FIRST-YEAR ENGINEERING STUDENTS' PERCEPTIONS OF ACTIVE LEARNING

Dr. An Mai[1] and Mackinley Love[2]
University of Calgary
an.mai@ucalgary.ca[1], mackinley.love@ucalgary.ca[2]

Abstract – *Active learning is an instructional method that involves students in activities such as discussions, problem-solving, and hands-on tasks, as opposed to traditional lectures where students passively receive information. Research consistently demonstrates that active learning fosters deeper understanding and long-term retention by encouraging students to engage directly with material rather than passively receiving information. These methods may be particularly effective in large, lecture-based courses where traditional methods can limit student interaction and engagement, but research has encountered difficulty in translating active learning methods to large-enrolment courses, such as those at University of Calgary's engineering department.*

Despite these benefits, student perceptions of active learning at the University of Calgary (U of C) vary significantly. Some find the approach engaging and motivating, while others find it intimidating, uncomfortable, or challenging. Students' perceptions of active learning are often influenced by their prior educational experiences and academic backgrounds. These perceptions significantly shape their willingness to engage with active learning strategies, which directly impacts the overall effectiveness of such instructional approaches in avhieving desired learning outcomes.

ENGG 204 is a general first-year materials science course at U of C's engineering department. It was first offered in the Fall of 2023. Since then, both the course and U of C's first-year program have undergone significant changes. There is a need to understand how students perceive the effect of these changes on their education and to evaluate the overall effectiveness of them in improving learning.

A survey has been conducted to evaluate students' overall attitudes and satisfaction with active learning techniques in their ENGG 204 course. It was also designed to identify perceived benefits and challenges of these techniques, and to explore demographic and contextual factors that may influence students' perceptions and engagement with active learning.

Keywords: active learning, experiential learning, first year course, blended format, studio sessions.

1. INTRODUCTION

Active learning is an effective instructional approach that enhances student engagement and learning outcomes. Unlike traditional lecture-based methods, active learning engages students through discussions, problem-solving, and hands-on activities, fostering active participation rather than passive information absorption [1]. Compared to passive methods, active learning promotes deeper understanding, improves knowledge retention, and enhances critical thinking skills [2, 3]. These benefits are particularly relevant in engineering education, where complex problem-solving and conceptual understanding are essential for student success.

However, implementing active learning in large-enrollment courses presents unique challenges. Large class sizes can negatively impact student learning, grades, satisfaction, and course ratings, and instructors can be perceived as less clear, responsive, and engaging [4]. Additionally, students' perceptions of active learning vary significantly; some finding the approach stimulating and beneficial, while others feel discomfort or resistance with the unfamiliar interactive learning formats [5]. These perceptions are influenced by factors such as prior educational experiences, learning preferences, and demographic background [6].

At the U of C, the engineering department has integrated active learning strategies into its first-year materials science course, ENGG 204, first offered in 2023. The entire first-year engineering program has been significantly modified from traditional to flipped classroom to enhance student learning and engagement, but there is a critical need to assess how students perceive these instructional changes and if they improve learning outcomes. This understanding is essential for refining course design and ensuring active learning effectively supports diverse learning needs.

This study aims to evaluate students' attitudes and satisfaction with active learning techniques in ENGG 204 and identify perceived benefits and challenges. By analyzing survey data from students enrolled in ENGG 204 during the fall semester of 2024, this research seeks to provide insights into how active learning strategies impact student experiences in a large-enrollment first-year

This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License.

engineering course, informing evidence-based improvements in course delivery and enhancing the effectiveness of active learning in materials science education.

2. COURSE STRUCTURE

The course was divided into 12 blocks with a maximum capacity of 100 students per block and had a total final enrolment of 865 students. The course was offered in a blended format with both synchronous and asynchronous components, and was taught and supported by 1 coordinator, 4 instructors, with student interns, teaching assistants (TAs) and studio technicians. Each instructor is responsible for 3 blocks.

2.1. Asynchronous Components

Asynchronous activities were utilized as self-paced resources for self-directed learning. Lecture slides and videos were posted in advance, allowing students to review the content before attending class and take notes directly on the slides during lectures, helping students to focus on discussions rather than rushing to copy notes. This review was intended to help students gain familiarity with key concepts, allowing instructors to concentrate on applying these ideas through examples.

Each week, students were provided with a curated list of recommended videos, textbook sections, and suggested problems, and were encouraged to watch the videos and attempt the problems before attending the studio sessions later in the week.

On average, two to three 20-minute-long videos were made available weekly. These videos aligned with the textbook content and covered both theoretical concepts and basic problem-solving. Solutions to the suggested problems were released a week later, enabling students to assess their understanding. If they encountered difficulties, they were encouraged to seek help from the teaching assistants during the studio sessions or from their instructors during the lectures.

2.2. Synchronous Activities

Each week began with two one-hour lecture-style sessions summarizing key concepts and demonstrating problem-solving applications. These sessions also provided opportunities to address students' questions and clarification.

Later in the week, students attended 2.75-hour studio sessions focused on experiential learning, supported by 2-3 TAs, one student intern, and one technician, maintaining an instructor-to-student ratio of at most 1:25 ratio. Studio sessions incorporated interactive tools such as 3D-printed models, simulators, demonstrations, and hands-on wet labs. Students completed worksheets during the session, including an optional upgraded section with challenging exam questions.

