une « bonne » note.

C'est pourquoi il a fallu innover en leur proposant un outil qui va changer leur regard sur l'évaluation et être source d'émulation. Dont l'objectif est de susciter leur engagement et de les évaluer différemment.

La classe l’ère du numérique : impacts sur les apprentissages

Fethi Boutelaa, Ecole polytechnique de Tours

Le numérique : de quoi parle-t-on? Quels sont les impacts de l’utilisation du numérique sur les apprentissages? Face un manque de motivation de certains étudiants et l’hétérogénéité de niveaux, nous avons été amenés travailler différemment en utilisant des outils numériques tels que edmodo, kahoot, wooclap, genially, padlet et Edpuzzle. Outre le travail important de l’enseignant pour la phase de préparation, le parcours de la classe numérique a été une expérience enrichissante et les étudiants semblent progresser. l’issue de l’année, nous avons constaté une meilleure communication avec les étudiants, une individualisation de la formation, de meilleurs résultats lors des évaluations, des étudiants ayant une plus grande confiance en eux, un accroissement de la motivation ainsi qu’un engagement plus important dans la réalisation des tâches. l’aide d’un sondage, nous sommes en mesure de constater que 76 percent des étudiants sont satisfaits de ce type d’apprentissage. Ils soulèvent les avantages de pouvoir consulter le cours en tout temps, de travailler leur rythme et de collaborer plus facilement en groupe. Les étudiants interrogés mentionnent toutefois que cette approche demande une autodiscipline plus importante et une plus grande charge de travail personnel. Ils critiquent également le fait que le cours est essentiellement en mode asynchrone.