Peer-Led Teaching: An Effective Approach to Enhancing Student Engagement and Deep Learning

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***Abstract*— This paper explores an interesting pedagogic method where students actively participate in the preparation and delivery of lectures. Over the past four years, this method has yielded positive feedback from both students and observers in the FYSA14 course: Introduction to Thermodynamics, Climate and Experimental methodology. In this approach, small groups of students prepare and teach portions of the course content, subsequently evaluated by their peers on various criteria. The primary motivation is the allocation of bonus points, encouraging students to engage deeply with the material, enhance their understanding, and develop skills in organizing information, teaching and creativity. This paper outlines the methodology, evaluates its effectiveness, and provides insights for its broader application.**

***Index Terms*— Peer-led teaching, Active engagement, Deep learning, Bonus points.**

I. Introduction

In the evolving landscape of education, traditional teaching methods are increasingly being complemented and sometimes replaced by active learning strategies. Traditional lectures, where the teacher is the sole provider of knowledge, often lack the interactive engagement that fosters deeper understanding. Active learning, which involves techniques such as group work, discussions, and problem-solving activities, interactive demonstration has been shown to enhance student engagement and learning outcomes (Prince, 2004; Freeman et al., 2014, Le et al., 2023). Despite these advancements, there remains a continuous search for methods that not only engage students but also empower them to take ownership of their learning process. In other words, students should be encouraged to actively invest time and effort in course materials through preparation, deepen exploration, and application-based enhancement.

We all know that attending lectures with prior preparation significantly enhances understanding. Having a basic idea of what the lecture will cover helps students connect more effectively with the underlying theories and concepts, and is therefore important for deep learning. From our observations over the years, students rarely prepare for lectures in advance and many efforts to encourage this habit have failed. This raises an important question: **How can we motivate students for pre-lecture preparation and in what format?**

One such effective method involves students in the preparation and delivery of lectures. This approach leverages the benefits of peer teaching, where students learn by teaching others, thereby reinforcing their understanding and developing essential communication skills (Topping, 2005). This paper discusses a specific implementation of this method in the Thermodynamics course, highlighting its structure, evaluation criteria, and the observed benefits and challenges.

In this approach, small groups of students are responsible for preparing and teaching parts of the course content (the last chapter of the course). Their performance is then evaluated by peers based on several criteria including understandability, accuracy, creativity, question handling, and engagement. The main motivation for student participation is the opportunity to earn bonus points, which encourages their deeper engagement with the material.

II. Methodology

The methodology involves several key steps designed to foster students' deep learning and engagement:

A. *Formation of Groups:*

Students are divided into small groups of three to five members. So far students have been free to choose their group members. However, this can be improved by applying collaborative leaning techniques to ensure balanced and productive group dynamics (Slavin, R.E., 1996), which I will discuss more in the challenges and considerations section.

B. *Assignment of Topics:*

We divided the chapter into five or six sections depending on the number of participants. We normally have five to six groups. Each group was randomly assigned a portion of the course content to prepare and teach by drawing lots. They hold a 20 to 25 minutes lecture per group.

C. *Evaluation Criteria:*

The performance of each group is evaluated by their classmates based on the following criteria. These criteria were selected based on my formative and self-regulated assessment of my teaching and from several pedagogic references. The references help me to establish clear, evidence-based criteria for evaluating student-prepared lectures, ensuring that the criteria are aligned with educational goals (Biggs & Tang, 2011) and best practices in teaching and assessment. Indeed, the seminal work by Bloom et al. (1956) and the revised version of Bloom's taxonomy by Anderson et al. (2001) provided insights into

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cognitive processes involved in learning and teaching, which include criteria such as understanding, accuracy, and the ability to answer questions. In the paper presented by Nicol and Macfarlane-Dick (2006), they outline principles of effective feedback, which can be applied to peer evaluation criteria such as clarity, accuracy, and engagement. In summary, with slightly improvements over the years, five below criteria were applied and recommended:

o Understandability: Clarity and comprehensibility of the presented material.

o Accuracy: Correctness of the information delivered.

o Creativity and Engagement: Use of creative methods to engage the audience.

o Question Handling: Ability to answer questions from the audience.

o Active Participation: Actively questioning and engaging with other groups' presentations.

D. Bonus Points:

Groups receive bonus points based on their performance, which contribute a maximum of 2 points (~ 8%) to their final grade. As this section is optional, students are not required to participate in it, meaning they can still achieve the highest grade if they perform exceptionally well on the final exam.

E. Feedback:

Both formative and summative feedback are provided to help students improve their teaching skills and understanding of the material. The teacher and peers are responsible for giving short feedback after each presentation. Additionally, the teacher will summarize important points in the last fifteen minutes of the session.

This method was applied during the last chapter of the Thermodynamics course, where students were already familiar with the foundational concepts and had experienced traditional and active learning methods.

III. Results and Discussion

A. Student Engagement and Deep Learning

The introduction of this method significantly increased student engagement. Approximately 70% to 80% of students participated (e.g., 73% this year), despite the optional nature of the activity and the relatively small bonus points. This high participation rate underscores the motivational impact of peer evaluation and the opportunity to earn bonus points.