Emphasizing collaboration, students worked in groups of 3 – 4, fostering teamwork and problem-solving skills. Each TA supervised 4-5 groups, providing feedback and assessing participation. Worksheets included multiple TA checkpoints to validate students' work and reinforce understanding. To ensure genuine collaboration, TAs and studio technicians monitored group dynamics, preventing task division.

At the end of each session, students submitted their worksheets that TAs quickly graded based on completed checks. This steamlined approach replaced homework, minimized gradint time, and emphasized completion over correctness. By actively guiding students during their session, TAs reduced pressure, discouraged task-splitting, and promoted engagement.

3. METHODOLOGY

3.1. Survey Design and Delivery

The student survey was approved by the University of Calgary's Ethics Board, under REB24-1718. The survey primarily consisted of closed-ended questions used to gauge average student sentiment on various topics, with five open-ended questions included to allow students to expand on their active learning preferences. The survey was designed to be completed in 6 – 8 minutes.

The survey had 8 sections. The closed-ended Likert-scale questions [8] covered attitudes towards active learning, perceived effectiveness of active learning strategies, active learning preferences, challenges and barriers, engagement and motivation, collaborative learning, and use of technology. A section with open-ended questions was also included. The full list of questions is available in the appendix.

The survey was administered via Qualtrics from January 29 to February 11, 2025. Students were invited by email and through the course's learning management system. Participation was analymous, with consent collected before starting.

Since ENGG 204 ended in December 2024, there was about a one-month gap before the survey. This delay allowed students to reflect more fully on the course, having completed the final exam and received their grades.

3.2. Quantitative Analysis

The closed-ended Likert-scale questions were analyzed using simple frequency analysis. Responses for each option were displayed in bar graphs, illustrating the distribution of student answer across the Likert-scale for each question.

3.3. Qualitative Analysis

The open-ended questions were subjected to qualitative content analysis [9]. Individual student responses were

used as the unit of analysis, and each open-ended question was treated as a high-level category heading. The data was read through to gain a complete understanding of student responses. Each student response was then assigned as many codes as needed to summarize the content of the response, generated inductively from the perceived themes present in student responses. The codes were refined until a coding matrix was generated completely summarizing the data. Additional coders were not used, and the final coded data therefore has limited inter-rater reliability.

After generating the coding matrix, the number of responses with each code were counted, showing the distribution of themes across each open-ended question.

4. FINDINGS

142 of the 865 students participated in the survey. While demographic data was collected, it is not included in this paper. Results from the closed-ended and open-ended questions are presented in the "Quantitative Data" and "Qualitative Data" sections, respectively. All figures and tables are presented on the following pages.

4.1. Quantitative Data

This section details the results from the closed-ended Likert-scale survey questions, presented in Figures 1-7 on the following pages.

Figure 1 presents students' attitudes towards active learning. Most students perceived active learning positively, with 72% of respondents moderately or strongly agreeing that active learning was more interesting, more engaging, and helped them understand the material better. However, despite these positive effects, only 46% of respondents moderately or strongly preferred active learning over traditional lectures.

Figures 2a and 2b illustrate the effectiveness of different active learning strategies, as perceived by the surveyed students. Students reacted most positively to the inclusion of sample exam questions, a strong request from students in previous years. Students also reacted positively to the use of experiments, simulators, and 3D-printed objects to illustrate physical concepts. Students also found the worksheets very effective, but the drop-off in responses for the "completely effective" category indicates room for further improvement.

Students were mixed on the use of collaborative activities. The responses to both group discussions and peer instruction had bilateral distributions, with the largest cluster around the middle rating of "moderately effective" and evenly dropping off towards the more extreme responses of "not effective" and "completely effective", which may potentially indicate room for improvement in how collaborative work was enacted in the course.

Students received the supplementary videos more negatively than other active learning components, with only 16% of respondents finding this strategy to be very of completely effective. Students found that videos showcasing solutions to selected problems were moderately effective but largely found videos supplementing the lectures to be ineffective. Since the videos were created in the previous iteration of the course and therefore had slightly different content, they were initially unavailable but were later added when students requested access. The videos were released along with a list of topics and suggested viewings for those interested.

Figure 3 displays surveyed students' preferences for different active learning strategies. Students reacted most positively towards the use of simulators and hands-on activities, as well as receiving regular feedback from their teaching assistants. Students also reacted positively towards the use of group work and Studio discussions, although to a lesser degree than the previous strategies, indicating room for improvement. Students overall did not see value in the use of individual reflection and writing assignments, with nearly half of responses clustering around "no preference" and nearly 40% indicating only a slight or moderate preference. The reflection assignments were designed to help students set goals and develop strategies to achieve them. After each midterm, students were asked to reflect on their goals, evaluate the effectiveness of their strategies, and make adjustments as needed.

Figures 4a and 4b highlight both positive and negative student perceptions of challenges and barriers. Most student responsed positively, reporting little anxiety about participation, ease in collaborating with peers, and no trouble staying focused. However, many felt active learning demanded more independent work than traditional lectures and found the Studio activities occasionally too fast-faced – also noting limited time to fully engage in some tasks. Views on the relevance of sessions were mixed; open-ended responses suggested early sessions felt like simple review, while some later ones lacked clear ties to theory.

