Engaging students in lectures to cultivate classroom equity

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Introduction

Interactive teaching is of importance for deep learning (Kember and Gow, 1994). However, traditional lectures, which have been widely used for centuries to disseminate knowledge, can result in more surface approached learning (Kember and Gow, 1994), as the interactions with students are often difficult or neglected. Furthermore, attendance and student engagement have been found to be lower in lectures compared to an alternative concept of ”deliberate practice” (Deslauriers et al., 2011). This is accentuated by the new generation students’ demands of more interaction during classroom teaching (Rocca, 2010). Thus, there is a need to re-think lectures to become more interactive to achieve deep learning (Kember and Gow, 1994; Rocca, 2010).

Here, I describe a pedagogical exercise where students were given short questionnaires during lectures, with the aim of increasing their deep learning through interactions and engagement in the course. The questionnaires were provided on paper and were answered anonymously, allowing the students to highlight areas of interest that would require extra attention in follow-up lectures, either out of pure curiosity or for additional explanations. The exercise can be considered an equitable teaching strategy (Tanner, 2013), aiming to teach and demand engagement of all students in the class. The selected course was Microbiology, a first-year bachelor course, taught at the Department of Plant and Environmental Sciences, University of Copenhagen in the Spring of 2026.

Justification

The pedagogical exercise had multiple purposes. Firstly, this was my first time teaching the course, and the questionnaire could provide feedback on the level of my teaching, allowing me to adjust the level. This contrasts with the student evaluations given after the course, which would primarily benefit students in the following years. Secondly, by engaging the students, this might open for active participation within the course and cultivate engagement in their future courses. Finally, by answering the questionnaire, they would also have to express themselves in writing which might be purposeful for their written exams.

Methods and background

I was giving three lectures during the course on two different dates. There were two weeks between the first lecture (week two of the course) and the second and third lectures (week 4). Hereafter, I did not have any interaction with the students. The lectures were part of a range of lectures given by others from the Section of Microbial Ecology and Biotechnology. The lectures were held in a lecture hall with fixed chairs. The students had weekly readings from a microbiology textbook. In this class, 66 students attended the written exams. In the beginning of lecture one, I introduced the students to the concept, highlighting that it was a way to have a direct impact on the teaching. Short questionnaires (three to four questions), with questions related to the curriculum and lectures, were distributed on a paper to the students prior to the lectures (see Appendix for the questions). It was highlighted that the questions were answered anonymously and it was voluntarily. The students were asked to answer the first question before starting the lecture, and the remaining afterwards. Hereafter, the questionnaires were collected.

Results from questionnaires

From the first round of questions, I received 36 replies out of ~50 students attending the lectures. More than half of the students did not read the curriculum text prior to the lectures (Appendix 1.1). Hence, they could not answer if they had any difficulties with the reading material. The vast majority found to various degrees that the lecture had been helpful in understanding the topics covered, and a few students endorsed the group

discussions/assignments given during the lecture. No student disliked that part. A small fraction of the students replied that they were interested in hearing more about isolation techniques of curiosity, while another subset was asking for extra explanation of the Winogradsky Column. The majority of the students did not respond to the third question or did not have any extra material they wanted covered. Based on the students' comments, those two topics, isolation techniques and the Winogradsky Column, were included in the beginning of the following lecture.

Reflection on the responses from the first lecture

It was surprising to see how many students had not prepared for the lecture and that a relatively large proportion relied on PowerPoint slides for studying instead of the textbook. Knowing that the following lectures would include more complex material, I decided to write an Absalon note, encouraging them to read and prepare for the upcoming lectures to increase their learning outcomes. Another interesting finding was that 2/3 either did not reply or replied no to the third question, where they had an actual possibility to partially influence the lecture content. I attribute this to the first time being exposed to such an approach and a lack of knowing the lecturer. The lack of preparation indicates a need to emphasize how lecture preparation is connected to teaching activities, e.g. in-class assignments or discussions. This will create better alignment among preparation, teaching activities and intended learning outcomes.

