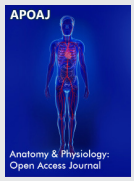

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Student-Led Lecture as an Innovative Active Learning Approach in Large Cohorts Teaching: A Case Study

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Abstract

How to improve student learning outcomes especially in a large cohort is always a challenge. In this paper, we reported an initiative, called "Student-led Lecture", to implement active learning in large classes with an aim to improve student independent learning skills. A 30-minute lecture was delivered by a student (first author) under the supervision of the module leader (corresponding author) to a cohort of 140 students in the Human Physiology module (Year 1) at one university in one academic year. Final exam marks at semester 2 as well as post-lecture and post-exam surveys were used to measure its impacts on learning outcomes. Our results showed that student-led Lecture can help to improve conceptual understanding, student motivation, exam preparation and performance. The independent learning skills explicitly explained in the lecture helped the cohort in their individual studies and had positive impacts on other modules too.

Therefore, we concluded that student-led Lecture as an innovative initiative can successfully implement active learning in large cohort class with a feasible delivery in an academic year, and importantly, it has potential in helping students to improve their independent learning skills.

Keywords: Student-led lecture (SLL); Active learning; Independent learning; Conceptual understanding; Large cohort

Introduction

Active learning is defined as a student-centered instructional method for students to engage in the learning process through various activities, e.g., group-work, collaboration, feedback [1], while passive learning allows students passively receive information from lecturing. Active learning aims to improve conceptual understanding [2] and has been shown to improve subject-related knowledge, professional, social and communication skills [3], and student motivation [4]. Various active learning approaches have been studied and revealed many benefits. For example, a meta-analysis of 225 studies in STEM subjects showed active learning increased student examination performance [5]. Active learning can also be beneficial in developing working skills which are important for students after graduation [3]. [6] also showed that active learning benefit students from disadvantaged backgrounds more than other students, making active learning very appealing to use in higher education.

Most active learning approaches are aimed at smaller cohorts [7], the greatest impacts were reported in small classes ($n \leq 50$) [5]. Most large classes predominantly use passive learning [1]. Although passive lecturing is not without its benefits, especially in delivering large amounts of information to large audiences [1].

Studies show active learning to be more effective when students experienced passive learning beforehand [8]. Therefore, implementing active learning alongside passive learning in larger

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classes could potentially maximize the positive learning outcomes as a higher number of students could make use of active learning [8], e.g., improved conceptual understanding [2] and professional skills [3]. There have been calls for more studies to investigate what type of active learning and its efficiency for various circumstances [5], e.g., classes with larger cohorts.

In this study, we developed a novel initiative, named "student-led Lecture (SLL)" and trailed it in one module during 2017-18 academic year. The main aims were to test whether SLL can be successfully used as an interactive active learning approach in large cohorts, and whether such an approach is feasible in the module. Therefore, benefits and potential drawbacks of these Lecture along with their feasibility were assessed. We further discussed the potential to use SLL to help students improve their independent learning skills. To our knowledge, no such approach has been trailed in large cohort classes before.

Methodology

Principle and design of student-led Lecture

SLL is a format of lecture designed and delivered by students under supervision of the module leader. It aims to employ active learning in large classes and help students develop transferable and independent learning skills. This was inspired partly by our own teaching philosophy: "Teaching is a three way of thinking between the lecturer, students, and sources. When mutual understanding between the three increases, the quality of Lecture and teaching, and learning outcomes are achieved." [Professor Lijun Shang, personal conversation].

SLL is not a replacement of core Lecture delivered by lecturers but acts as a supplementary activity to involve students in the learning process. The module leader discusses details of the lecture plan with the student presenter. These include choice of the lecture, depth, and accuracy of content, as well as date, time, and duration of delivery. The student presenter then develops and prepares the lecture under supervision. SLLs can be delivered entirely by student(s) or a group, which will have the added value of improving teamwork abilities, or with help from the module leader, who in both cases will be present to monitor the quality of the lecture delivery.

Lecture content can be module content summary, extra relevant information, case studies, or any topic which students struggle with, and usually be decided according to pre-lecture surveys. Contrary to core Lecture, SLLs do not have a fixed content that needs to be taught in a limited time and allow more time for discussion. The lecture may also be used to present a problem, possibly divided into several sections, which will be solved through students working together. These contents were not examinable.