Figure 5 presents the surveyed students' motivation and engagement in relation to the utilized active learning strategies. Responses to all four questions clustered around "moderately agree", indicating students feel more motivated for active learning, understand the course content better as a result, and feel more responsible for their own learning and their peers.

Figure 6 illustrates the surveyed students' attitudes towards the collaborative learning elements of their active learning classes. Students were generally positive, with responses to all four questions clustering around the second-highest rating of "moderately agree". Students enjoyed working with their peers, finding that their group discussing and collaboration helped their understanding, made it easier to grasp difficult concepts and improved the

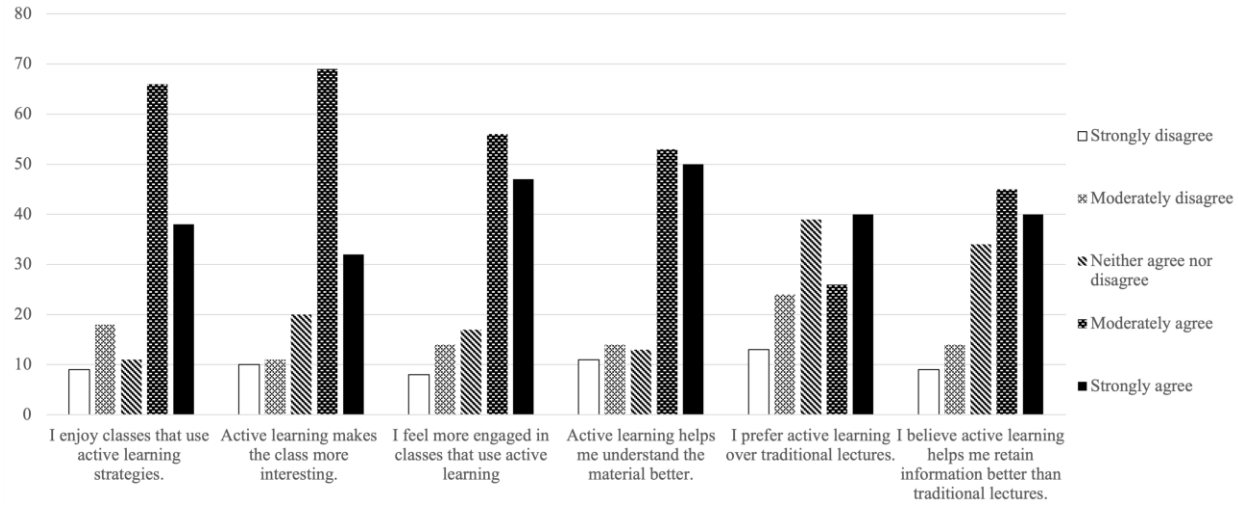


Fig. 1: Preferences for active learning

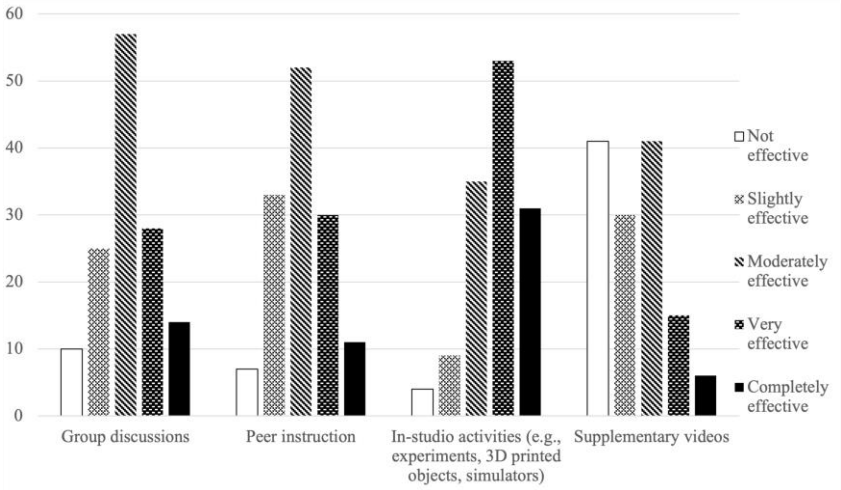


Fig. 2a: Perceived effectiveness of active learning strategies

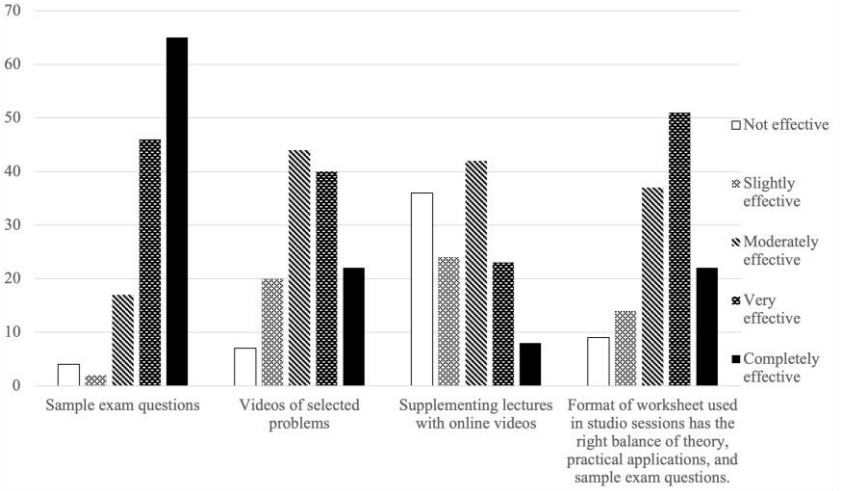


Fig. 2b: Perceived effectiveness of active learning strategies (cont.)