Responses from second and third lectures

Out of the 27 that handed back the questionnaire, six students had not read the curriculum and four did not answer the first question (Appendix 1.2). Approximately 30% (8/27) answered that most of the curriculum for this lecture had been complicated, four mentioned the Redox Tower as the most complex topic, whereas the remaining five provided 5 distinct topics. For the majority of the students (19/27) the lectures had been helpful for their learning process. Four indicated that the pace of the lecture was too fast, and one did not find the lectures helpful. The Redox Tower ranked number (six students) one as the most important topic they learned during the lectures, while four and three mentioned

phosphorylation and diversity in catabolic activity as the most important topic, respectively. Three students did not know and five did not answer this question. The majority of the students found the questions helpful to various degrees. However, two and three students questioned why the textbook was used for in-lecture assignments and why slides were not uploaded prior to the lectures, respectively.

Reflection on the responses from the second and third lectures

Expectedly, a high proportion of the students found the curriculum difficult for these lectures. Microbial metabolism and electron donor/acceptors are often found complex for the students. The proportion of students that had read in advance increased from lecture one, indicating that Absalon reminder had helped. Compared to the first lecture, a higher proportion had identified key topics that they found difficult. This suggests that through preparation, the students start to reflect upon the course topics. Interestingly, the Redox Tower was identified by most students as the most difficult topic and was also ranked number one as the most important topic they learned during the lectures. This indicates that students paid more attention to certain topics after having prepared and reflected upon the course material. According to most students, the lectures had benefitted their learning outcome to various degrees. A few found the pace too fast. While it should not be neglected that some students find the pace too fast, the overall answers suggest that the lectures had an appropriate level. The students' replies to question four suggest that some of them endorsed the assignments that were provided to them during lectures and not the questionnaire. Afterall, the questionnaires were not meant to increase their learning outcome as some responded. The answers mentioning the textbook in the replies support this, as some assignments were related to values in tables from the book. The comments on this matter show that students do not bring the book or might not even have it. Since the curriculum is mainly based on the textbook, assigning them questions where they have to search for the answers in the textbook, prepares them for the exam, ensuring congruence.

Concluding remarks

The use of anonymous questionnaires provides all students the opportunity to engage and ask questions without feeling uncomfortable and cultivate classroom equity (Tanner, 2013). In this study, most students endorsed the approach and found it useful. While the curriculum is set a priori, year-to-year variation in students' levels and knowledge requires adaptations in the lectures and can guide the teacher to focus more on certain topics. Some questions need to be modified to increase specificity (e.g. Q4 for lectures 2 and 3). In contrast to the course evaluations filled out by students at the end of a course on Absalon, they might be more entitled to comment on these questionnaires during the course, as adjustments to lectures will benefit themselves, instead of students in next year's course. Besides the questionnaires, in-lecture group assignments were used to encourage deep learning (Hunt, 2003). Since the purpose of these assignments was not clear to all students, I will emphasize the reasoning for providing them next year (*i.e.* encourage deep learning, congruence between teaching and exam). One student suggested using an online tool for the questionnaire. This suggestion is reasonable, although writing requires more effort, and a meta study has found that written notes improve learning compared to typed notes (Flanigan et al., 2024). Furthermore, online tools with real time updates of answers might also affect the students' responses, and students that do not bring a phone or computer would be excluded from answering. Albeit not related to the questionnaires, several students commented on the lack of slides prior to the lectures. From the answers to lecture one, it was clear that students expected this and were caught by surprise. Not providing lecture slides was an intentional decision, as I believe it is important to approach the curriculum in different ways, including reading, attending lectures, solving problems, and discussing. However, lecture slides, if provided, would be the sole focus and replacing the reading, as revealed in their replies. Thus, by not providing lecture slides, students are encouraged to read, reflect on the material which will enable them to determine what areas need more work, which areas are the most interesting and which are likely the most important. To develop the concept of using questionnaires, student responses can be used to adjust

not only the content of the lectures, but also the teaching activities to support the learning of the students.

In conclusion, I will include questionnaires as part of the lectures for the upcoming Microbiology course, with some minor modifications. Firstly, I will highlight the potential benefits for them (direct influence on part of the lectures) as a reason for participating. Secondly, I will encourage them to be specific in their replies for the best outcome. And finally, I will use the responses to adapt the teaching activities to increase the learning outcomes.