A successful SLL requires a student presenter capable of preparing and presenting a lecture with accurate information, confidence, and enthusiasm. Students are encouraged to volunteer so that only those who feel comfortable participate. Students with higher grades usually correlate with increased module understanding and stronger independent learning skills. As these skills can be explicitly explained or implicitly demonstrated to other students during the lecture, we therefore also investigate whether SLLs could have an impact on student independent learning skills.

Implementation of student-led lecture

The SLL was presented as a Trail in the Human Physiology module (BIS4009) of Biomedical Sciences course (1st Year, Level 4) at one university in one academic year. The 30-minute lecture was presented to a large class cohort of n=140 at the end of Semester 2 (spring term). The content of the lecture involved three main sections:

- Summary of topics covered in 2nd Semester of the module, i.e., Cardiovascular, Respiratory, and Renal organ systems and the regulation mechanisms which each system employs individually and the relationships between
- Case study linking the three organ systems together and analyzing their roles in everyday life and homeostasis, named "24 hours in the life of an individual and the mechanisms that regulate homeostasis"
- Acidosis as a physiological disorder, and the metabolic and respiratory pathways which the body uses to resolve it

The above lecture content was chosen by a pre-lecture student online survey to identify problems and to reflect student demand. The first section was predominantly discussion-based module contents summary but taking from an alternative perspective of students views compared to a normal "teaching lecture". The presenter facilitated the discussion and students were divided into groups to summarize and explain one of each topic so that all groups had a chance to be involved. The presenter occasionally incorporated contents from other modules such as Introductory Biochemistry (BIS4007), and Human Development and Genetics (BIS4010) to illustrate how different modules connect. The second section was using a case study to connect theories and concepts learned throughout semesters to real-life examples. This section also employed student discussion in the form of questions and answers. The third section was about a physiological disorder, acidosis, chosen by the pre-lecture survey. In the explanation of this complicated disorder which puzzled most students, the presenter also explicitly stated how he break down details of the topic and his learning process and pattern of learning. This was aimed to explore the potential use of SLLs in improving student independent learning skills.

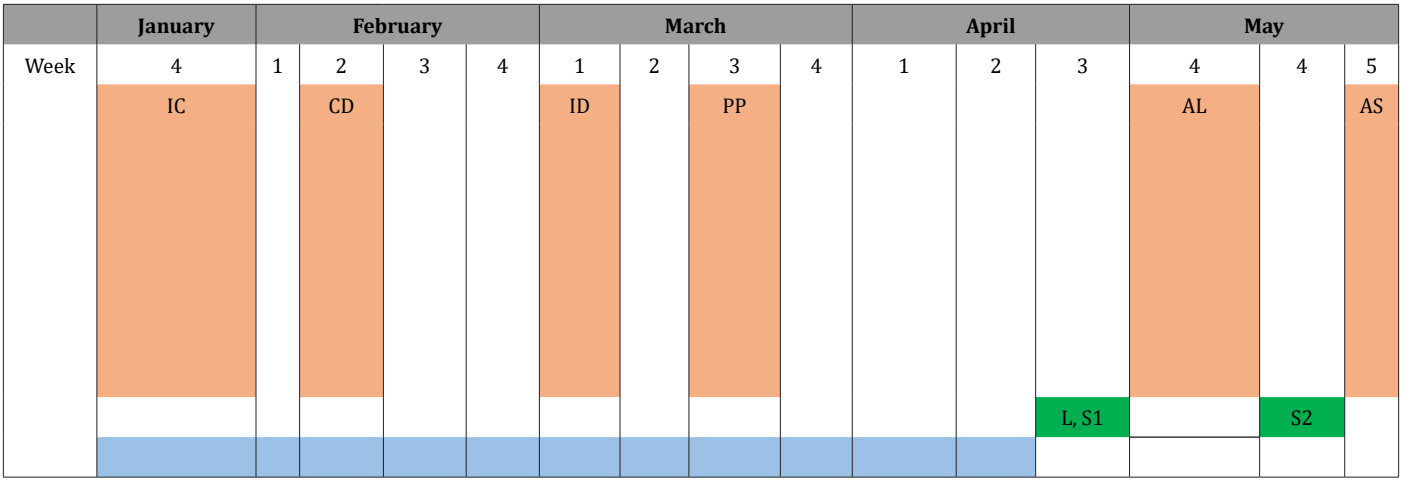
Evaluation of student-led lecture

To evaluate this Trial lecture, students' module grades and post-lecture surveys were used. Module grades were taken from the final module exam. The surveys data were from the cohort, the presenter, and the module leader. The cohort surveys consisted of a series of Likert scale-based questions [9], with a short, open-ended section in the end. Questions in the second survey were predominantly related to learning skills, improvement in understanding, and exam preparation and performance after the final exam which allowed