experience. However, the clustering around the second-highest rating rather than the highest indicates that this aspect of active learning can be improved.

Figure 7 presents surveyed students' evaluations of the effectiveness of the technology used in their active learning sessions. Students found that learning management systems and simulation software were significantly effective in improving their learning, but with room for these systems to be improved. Students were overwhelmingly negative towards the use of online discussion forums, with nearly two-thirds of respondents rating them as ineffective or only slightly effective.

4.2. Qualitative Data

The results of the open-ended questions are summarized in Tables 1-5. Each table contains a "Miscellaneous" code to collect those codes which only occurred a single time. Note that a single response could generate multiple codes and not all responses contributed codable data, meaning they did not relate to the question or course, the total count of codes for each question does not necessarily equal the total number of student responses.

Table 1 presents the coded results from the question, "What do you like most about active learning?" Students

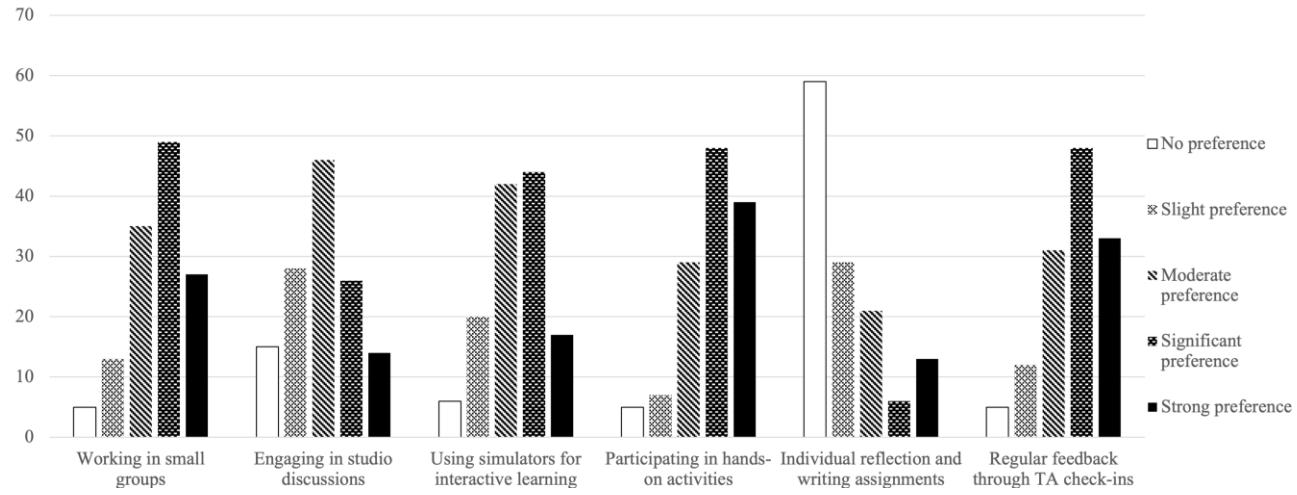


Fig. 3: Preferences for active learning

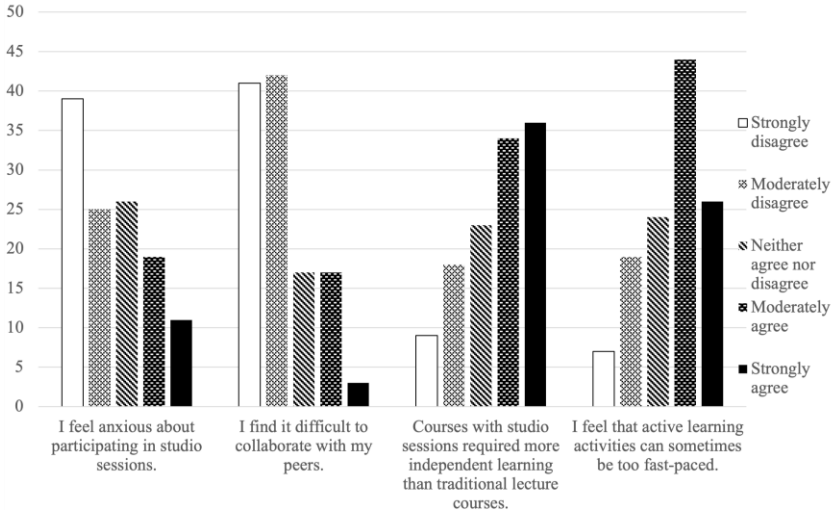


Fig. 4a: Challenges and barriers in active learning

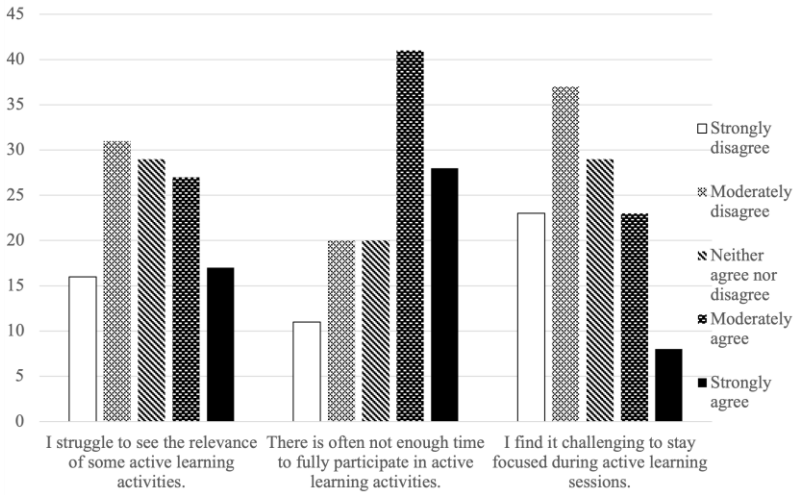


Fig. 4b: Challenges and barriers in active learning (cont.)

most liked being able to work in groups, finding it better than individual work and helping them to "learn the material efficiently", as one student wrote. Students appreciated that they could select their own groups and work in an open-book setting with feedback and participation grading. Students also liked active learning sessions that contained applications to practical problems; this addresses a common challenge in designing first-year engineering science courses, where, given the introductory nature of the material, it can be difficult to relate course material to real-world applications [10]. One student noted that these application problems were "more helpful than the lectures in understanding what was going on in classes and what we've actually learned," and another appreciated "learning by doing actual problems and examples."

Students also greatly appreciate the teaching assistant and instructor feedback they received in their Studio Sessions, with the TA checks helping to "address some misconceptions early on." Students found that the TA and instructor feedback encouraged participation and made assistance more accessible, with one student writing, "You don't have to find your own time to seek help." Accessible assistance is important, as students

