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Factors Influencing Identity and Belonging Among Second-Year Science Students

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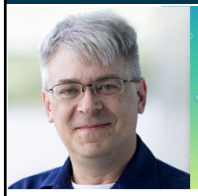
Acknowledgements

Emily Taylor, BSc

- UBC Okanagan
  - Department of Chemistry
  - Centre for Teaching & Learning Teaching Fellows Award
- second-year science students of UBC Okanagan

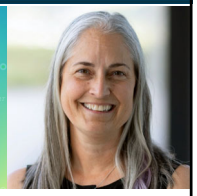
artwork: Jacky Deng

Long-term project at UBC Okanagan: improve first-year chemistry!



Stephen McNeil

artwork: Jacky Deng



Tamara Freeman

curriculum: explicit cognitive and affective learning objectives
context-embedded, relevance of chemistry to society
pedagogy: active learning and peer-interaction throughout
outcomes: positive student views toward societal impacts of chemistry
dramatic improvement in student completion rates
STLHE D2L Innovation Award in Teaching and Learning

Emily had some questions: here's what we know...

Emily Taylor, BSc

- Active learning practices can promote stronger senses of identity and belonging.[1]
- Senses of disciplinary identity and belonging are linked with increased performance and retention in STEM.[2]
- Such effects disproportionately impact underrepresented and marginalized students.[3],[4]

[1] Wieman, C., et al. *CBE—Life Sci. Educ.* **2017**, *16*, ar56.
[2] Frey, R. F., et al. *Chem. Educ. Res. Pract.* **2023**, *24*, 327–352.
[3] Frey, R. F., et al. *J. Chem. Educ.* **2022**, *99*, 71–82.
[4] Frey, R. F., et al. *Chem. Educ. Res. Pract.* **2020**, *21*, 1042–1062.

active learning → **cognitive and affective engagement** → **identity and belonging** → **persistence in STEM**

Emily had some questions: …so here's what we're wondering

Emily Taylor, BSc

1) To what extent do learning activities in first-year science courses influence students' choice of major?
2) What are chemical and life science student perspectives of the frequency and learning impacts of active learning experiences in their first- and second-year courses?
3) Do senses of belonging and identity with a disciplinary program change during the second year of study?
4) Do senses of belonging and identity within a disciplinary program differ by gender or linguistic background?

active learning → **cognitive and affective engagement** → **identity and belonging** → **persistence in STEM**

Instruments and Methods

Study Cohort: ~350 students in second year of BIOL BIOC CHEM ENCH programs (~2:1 W:M gender ratio, ~20% international students)

Study Participants: UBC Okanagan students in second-year organic chemistry (required courses for BIOL BIOC CHEM ENCH majors), incentivized with random draw gift cards.

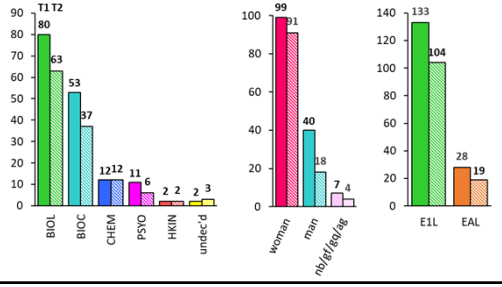
Research Survey: 3 active learning activity questions, 17 six-point Likert-scale identity and belonging prompts, demographic prompts, χ^2 test to measure differences across samples.

Semi-Structured Interviews: convenience sample of survey participants (N = 8) transcripts subjected to inductive coding via iterative two-coder process to generate reliable coding scheme, thematic analysis.

Fink, A.; Young, J. D.; Vuppala, N. K.; Frey, R. F. *Chem. Educ. Res. Pract.* **2023**, *24*, 327–352.
Hosbein, K. N.; Barbera, J. *Chem. Educ. Res. Pract.* **2020**, *21*, 852–877.