enough time for independent study before evaluation. Both surveys were displayed in Supplementary document. Presenter and module leader surveys were predominantly open-ended questions to allow reflection and full analysis of the lecture. The module leader also commented on the feasibility of this initiative.

To determine lecture feasibility, a Gantt chart (Table 1) was used to record all activities involved in lecture preparation, delivery, and evaluations. Initial communication between the presenters and the module leader began at the start of semester 2. Three meetings took place before the lecture and allowed enough time to determine the content and delivery, to review the initial draft of presentation, and to practice the lecture. After the lecture, a revision meeting took place to assess the lecture, to analyze the practicability of lecture incorporation in the module timetable, and to provide feedback to the presenter. Improvable areas were identified and used to further enhance the initiative. A final meeting was held after the second survey to compare results with the first survey.

Table 1: Gantt chart of activities during the student-led lecture in semester 2.



Gantt chart of activities involved. Orange: Meetings; Green: Lecture and/or Surveys; Blue: Presenter Independent work (Block of time used for studying, revision, making and practicing presentation); IC: Initial communication; CD: Content and date determination; ID: Initial draft; PP: Presentation practice; AL: Post-lecture and first survey meeting; AS: Post-second survey meeting; L, S1: Lecture and first survey; S2: Second survey

Results

Cohort results on module exam and surveys

Table 2: Cohort exam results and survey results

A: Exam Marks		
100% pass rate for all students who sat second semester exam		
5% increase in class average grade in current academic year compared to those in previous year		
B: Likert scale responses	**Score**	
Overall lecture satisfaction	8	
Wanting the lecture to be used more often in the future	8	
Advantageousness of class-wide discussion in summary section in understanding concepts (S1)	7	8
Advantageousness of alternative perspective used in summary section in understanding concepts (S1)	8	9
Comfort in speaking out loud in the class in front of peers (S1)	5	
Easiness of participating in discussions when peer is presenter compared to lecturer (S1)	8	
Comfort of working in groups (S1)	6	
Improvement of ability to integrate knowledge from different sources after observing the integration of two other modules in the lecture (S1)	7	8
Effectiveness of case study in connecting theory to real-life example (S2)	7	7
Understanding the presenter's pattern of learning (S3)	8	
Using the same pattern of learning explained by the presenter in independent study (S3)	4	5
Motivation to develop own pattern of learning after explanation of presenter's pattern (S3)	7	8
Advantageousness of exposure to this pattern for exam preparation (S3)	7	9

Advantageousness of exposure to this pattern for exam performance (S3)	6	8
Increased motivation for studying after the lecture	7	9
Open-ended section comments: For first section (summary) of lecture:		
• Greater sense of subject mastery felt while summarizing, increasing motivation to summarize more in revision as it stimulated minds and helped increase content proficiency and conceptual understanding		
• "Viewing topics from alternative perspective helped independent study skills, as I learned how to do this with other modules as well, helping exam performance; using perspectives other than the conventional textbook one stimulated my mind more and changed how I think about the information"		
• "Having peer as presenter made me more comfortable and relaxed about speaking out loud in class"; motivation for teamwork and studying and confidence also increased		
• "Peer presenter used examples more relevant to our generation, which aided explanation, learning of concepts, and especially student interests"		
• Learning how to integrate knowledge from other sources e.g., modules helped independent studies, and will help in future for writing assignments, e.g., essays		
• "Even though I am not totally comfortable in class discussions, I feel my confidence increased, and class-wide discussions and collaboration helped me get a greater sense of unity and belonging in the class"		
• A greater understanding of content included in the lecture was developed and this significantly helped preparing for and performing on questions on this content in the exam, compared to others (this comment is related to other sections as well). "Overall, the lecture had a positive impact on my exam."		
For second section (case-study):		
• "Viewing the case study connecting theory to real-life examples helped me learn how to do the same for my independent study in different modules."		
• Proficiency in concepts increased		
• Had a positive impact on exams		
For third section (acidosis explanation):		
• Peer presenter explained problematic and complicated concepts with less details and information, aiding understanding of the major points.		
• "Observing presenter's pattern of learning motivated me to develop my own pattern, which increased independent study efficiency and concept understanding in many modules greatly, and helped exam preparation and performance"; "this also increased my feeling of responsibility for learning"		
• "Learning how to study has increased my enthusiasm and motivation for learning"		