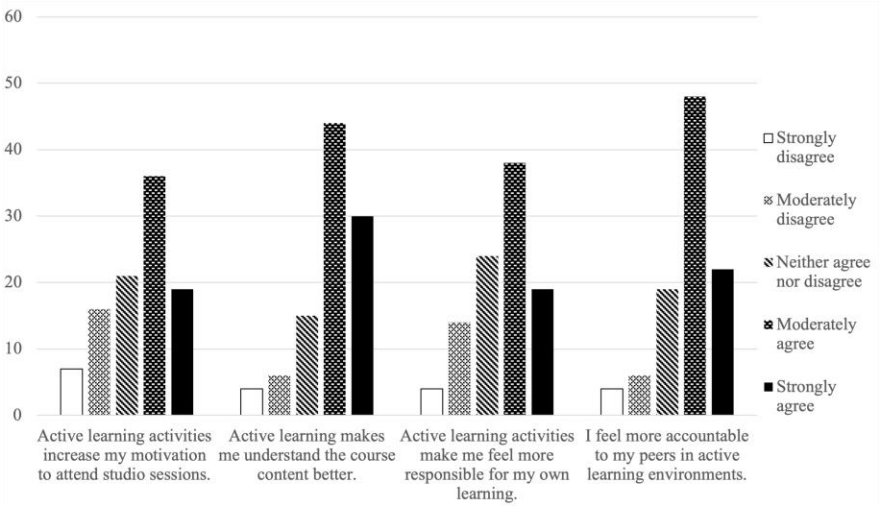


Fig. 5: Motivation and engagement

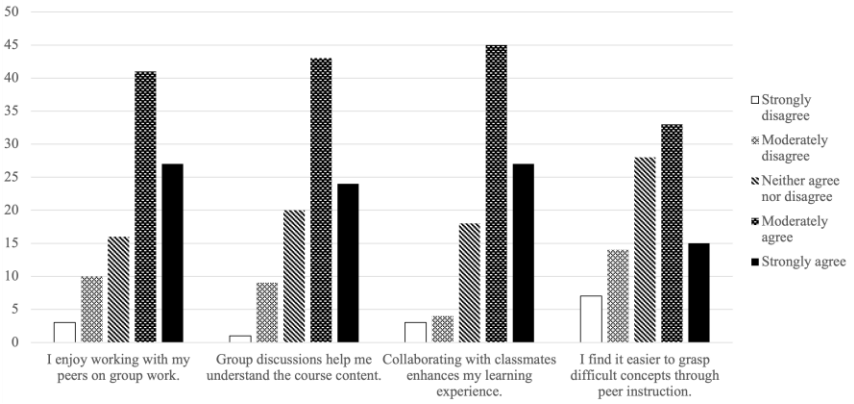


Fig. 6: Collaborative learning

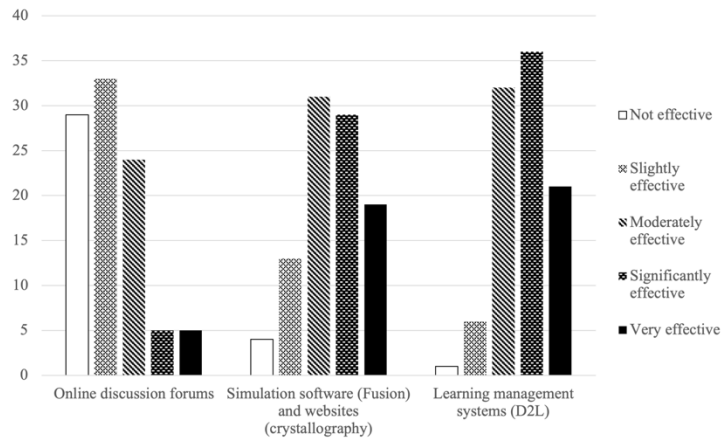


Fig. 7: Use of technology

have a tightly-packed schedule of challenging courses and must take time out of their day to attend professor office hours. Students also liked the practice problems and exam-style questions, with the questions "accurately reflect[ing] the exams."

Table 2 summarizes student responses to the question, "What did you find most challenging about active learning?". The most common challenge was the studio sessions, particularly the lengthy worksheets. Many students felt time constraints forced them to "divide and conquer", completing sections individually rather than collaboratively. This led to frustration, with some feeling the sessions prioritized worksheet completion over actual learning and noted the "lack of time to take things at my own pace."

Despite positive feedback in Table 1, group work was also cited as a challenge. Students struggled with differences in peers' motivation and knowledge levels – some found their groupmates unfocused and unprepared, while others struggled to keep up. Social dynamics played a role, as some students hesitated to ask peers or TAs questions due to a lack of confidence or fear of being a burden; as one student noted that they sometimes "feel bad for the TA about my questions so I don't ask," reinforcing the importance of these social skills.

Table 3 lists the responses to the question, "Describe a specific active learning activity that you found particularly effective." Students exhibited a strong preference for the interactive components of their course, including the Studio Session on crystallography, where crystal unit cells and slip planes were visualized using 3D-printed models and computer simulations. Students found these models useful for their calculations and helped to visualize the unit cell,

Table 1: Most-liked elements of active learning

Code	Count
Group work	25
Application to practical problems	21
TA/instructor feedback	18
Practice and exam preparation	16
Deepens understanding	11
Miscellaneous	8
Slower pace / self-paced	7
Hands-on activities	6
Accountability	5
Engagement	5
Low-stress environment	3
Variety	3
Studio sessions	3
Nothing	3

Table 2: Most challenging aspects of active learning

Code	Count
Studio sessions	41
Group work	20
TA/instructor feedback	10
Asynchronous content	9
Active learning design	8
Engagement	8
Miscellaneous	7
Independent learning	6
Questions	5
Nothing	3
Lectures	2

Table 3: Effective learning activities

Code	Count
Crystallography	29
Interactive components	28
Additional resources	14