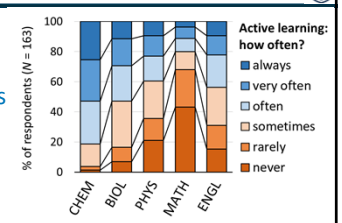
Study Participants

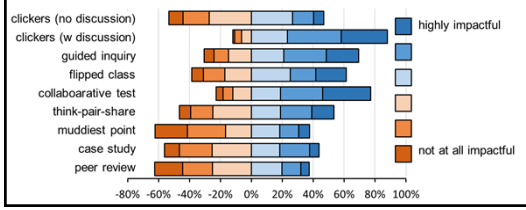
- W2023 and W2024, T1 (Sep) (N = 161) and T2 (Feb/Mar) (N = 123)
- > 80% BIOC and BIOL
- T1 2.5:1 women:men, T2 5:1 (~4% nb, other gender identities)
- 5:1 English first language (E1L) : English additional language (EAL)

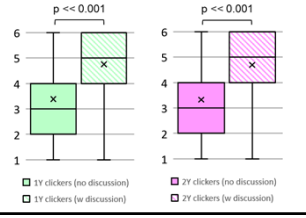


Active Learning Perceptions

- in 1Y courses, active learning most common in CHEM/BIOL, least in MATH
- clickers with discussion and collaborative exams regarded as most impactful
- clickers with peer discussion ***much*** more impactful than without



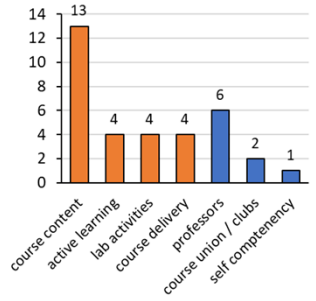




Survey open prompt: 1Y curriculum influences on choice of major

W2023T1 (*N* = 87): "Consider the activities, material, and topics you saw in all your first-year courses. Is there anything that significantly influenced your decision about your choice of major? If so, describe it one or two sentences."

- 37: no response
- 20: response indicating no impact (e.g. "n/a" "none" or citing interest before beginning university)
- < ½ respondents thought aspects of first-year courses influences their choice of major, most to do with course content or the professor



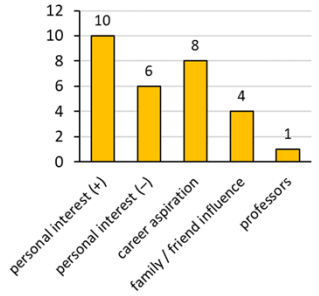
Interviews: influences on choice of major

W2023T1 (*N* = 8):
"What has influenced your choice of major?"

- presence and/or absence of personal interest in subject matter, and career aspirations, cited by all interview participants
- these factors established before university (but perhaps refined in first-year courses)

"What particular learning activities or topics in your first-year courses influenced your choice of program?"

- no specific activities or topics from first-year courses described as influencing this decision (even upon request for elaboration)



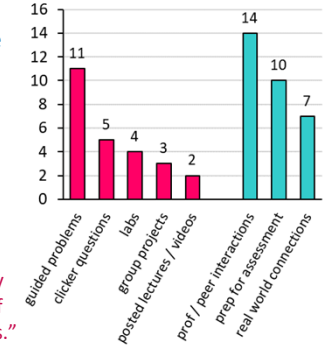
Interviews: active learning impacts

W2023T1 (*N* = 8): "What specific learning activities or topics in your first-year courses do you feel were especially impactful for your learning?" "Why were those activities impactful?"

- guided in-class problems, clicker questions, laboratories most commonly described
- opportunities for peer and professor interaction, self-assessment, and application of concepts to real-world contexts or lab activities

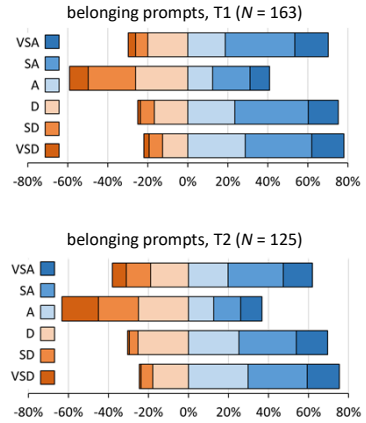
"If … I have no idea how to answer a question then my friend might know, and it's helpful to bounce ideas off each other … You can hear all the different perspectives."

