

CAN WE ENSURE THAT EVERY STUDENT THRIVES IN TEAMWORK?



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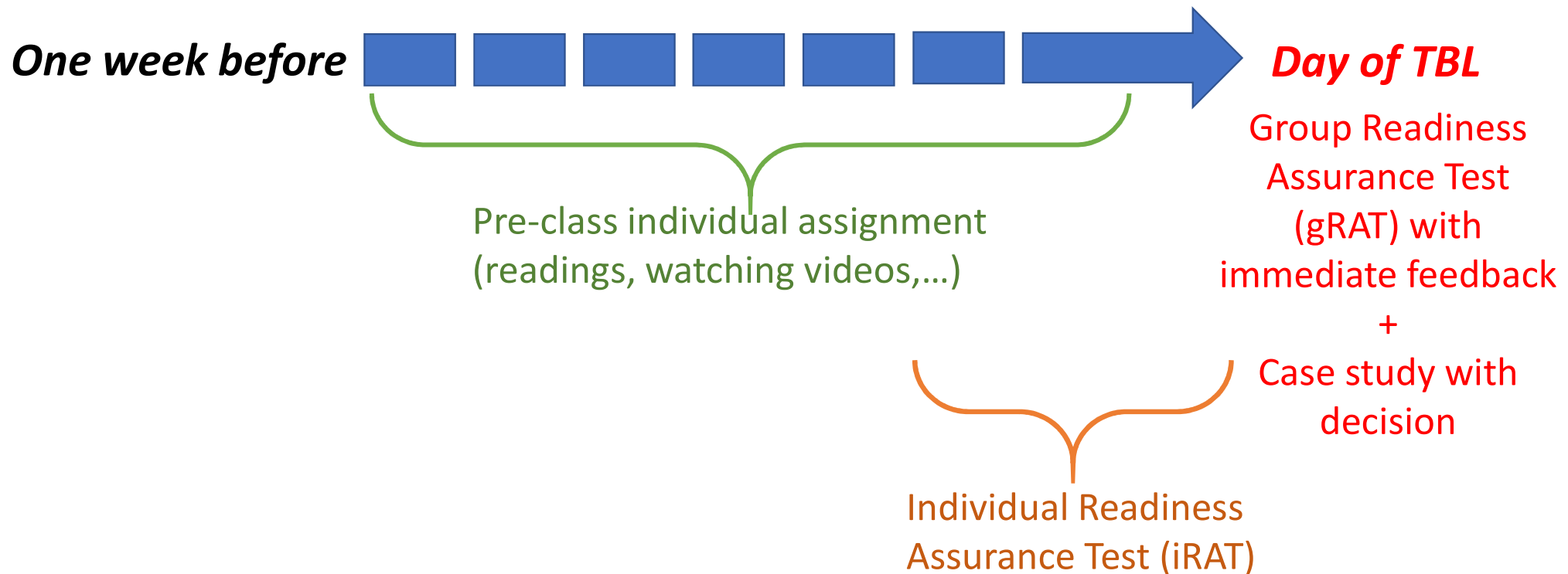
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UBC Ethics #: H22-01931

Team-Based Learning¹ (TBL)