Worksheets/Studio sessions	11
TA/instructor feedback	5
Group work	4
Nothing	3
Miscellaneous	2

which was a frequent point of misunderstanding for students in previous years of the course. Students also liked the experiments in their Studio Sessions on conductors, thermal expansion, and especially necking and yield strength, liking that they were "able to see the concepts we were learning in class in real life"; this follows from the student preference in Table 1 for course material that can be directly applied and for hands-on activities. Students also appreciated the additional resources provided such as online notes, supplementary and exam-style problems, and practice exams. Finally, students also expressed a preference for their Studio Sessions, enjoying how they applied knowledge and how the weekly scheduling provided a regular reinforcement of the knowledge learned in lecture.

Table 4: Ineffective learning activities

Code	Count
Studio sessions	29
Nothing	13
Interactive components	12
Lectures	8
Asynchronous content	8
Group work	6
Miscellaneous	4
TA/instructor feedback	3
Theory review	2
Practice and exam preparation	2
Reflection activities	2

Table 5: Recommended improvements for active learning

Code	Count
Worksheets/Studio sessions	35
Lectures	20
Miscellaneous	10
Nothing	7
Additional resources	6
Experiments	5
Group work	5
TA/instructor feedback	5
Asynchronous content	4
Remove active learning	2

Table 4 provides the results from the question, "Describe an active learning activity that you found ineffective or unhelpful." Many students had complaints about elements of the Studio Sessions. Similar to the results from Table 2, a strong theme was that the worksheets were too long to be completed in the sessions, and some groups "never got to the sample exam questions on the back [of the worksheet]." Some students also found some of the questions to be unhelpful or irrelevant, with some questions "ask[ing] about theory in a way that confused us" and others not being covered previously in the lectures or online videos. Some students also critiqued the various experiments in the Studio Sessions, finding them time-consuming and not helping to expand their knowledge. One student specifically complained about instructions for using the Fusion crystallography software, finding them to be inadequate and ultimately inhibiting their learning.

Promisingly, a significant number of students did not find any active learning activities to be ineffective. This contrasts with some of the "Nothing"-coded responses in Table 1, which expressed a preference for traditional

lectures, and the two responses in Table 5 requesting that active learning be removed from the first-year program.