"[It] was super, super helpful because it gave us an opportunity to kind of get into [the professor's] mind."



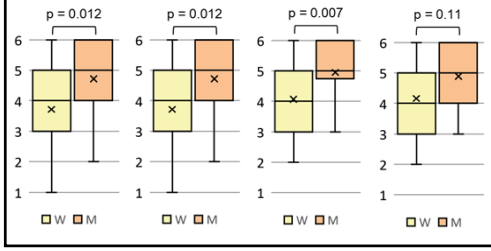
Sense of Belonging: aggregate

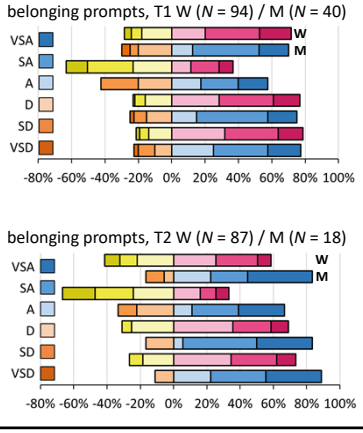
- generally high sense of belonging at start of T1
- sense of belonging persists across second year
- lower scores on Q7 prompt: "When I don't perform well, I feel like maybe I don't belong in my chosen program" (reverse scored).



Sense of Belonging: gender

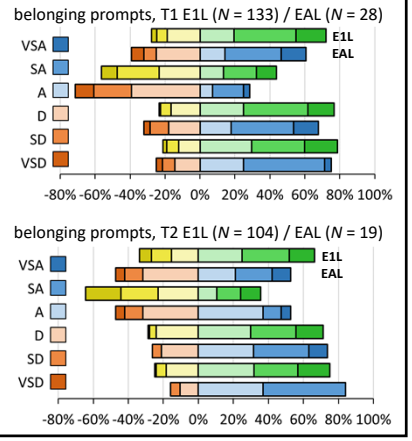
- lower Q7 score driven by W
- comparing T1 to T2, all belonging scores W↓ and M↑
- T2 shows (near) significant gender differences on all four belonging prompts





Sense of Belonging: language

- no significant differences comparing E1L to EAL cohorts
- no significant changes T1 vs T2

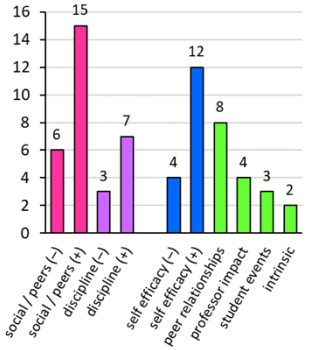


Interviews: belonging

W2023T1 (*N* = 8): "Do you feel like you belong in your degree program? Have you ever felt out of place in your program? Have these feelings changed with time?"

- 3 of 8: no change; 5 of 8: positive change (counter to survey data)
- themes of ***social*** belonging more common that ***disciplinary*** belonging
- themes of self-efficacy and peer interactions most commonly cited as drivers of belonging changes

"You really want to go to your classes if your friends are encouraging you and making you feel like, you know, you're all in this together."