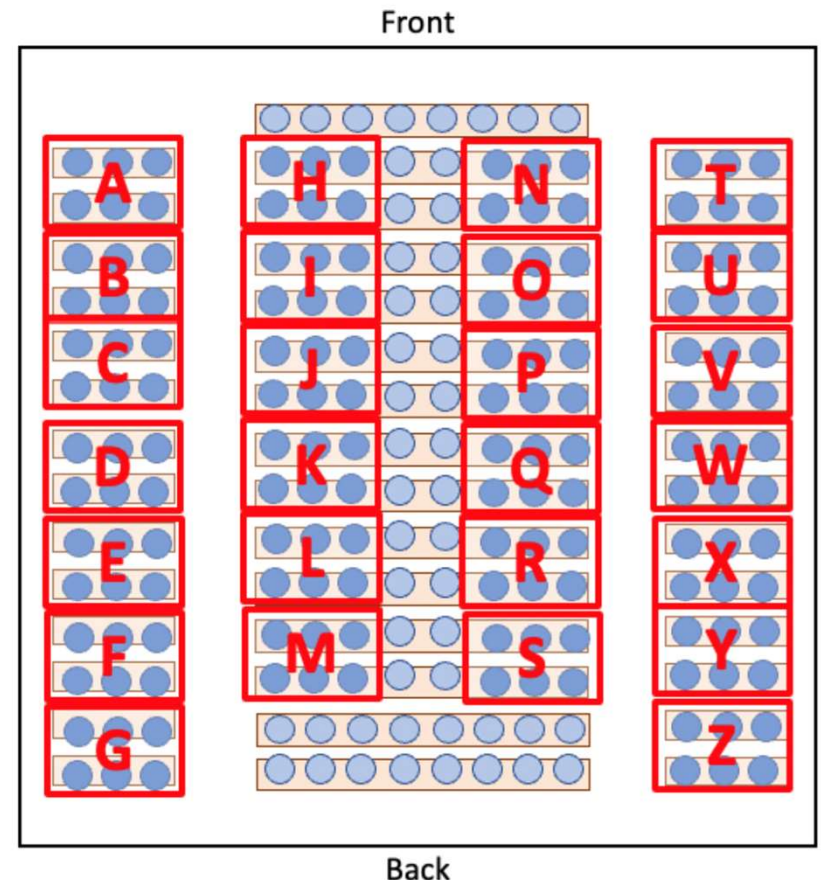


¹ Team-Based Learning : *A Transformative Use of Small Groups in College Teaching*
Edited by [Larry K. Michaelsen](#), [Arletta Bauman Knight](#) and [L. Dee Fink](#) 2004

Team-structure

- 4-6 students per group
- Instructor-assigned, mixing academic level and background
- Same teams all term
- For large classes, assigned seating in lecture hall by team letter or number (Lekhi and Varao-Sousa 2023)

TBL Seating Plan EOSC 474 Room LSK 101



Example of Case Study and Decision

<p>Case Study</p>	<p>In 2014, the people of Flint Michigan began noticing strange health scares such as hair thinning, growth and speech problems in children, and users of household swimming pools developing “scabies-like” rashes. This was followed by another strange scare: yellow and brown water coming out of the faucet. The city’s water was heavily contaminated by lead, which studies have linked to chronic and irreversible health problems, especially for children, including learning disabilities, intellectual disabilities, stunted growth, seizures and even death. Cities no longer install lead pipes. But older cities such as Flint still rely on both lead and iron pipes.</p> <p>Flint made the switch to getting its water from the Flint River back in April 2014, as a money-saving exercise. Previously it got its water from Detroit. Water from the Flint River contains relatively high levels of dissolved chloride ions (about 8 times more than the Detroit water) which makes the water more corrosive. Dissolved ions increases water’s ability to carry a current and speeds up the corrosion process. Chloride ions in water can break the protective oxide layer that forms on the surface of some metals, making the metal more susceptible to corrosion. More corrosive water leads to leaching of metals such as iron and lead from water pipes. In the August following the switch, E. coli was found in the water. In January 2015, officials in Flint announced that the water had high levels of organic molecules called trihalomethanes (THM).</p> <p>The following actions all contributed to the levels of chloride in Flint River:</p> <ul style="list-style-type: none"> • De-icing the road. The high chloride levels are largely due to road salt which runs into the river. • Extra Cl₂ was added as a disinfectant to remove e-coli. • Ferric chloride, FeCl₃, acts a coagulant, allowing for the removal of trihalomethanes. • Dissolved Fe²⁺ from corroded iron pipes reacts with Cl₂ to form Cl⁻: $2 \text{Fe}^{2+} + \text{Cl}_2 \rightleftharpoons 2 \text{Fe}^{3+} + 2 \text{Cl}^-$
<p>Decision Task (multiple choice question)</p>	<p>Which of the following actions could have prevented lead contamination?</p> <ol style="list-style-type: none"> A. Cities should stop relying on salt to de-ice roads and use alternatives such as potato juice (used mountain roads of Tennessee) or build roads using special concrete that would prevent ice from forming in the first place. B. Cl₂ should not have been used as a disinfectant. There are alternatives such as ozone. C. Instead of adding FeCl₃, an alternative coagulant should have been used. D. Orthophosphates should have been added.
<p>Questions</p>	<ol style="list-style-type: none"> 1. Provide a rationale for your decision 2. ... 3.