Table 5 highlights the results from the question, "What improvements would you suggest for the active learning activities in your course?" Students primarily targeted the worksheets and Studio Sessions, asking that content be reduced so that students can complete worksheets within the session; one response asked that the sessions be lengthened to accommodate the current worksheets. Students also asked that more exam-style questions be added to the worksheet and suggested increasing the number of worksheets printed so that every student can access a physical copy. One student asked that the single group submission be kept if the number of physical worksheets is increased, saying the group submission encourages more participation.

Many students found the lectures to be ineffective or to just be a summary of the asynchronous videos. This aligns with student responses under the "asynchronous content" code asking that the videos be removed or made more helpful. Students mainly suggested lengthening the lectures to allow more content to be covered in greater depth.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

The survey results provide valuable insights into student perceptions of active learning in a large-enrollment first-year course. Students demonstrated a positive attitude toward active learning and recognized its benefits in engagement, knowledge retention, and exam preparation. Students especially appreciated hands-on activities, group work, TA and instructor feedback, and the application of concepts to real-world problem. Additionally, interactive components such as simulations and 3D-printed models were well received, helping students to visualize and understand complex concepts more effectively.

However, several challenges were also identified. Many students found the worksheets too lengthy, and the time constraint encouraged students to divide tasks rather than work collaboratively. While group work was appreciated, some students reported difficulties due to peer disparities in knowledge levels and motivation. Additionally, some students expressed concerns about the variability in TA support, noting that inconsistent feedback and limited availability hindered their learning experience.

Regarding instructional materials, students showed a strong preference for sample exam questions and problem-solving exercises but were less enthusiastic about online videos and discussion forums. Students also noted that there was insufficient time for studio sessions, limiting their ability to fully engage in the learning activities.

5.2. Recommendations

Based on the findings, the following recommendations are proposed to enhance the effectiveness of active learning strategies in large-enrollment courses:

1. Optimize worksheet design and studio sessions – reduce the content in worksheets, ensuring students can complete them within the session and promoting a deeper focus on problem-solving.
2. Enhance group work and TA support – provide clearer guidelines for effective collaboration to minimize the impact of knowledge disparities within students group, and improve TA training to ensure consistent feedback, professionalism, and support during studio sessions.
3. Adjust lecture and asynchronous content – revise asynchronous videos to make them more relevant and ensure alignment with studio session activities. Add more videos on problem solving.
4. Improve active learning technologies – enhance simulation based learning tools, provide adequate training for both students and TAs, eliminate the reliance on online discussion forums, and explore another method for Q&A.
5. Address pacing and engagement challenges in both lectures and Studio Sessions.

Acknowledgements

The authors would like to thank the co-instructors for their valuable contributions to this collaborative endeavor. We also extend our sincere appreciation to the Schulich Studio Team for their support with the Studio sessions and various administrative task.

Mr. Love would also like to acknowledge the indispensable support and advise of his supervisor, Dr. Philip Egberts, and the Taylor Institute for their Teaching and Learning Grant, which funds his research.

References

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

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

[3] J. Michael, "Where's the evidence that active learning works?", *Advances in Physiology Education*, *30*(4), 159-167, 2006.

[4] M. Ocampo and J. Bruschke, "Class Size Effects on Students and Instruction",

https://thesenateforum.wordpress.com/2020/11/20/class-size-effects-on-students-and-instruction/

[5] L. Deslauriers, L.S. McCarty, K. Miller, K. Callaghan, and G. Kestin, "Measuring actual learning versus feeling of learning in response to being actively engaged in the classroom", *Proc. Nat. Acad. Sci.*, vol. 116, no. 39, pp. 19251-19257, 2019.

[6] J. Henning, C. Ballen, S. Molina, and S. Cotner, "Hidden Identities Shape Student Perceptions of Active Learning Environments", *Frontiers in Education*, Vol 4, 2019.

[7] T. Shilling, J. Thayer, A. Coria-Navia, "Student Preferences for Active Learning and Their Beliefs, Experiences, and Knowledge", *Teaching and Learning in Communication Sciences & Disorders*, 7(2), 2023.

[8] G. Margarov, E. Mitrofanova, and R. Gevorgyan, "Designing effective online surveys for engineering study programs development based on feedback from stakeholders," in *Proc. of 2017 IEEE EDUCON*, Athens, Greece, Apr. 2017, pp. 239-247.

[9] S. Elo and H. Kyngäs, "The qualitative content analysis process," *J. Adv. Nurs.*, vol. 62, no. 1, pp. 107-115, Apr. 2008, doi: 10.1111/j.1365-2648.2007.04569.x.

[10] S. Sheppard, K. Macatangay, A. Colby, W.M. Sullivan, and L.S. Shulman, *Educating engineers: Designing for the future of the field*. San Francisco, CA, USA: Jossey-Bass, 2009, doi: 10.1007/s10734-009-9253-6.

APPENDIX: SURVEY QUESTIONS

The active learning student survey included the following questions and sections.

Opening text:

Active learning is a teaching approach that actively engages students in the learning process through activities like discussion, problem-solving, or hands-on tasks, rather than passively receiving information.