References

Deslauriers, L., Schelew, E., Wieman, C., 2011. Improved Learning in a Large-Enrollment Physics Class. *Science* 332, 862–864. https://doi.org/10.1126/science.1201783

Flanigan, A.E., Wheeler, J., Colliot, T., Lu, J., Kiewra, K.A., 2024. Typed Versus Handwritten Lecture Notes and College Student Achievement: A Meta-Analysis. *Educational Psychology Review* 36. https://doi.org/10.1007/s10648-024-09914-w

Hunt, S., 2003. Encouraging student involvement: An approach to teaching communication: *Communication Studies*: *Vol 54* , No 2 - Get Access. Communication Studies.

Kember, D., Gow, L., 1994. Orientations to Teaching and Their Effect on the Quality of Student Learning. *The Journal of Higher Education 65*, 58–74. https://doi.org/10.1080/00221546.1994.11778474

Rocca, K.A., 2010. Student Participation in the College Classroom: An Extended Multidisciplinary Literature Review. *Communication Education 59*, 185–213. https://doi.org/10.1080/03634520903505936

Tanner, K.D., 2013. Structure Matters: Twenty-One Teaching Strategies to Promote Student Engagement and Cultivate Classroom Equity. *CBE—Life Sciences Education* 12, 322–331. https://doi.org/10.1187/cbe.13-06-0115

Appendix 2.1

Questions for the first lecture (Questions were provided in Danish):

1. Were there any parts of the curriculum that was difficult to understand?
2. Did the lectures help in your understanding?
3. Is there any topic from today's curriculum that you want to be elaborated on in the next lecture? Either because you are curious or you found it difficult?

Out of the 66 students that attended the written exam, 36 answered the questionnaire. I estimated the attendance to be ~50 for this lecture.

Below the comments/answers to the above questions are included.

Question 1:

Answer	**Number of students**
No	5
The Winogradsky Column	5
Characterization of bacteria	1
Live/dead staining	1
Chemistry	1
Specific method	1
Did not answer the specific question	1
Did not reply	1
Did not read	20

Question 2:

Answer	Number of students
Yes	14
Yes – in-lecture assignments helped	4
Yes – to some degree (unspecified)	3
Yes – to some degree (specified)	2
Yes – but slides were lacking	5
Slides lacking	2
Too much content outside curriculum	1
It helped searching online during the lecture	1
Not sure	1
Did not answer	3

Question 3:

Answer	Number of students
Yes – topics not specified	2
DAPI staining	1
Winogradsky columns	3
Isolation strategies	2

Isolation techniques	3
Shotgun metagenomics	1
No	10
Did not answer	14

Appendix 2.2

Questions for second and third lectures:

1. Were there any parts of the curriculum that were difficult to understand?
2. Did the lectures help in your understanding?
3. What was the most important part you learned from today's lectures?
4. What do you think of receiving such a questionnaire?

Out of the 66 students that attended the written exam, 27 answered the questionnaire. I estimated the attendance to be ~40 for these lectures.

Below the comments/answers to the above questions are included.

Question 1:

Answer	**Number of students**
Everything or almost everything	6
Yes (but unspecified)	2
Chapter 14	1
Anaerobic respiration	1
Electron transport chains	1

Interspecies H2 transfer + Gibbs energy	1
Redox	4
Phosphorylation	1
Did not answer the specific question	2
Did not reply	2
Did not read	6

Question 2:

Answer	**Number of students**
Yes	12
Yes – in-lecture assignments helped	2*
Pace is too fast	4*
Yes – to some degree (unspecified)	2
Yes – to some degree (topics specified)	3
Slides lacking	3
No	1
Did not answer	1

*One student replied that lectures had helped, while pace was too fast.

Question 3:

Answer	Number of students
Apply the knowledge to growth media design	1
Syntrophy	1
Anaerobes generating ATP	1
Redox tower	6*,#
Citric acid cycle /glycolysis	2
Phosphorylation	4*,#
Denitrification	1*
Electron transport chain	1
Diversity in catabolic activity	3
Not specified	1
Too fast	1
Did not know	3
Did not reply	5

one student named two topics, * one student named three topics

Question 4:

Answer	Number of students
Helps understanding the curriculum	4
Great	4

Okay/fine	7
Shows willingness to adapt	1
Helpful – but do not understand why questions are related to topics in the book	2
Providing a qualified answer takes time	1
Good, but why not upload slides ?	3
Bad conscience for not reading	1
Did not reply	3
Do not know	1