Motivation

Anka has been teaching using team-based learning in Environmental Chemistry course

Benefits of TBL has been highlighted by quantitative research:

- TBL significantly improves students' engagement, team-building skills, critical thinking and ultimately contextualized understanding of concepts (Michaelsen and Sweet 2008, Swanson et al. 2019).
- Students involved in TBL activities often obtain better grades (Lekhi and Varao-Sousa 2023).

TBL works for the majority of students... but does TBL work for students who may face barriers to participate in teams?

Examples of barriers?

- **Personal, Cultural, and Ethnic backgrounds:**

Students who feel pressure to conceal certain aspects of their **identity, such as sexual orientation, political affiliation, or religion** have negative experiences of group work (Henning et al., 2019)

Students from a **historically marginalized racial and ethnic group**, worry how others might perceive them if they ask questions (Nardo, 2022).

- **Socioeconomic background:**

It has been shown that the **socio-economical background** leads to differences in the way children ask for help during independent learning, favouring middle- to upper-class children (McCrorry, 2011)

- **Neurodivergence and mental illness(es):**

Neurodiverse students and **students struggling with their mental health** (anxiety, mood disorders...) are likely to feel uncomfortable or to withdraw from group activity depending on the severity of their symptoms or on their thinking style (Anderson 2017, Pardon 2006, Belch 2011, Pascoe 2020).

Our Research Questions

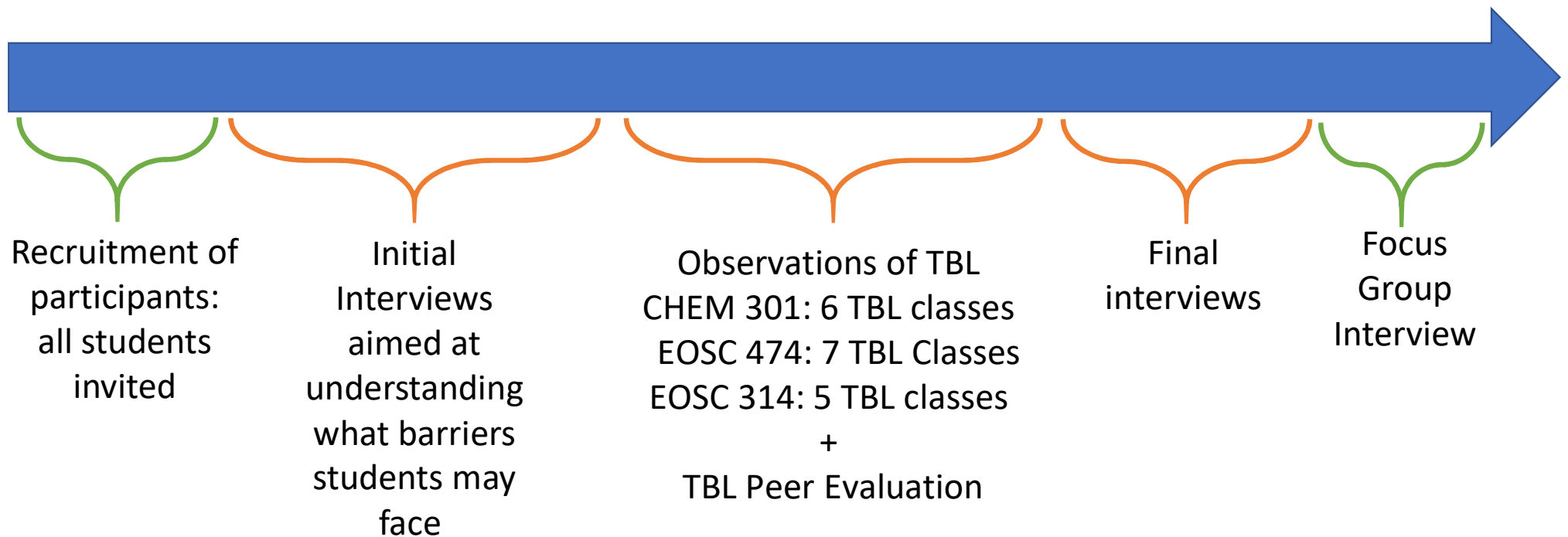
In what ways is team work inclusive in TBL?