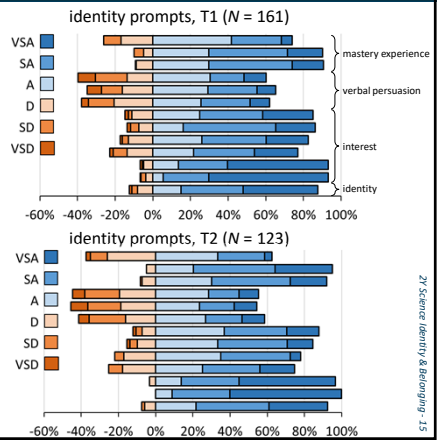
Sense of Identity: aggregate

- generally very high sense of identity, which persists across second year
- Highest T2 means in value interest and overall identity prompts:

"I see myself as a [science] person": 4.93

"Discoveries in my discipline have a positive impact": 5.32

"Science will be a part of my future": 5.51



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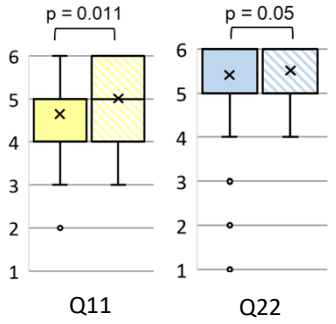
  "I see myself as a [science] person": 4.93

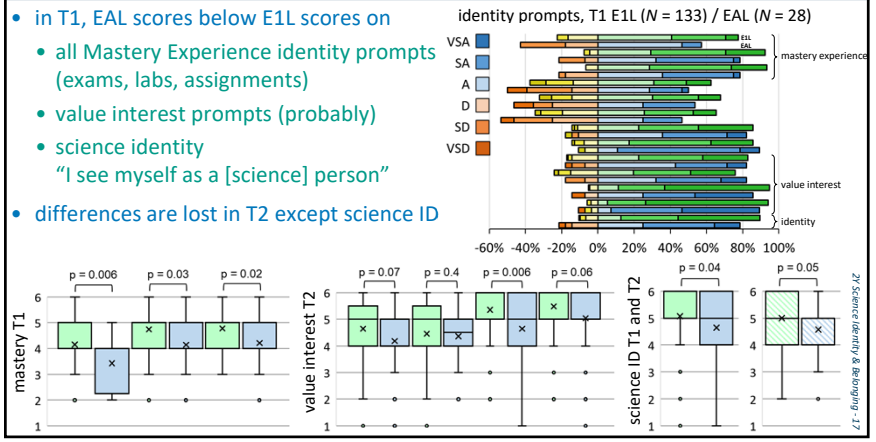
  "Discoveries in my discipline have a positive impact": 5.32

  "Science will be a part of my future": 5.51
- ↑Q11: "I do well in labs" and ↑Q22: "Science will be a part of my future" (100% agreement in T2)
- no significant gender differences



Sense of Identity: language

- in T1, EAL scores below E1L scores on
  - all Mastery Experience identity prompts (exams, labs, assignments)
  - value interest prompts (probably)
  - science identity "I see myself as a [science] person"
- differences are lost in T2 except science ID



Answers to our questions

1) To what extent do learning activities in first-year science courses influence students' choice of major?

   They don't! Career aspirations and personal interest are key factors, which form primarily before first-year.

2) What are chemical and life science student perspectives of the frequency and learning impacts of active learning experiences in 1st- and 2nd-year courses?

   Highest frequency: first-year CHEM & BIOL. Lowest: MATH. Most effective: activities with peer interaction, self-assessment, real-world connection.

Answers to our questions

3) Do senses of belonging and identity with a disciplinary program change during the second year of study?

   ID and Disciplinary: Not much! They start very high and are maintained. But! Social belonging: maybe? Improved peer interactions drive sentiments of social belonging and self-efficacy.

4) Do senses of belonging and identity within a disciplinary program differ by gender or linguistic background?

   Gender differences in sense of belonging emerge during second year. EAL learners begin second year with lower sense of identity across multiple factors, but these differences appear to (mostly) disappear during second year.

Summary Conclusions

- Curriculum and active-learning pedagogies strongly impact learning and engagement, but not students' choice of major.
- Gender: Women's sense of disciplinary belonging is more negatively impacted by poor academic performance, and falls below men's overall during second year.
- Language: EAL learners report lower senses of disciplinary identity at beginning of second year, but this gap appears to close.
- It's not (just) the course content, *it's the people in the courses.*

Ensure your active learning activities offer regular opportunity for peer discussion and interaction!