This study, approved under the University of Calgary's Conjoint Faculties Research Ethics Board identification REB24-1718, aims to gather your opinions on the active learning elements in your ENGG204 course last semester. Your responses will be used to develop improvements for future offerings of the course, as well as a conference paper detailing the improvements.

Before beginning the survey, please provide your consent for your anonymous survey data to be used in this research project.

- I consent to participate in this research study.
- I do not consent to participate in this research study."

Section 1: Attitudes Towards Active Learning

Active learning involves classes that engage students and requires their participation, in contrast to traditional passive learning, where students simply listen to a lecturer.

Rate your agreement with the following statements on a scale from 1 to 5 as shown below.

1: Strongly disagree, 2: Moderately disagree, 3: Neither agree nor disagree, 4: Moderately agree, 5: Strongly agree.

1. I enjoy classes that use active learning strategies.
2. Active learning makes the class more interesting.
3. I feel more engaged in classes that use active learning.
4. Active learning helps me understand the material better.
5. I prefer active learning over traditional lectures.
6. I believe active learning helps me retain information better than traditional lectures.

Section 2: Perceived Effectiveness of Active Learning Strategies

Rate the effectiveness of the following active learning strategies in helping you learn the course material on a scale from 1 to 5 as shown below.

1: Not effective, 2: Slightly effective, 3: Moderately effective, 4: Very effective, 5: Completely effective.

1. Group discussions
2. Peer instruction
3. In-studio activities (e.g., experiments, 3D printed objects, simulators)
4. Supplementary videos
5. Sample exam questions
6. Videos of selected problems
7. Supplementing lectures with online videos
8. Format of worksheet used in studio sessions has the right balance of theory, practical applications, and sample exam questions

Section 3: Preferences for Active Learning

Indicate your preference for the following types of active learning activities on a scale from 1 (no preference) to 5 (strong preference) as shown below.

1: No preference, 2: Slight preference, 3: Moderate preference, 4: Significant preference, 5: Strong preference.

1. Working in small groups
2. Engaging in studio discussions
3. Using simulators for active learning
4. Participating in hands-on activities
5. Individual reflection and writing assignments
6. Regular feedback through TA check-ins

Section 4: Challenges and Barriers

Rate the extent to which you agree with the following statements about challenges and barriers to studio sessions, which are all active learning, on a scale from 1 (Strongly Disagree) to 5 (Strongly Agree) as shown below.

1: Strongly disagree, 2: Moderately disagree, 3: Neither agree nor disagree, 4: Moderately agree, 5: Strongly agree.

1. I feel anxious about participating in studio sessions.
2. I find it difficult to collaborate with my peers.
3. Courses with studio sessions required more independent learning than traditional lecture courses.
4. I feel that active learning activities can sometimes be too fast-paced.
5. I struggle to see the relevance of some active learning activities.
6. There is often not enough time to fully participate in active learning activities.
7. I find it challenging to stay focused during active learning sessions.

Section 5: Open-Ended Questions

Please provide brief responses to the following questions:

1. What do you like most about active learning?
2. What did you find most challenging about active learning?
3. Describe a specific active learning activity that you found particularly effective.
4. Describe an active learning activity that you found ineffective or unhelpful.
5. What improvements would you suggest for the active learning activities in your course?

Section 6: Engagement and Motivation

Rate your agreement with the following statements on a scale from 1 (Strongly Disagree) to 5 (Strongly Agree) as shown below.

1: Strongly disagree, 2: Moderately disagree, 3: Neither agree nor disagree, 4: Moderately agree, 5: Strongly agree.

1. Active learning activities increase my motivation to attend studio sessions.
2. Active learning makes me understand the course better.
3. Active learning activities make me feel more responsible for my own learning.
4. I feel more accountable to my peers in active learning environments.

Section 7: Collaborative Learning

Rate your agreement with the following statements on a scale from 1 (Strongly Disagree) to 5 (Strongly Agree) as shown below.

1: Strongly disagree, 2: Moderately disagree, 3: Neither agree nor disagree, 4: Moderately agree, 5: Strongly agree.

1. I enjoy working with my peers on group work.
2. Group discussions help me understand the course content.
3. Collaborating with classmates enhances my learning experience.
4. I find it easier to grasp difficult concepts through peer instruction.

Section 8: Use of Technology in Studio Sessions

Rate the effectiveness of the following technological tools in facilitating your learning on a scale from 1 (not effective) to 5 (very effective).

1: Not effective, 2: Slightly effective, 3: Moderately effective, 4: Significantly effective, 5: Very effective.

1. Online discussion forums
2. Simulation software (Fusion) and websites (crystallography)
3. Learning management systems (D2L)

Demographic Information

1. Age
2. Gender
    a. If you selected "Other" for gender, please specify here.
3. Major/Field of Study
4. Do you have past experience with active learning?
5. Education background:
    a. Finished high school in June 2024
    b. Back to university after one or more years of working
    c. Finished a post-secondary certification in another discipline
    d. Transferred from another undergraduate university program
    e. Other
        i. If you answered "Other" for educational background, please specify here.
6. Domestic status:
    a. I am from Calgary
    b. I am from another location in Alberta
    c. I am from another province
    d. I am an international student
    e. Other
        i. If you answered "Other" for domestic status, please specify here.