In what ways can TBL improve for students who may experience barriers?

Methods: 3 Courses and $N = 15$ Participants (3 Teams)

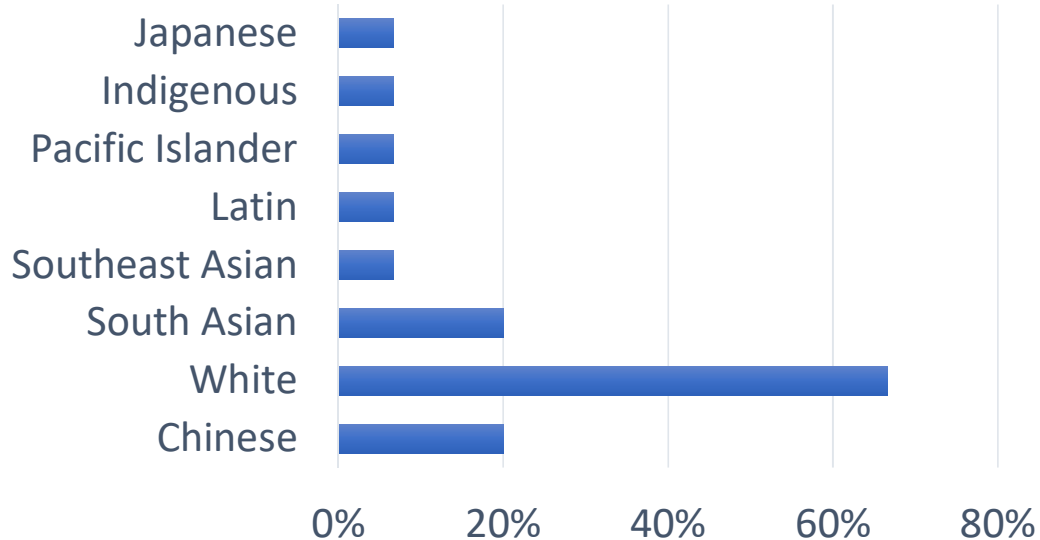
2022/2023 Fall Term: CHEM 301 and EOSC 474

2022/2023 Winter Term: EOSC 314



How do participants self-identify?