Students reported a deeper understanding of the topics they prepared and taught. The process of organizing content logically, anticipating questions, and teaching their peers required a comprehensive grasp of the material, which reinforced their learning. Moreover, the need to meet diverse evaluation criteria encouraged creativity and active engagement with the course content. “I really much enjoyed the Chapter 20 presentations. I understood the concept well and was able to teach it” (Student feedback 2024).

B. Development of Teaching Skills

By preparing and delivering lectures, students developed essential teaching and communication skills. They learned to present complex information in an understandable manner, engage an audience, and handle questions effectively. These skills are valuable not only academically but also professionally. Over the years, students have applied various teaching methods. These include traditional approaches, such as using mathematics to describe the Carnot engine, active learning with demonstrations like mixing colors in water to explain entropy, and demonstrations of various engines such as diesel and Stirling engines. Additionally, they frequently utilized interactive activities such as quizzes, Mentimeter, and gamification to enhance learning and evaluate peer understanding.

C. Challenges and Considerations

While the method proved beneficial, several challenges were noted:

1. Preparation Time: Significant time was required for students to prepare their presentations adequately. This included researching, organizing content, and rehearsing their delivery.
2. Coverage of Content: Ensuring that all course content was adequately covered posed a challenge, especially if some groups were less thorough in their preparation. This can be mitigated by forming student groups effectively, ensuring productive collaboration and positive learning experiences, which we will discuss next.
3. Cooperative learning: Many research and my observation show that students are often comfortable to form and stick to a small group of students who have similar learning style, communication ability and learning ability. Although it worked fine in my course, we can even enhance student achievement and communication skills by guiding them forming groups with other students who have less interactions before. This fosters positive interdependence and individual accountability (Millis, B. J., 1998). This consideration was also mentioned by a student “Maybe when making groups of students work on a particular activity, the lecturer could separate the students to different groups instead of letting the students decide by themselves. This is because we are always comfortable with those we stay with the most so to inspire new friendships and self-improvement, there must be a sense of discomfort.” (Student feedback 2024)
4. Assessment Fairness: Balancing peer evaluations to ensure fairness and consistency required careful consideration and sometimes teacher intervention.

D. Feedback from Students and Observers

Feedback from external observer and students who attended the lectures was overwhelmingly positive. Observer noted the high levels of engagement and creativity displayed by the students. “In 2023, I participated as an observer in the student-led lectures for FYSA14. My impression of this section of teaching is that all the students were very interested and engaged with the material they were required to teach. They put thought into learning it and spent time and effort on how to present it. The classroom atmosphere was welcoming and inclusive, making the students feel comfortable both presenting and asking questions of the presenters.” (Anna-Lena Sahlberg, Senior Lecturer at Department of Physics). Students appreciated the opportunity to take on a teaching role and found the experience enriching. Figure 1 shows a copy of the summative student feedback evaluation for this section from this year. Among 30 feedback responses, 10 students did not participate in the section or felt irrelevant as they redo some other elements of the course such as lab works. Of the remaining 20 feedback responses, 19 students agreed that it was crucial and helpful, while one student believed it had minor benefits.

Involve in preparing lectures (Chapter 20)

Involve in preparing lectures (Chapter 20)	Number of responses
crucial	5 (16,7%)
helpful	14 (46,7%)
of minor benefit	1 (3,3%)
I did not do this (or very little)	7 (23,3%)
not applicable	3 (10,0%)
Total	30 (100,0%)

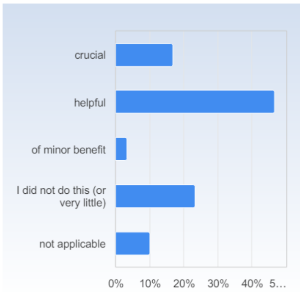

***Figure 1**: Student feedback on the role of involvement in preparing and teaching Chapter 20*

Students highlighted the value of peer feedback, which helped them identify areas for improvement and build confidence in their teaching abilities. They also expressed a greater appreciation for the complexities involved in teaching, which fostered a deeper respect for the educational process.

Notice that this method has been demonstrated to work well in courses with fewer than 30 participants, consisting of two 90-minute lectures. To apply this method to larger courses with more students, the methodology should be slightly modified. For larger classes, more materials and extended time are necessary, as there will be more groups. Additionally, incorporating more structured guidelines for group work and utilizing technology to facilitate interaction and feedback can help manage the increased number of participants effectively.

IV. Conclusion

Involving students in preparing and delivering lectures is an effective pedagogic strategy that enhances engagement, deepens understanding, and develops essential skills. This method, applied in the Thermodynamics course, received positive feedback from both students and observers. The experience encouraged students to take ownership of their learning, demonstrated the benefits of peer teaching, and fostered a collaborative learning environment.

While challenges such as preparation time and content coverage need to be managed, the overall benefits make this approach a valuable addition to traditional and active learning methods. Future implementations could explore variations in evaluation criteria, support structures, and integration with other pedagogic strategies to further enhance its effectiveness.

By embracing innovative teaching methods that actively involve students in the learning process, educators can create more dynamic and effective educational experiences. This approach not only enhances academic outcomes but also prepares students with the skills and confidence needed for future success.

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