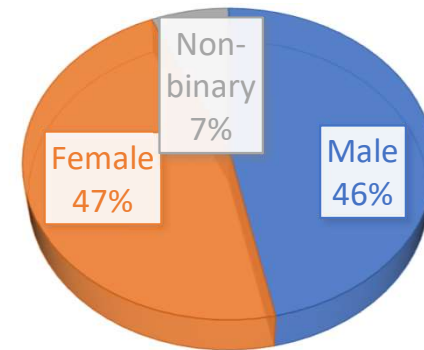
Ethnicity



First language



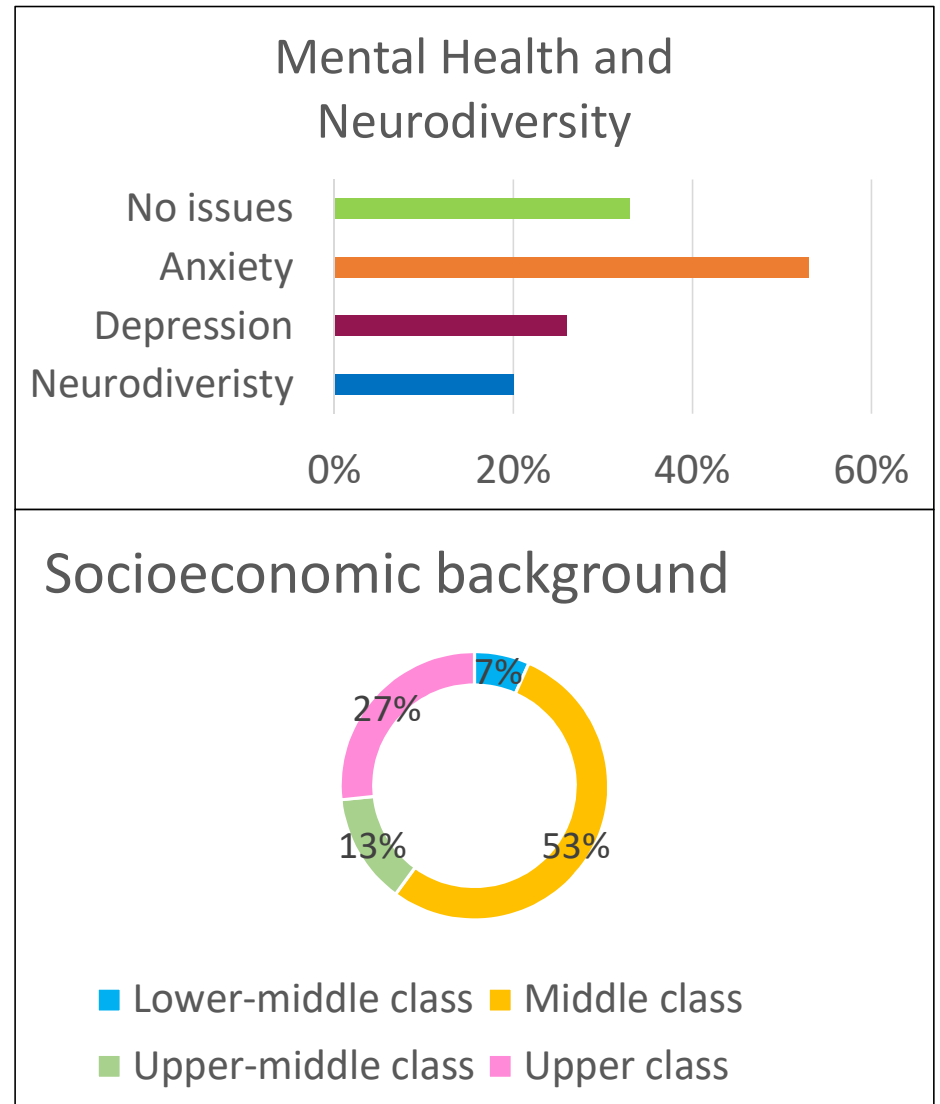
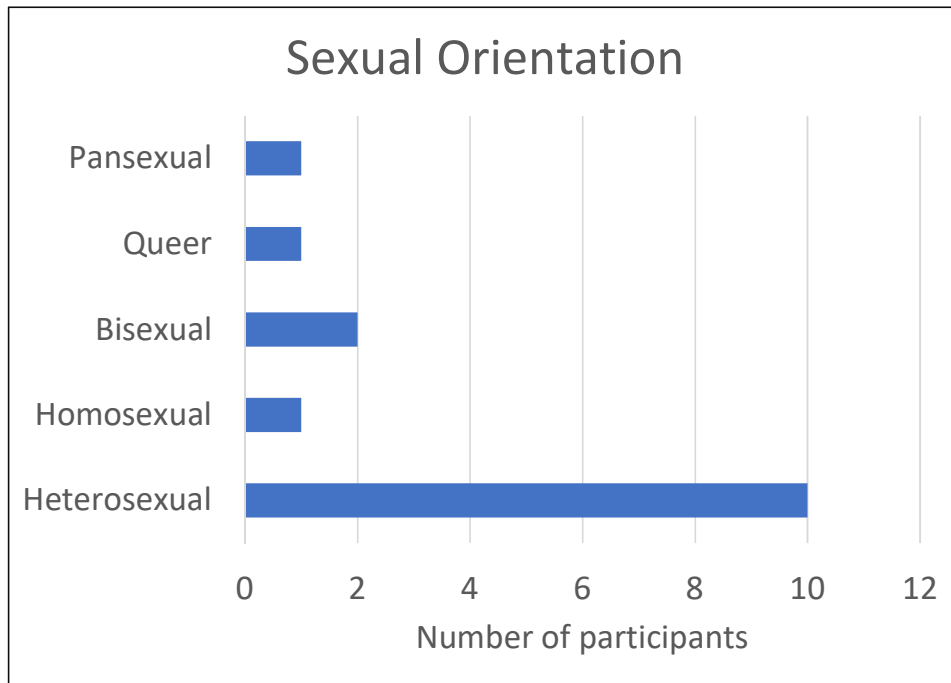
GENDER



UBC Statistics for the Faculty of Science in 2022 (UBC PAIR Nov. 1st Data):

- Gender: Female (49%) Male (50%) Non binary (1%)

How do participants self-identify?



Results:

Question 1: In what ways is team work inclusive in TBL?

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Groups remain unchanged over time

At first, the members who are quieter are those with barriers.

- For example, in one 4-person team, a team member who has **dyslexia and anxiety disorder** and a team member who has a **language and cultural barrier do not contribute** much to the discussion.
- In a second 6-person team, two team members who **belong to a minority group** are **quieter**:

“I think it was me and then [name of other student], who were the only people of colour. And I did find that we were the ones that engaged a little bit less than the others. I'm not sure like why this is something I noticed. I know that I personally felt a little bit uncomfortable.”

Results for Question 1: In what ways is team work inclusive in TBL?

Groups remains unchanged over time

However, over time, this changes and contributions become more equal because the teams stay the same

- Observations indicate that a **student with a language barrier** who starts off as quiet **becomes a leader of the group over time**. She began voicing how her team should proceed, by stating things like, “I think we should discuss all the possibilities.”

- Interviews indicate that **team members feel more confident to express their thoughts:**

“I was just feeling more comfortable and I think that was because of the socialization and the fact that we were in the same groups throughout. I think if we switched groups it would have been like reset to zero and then building it up again. Yeah, I did notice change. I was able to ask more questions.”

Results for Question 1: In what ways is team work inclusive in TBL?

Groups remains unchanged over time

A team identity emerges

- Students become protective of their team. Even when participants acknowledged in the interviews that a team member contributed less, this was never reflected in the post-TBL peer/self evaluations (also read by instructors)

- Students trust others to help fill in the gaps:

“Yes, I think [name of the student] also helped me revisit the material itself, making sure I'm fact checking and citing sources”

Results for Question 1: In what ways is team work inclusive in TBL?

Team members are not assigned tasks

Students choose different roles to ensure that their team is functional to achieve their goal.

- Leader (notetaker, timekeeper, quality control)
- Elaborate answers
- Check references, complete literature searches
- Emotional leader (encouraging others to participate, validating answers)

I want to make sure that everything gets done and done well and so I'll just kind of like step into that position to make sure that happens.

“When as younger, I wasn't always included in everything and I would always hate to be the person who's taking notes and then ignore somebody and make somebody feel left out. So I make a conscious point on trying to make sure that everybody has a chance to speak, even if they don't feel confident about what they say,

Results for Question 1: In what ways is team work inclusive in TBL?


Team members
are not
assigned tasks

Multiple ways to contribute to the team; students choose based on their own strengths and they may take different roles at different times.

- There were some students who may have felt uncomfortable taking tasks but felt very engaged by doing some others.

“I wanted to expand on the groups answer by contributing. But I also thought that even in times when I didn't know the answer to help somebody, to explain their answer. Just letting them to elaborate or encouraging them to elaborate, I thought that would be a constructive role to play.”

Results for Question 1: In what ways is team work inclusive in TBL?



Dedicated
time for
activity

Having the team work only within the class time alleviated stress on the members:

"I think TBL's good because other groups you have to organize to meet up in your own time, which is inevitably be difficult and they'll often be a lot of people that like you, can't make your schedules work ...you kind of do all the organization of it, it can just be a big mess and it ends up [with] really unequal participation of some people. Some just kind of never turn up."

Results:

Question 2: In what ways can TBL improve for students who may experience barriers to participate in team work?

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Opportunity to socialize is important to those with anxiety/depression and cultural barriers

- In one of the courses, there was **no opportunity for an icebreaker**.

As a result, a student experiencing anxiety and depression, **did not contribute as much and did not attend one TBL class** due to his anxiety:

"I would have been able to overcome these barriers if I had known them better."

- In a different class where the **team had an opportunity to get to know each other** and there were also team members suffering from anxiety and depression, no one was observed to contribute less due to their mental health problems.

"I felt like actually all the team members were super open and just kind for the TBL so I didn't have too many problems with anxiety actually."

Results for Question 2: In what ways can TBL improve for students who may experience barriers to participate in team work?

Making any heavy or high stakes in-class reading accessible in advance for students who are neurodivergent and language barriers.

- A **student with ADHD** chose to be the recorder for their team because she could not comprehend the case study in the few minutes given to read it:

“For a lot of the case studies, I can't read fast enough and understand. So I don't understand a lot of the case studies. When I read the paragraph that quickly, like my brain doesn't work. It doesn't make any sense to me in the moment.”

- A **student whose first language is not English** mentioned:

“The reading material for a group activity was started to provide in advance from the middle of the term, which I had asked for before. That was really helpful.”

Results for Question 2: In what ways can TBL improve for students who may experience barriers to participate in team work?

Use of Google docs (and similar) should be strategic.

- Encourages “divide and conquer” behavior, rather than consensus-building and discussion.
- A student with anxiety disorder was personally effected when his team-mate deleted his contributions to the google doc. He seemed to withdraw from the team for a period.

“I noticed that sometimes some of sentences I wrote were erased and replaced by something else without any discussion.”

Conclusions

- Persistent groups that have dedicated class time to work enhance inclusion in teams.
- There are easy changes an instructor can make to team work to make it even more inclusive. This includes having time for an icebreaker and posting large and/or high stakes readings ahead of class.

Extending Results to Recommendations to the Instructor (Anka)

- 1) Requested a classroom conducive for team work
- 2) Provided expectations of team work early on. Made grading expectations clear.
- 3) Provided reasons for teamwork. How could the activity benefit to the student?
- 4) Encouraged participation from everyone; Verbally acknowledged value in multiple ways of contributing to the group.
- 5) Added an Ice breaker (guided or self-paced).
- 6) Provide case study readings ahead of time.
- 7) Circulated and checked in with teams during teamwork
- 8) Provided a paper worksheet and gave students the option to work electronically. Handwriting on paper is fostering memorization and understanding of the information.
(K. Umejima et al., 2021; F. R. (Ruud) Van der Weel and Audrey L. H. Van der Meer, 2024)

Test of these recommendations: CHEM 301, 2023 W1

Anka implemented the recommendations in her CHEM 301, 2023 W1 TBL.

Celine extended the study to this class by applying the same protocol as for previous lectures. Four students were recruited.

- Students appreciated most of implementations of the recommendations
- Sitting of students in the classroom can play a big role, e.g., facing each others
- Some improvements are still required (pre-readings). Some implementations have to be envisioned in a different way (how instructor circulates in the room and interacts with students).

What are the implications for group work in your classroom? Groups of 2 or 3.

Acknowledgements

- The students who openly discussed their personal situations and experiences for the purpose of this study.
- Kristin Orians and May Leah Ver for allowing access to their classrooms.
- Natalie Westwood from CTLT who helped inspire the project
- UBC CIRTl TAR Project

Future Work

- UBC SoTL Linkage grant to conduct a similar study investigating student experiences in different types of group work in various science courses.
- In collaboration with Meghan Allen (CS), Georg Rieger (PHAS), Olúwakémi Olamudzeni (CS), Matt Coles (MATH), Reid Holmes (CS)

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