A: Students' exam grades for Human Physiology, B: Survey results, Main Likert-scale questions were included along with scores. Questions asked in the second short survey presented by the second grade on the right. Answers range from 1 (not at all) to 10 (a very high extent). Some questions refer to a specific section and this has been indicated in parenthesis, i.e., S1, S2, S3 refers to Section 1, 2, 3. Open-ended section of survey was included below Likert-scale section, and comments presented were divided based on section of lecture they refer to. Comments were simplified for illustration purposes.

Table 2 displayed the cohort Semester 2 exam grades for Human Physiology module (A) and survey results (B). All students sat the Semester 2 exam passed the module (i.e., exam had a 100% pass rate) and there was an increase of 5% in the class average grade in the current academic year compared with those in the previous year.

The survey results were displayed in Table 2B. 65% (n=91) responded to the first survey and 60.7% (n=85) responded to the second in total cohort of n=140. All scores in the survey were high except for speaking out loud in class, working in groups and utilizing the same pattern of learning the presenter used. The second survey, which was conducted after enough time for independent study and sitting examinations, showed that all scores were higher than those in the first survey, except for the question related to the case study, where the score stayed the same.

Overall satisfaction from the lecture was high (8/10), with student desire for more SLLs in the future scoring 8/10. Motivation to study was initially high (7/10) and further increased (9/10) in the second survey. Questions about advantages of multiple perspectives and discussion scored 7- 8/10 at first but increased to 8-9/10 in the second survey, respectively. Except for using the presenter's pattern of learning, independent study questions scored 6-8/10 in the first survey and increased to 7-9 in the second.

All sections received additional open-ended comments, some selections were displayed in Table 2. Only comments received by a minimum of 20 students were displayed. Comments on the first section of lecture were related to summarizing and using an alternative way of learning and their effects on abilities of

independent study. Various positive points on having a peer as a presenter were also mentioned, e.g., usage of more relevant analogies and examples, and being more comfortable in discussions. Many students also reported an increase in confidence, unity and belonging, despite being not very comfortable in class discussions previously. Comments on the second section were focused on using case studies to improve independent learning in this module and others, and the effect on conceptual understanding and exams. In the third section, students commented on how the presenter's pattern of learning helped them to develop and improve their own. Students mentioned numerous benefits in terms of understanding and exam performance which also help to increase students' responsibility of learning, not just for this module but for all modules. Students also reported the reduced level of detail used by the presenter in the lecture was advantageous in the explanation of complicated topics.

Motivation to learn and study also increased with the improved abilities in independent study. Students elaborated on how they thought exposure to presenter's pattern of learning aided their own exam preparation and performance. For all sections, students felt a positive impact from the Trail lecture on their exams.

Presenter and Module Leader surveys

Table 3A and 3B displayed the exam and the survey result for the presenter, respectively. The presenter achieved an increase in exam grade of 13% for the module from 82% in Semester 1 to 95% in Semester 2. The presenter's survey focused mainly on understanding and the exam of the module. The comments showed how delivering the lecture helped him to increase content proficiency, which the presenter believed directly account for the 13% increase in exam grade. Comments also touched on the feasibility of the preparation and other skills derived from the presentation itself, e.g., increased confidence and presentation skills.

The module leader's comments (Table 3C) focused on the topic identification for the lecture in subsequent years. The module leader also commented on the positive points of improved student enthusiasm and encouragement in independent learning process, as well as the interactive nature of the Lecture. The lecture also acted as unofficial firsthand feedback on the module from the student presenter. In addition, the survey showed that the preparation for the SLL went smoothly (Table 1) and the delivery of the lecture in an academic year was feasible.

Discussion

SLL works as an active learning approach for large cohorts

For the first time, SLL was used as a new active learning approach in large cohorts. The analysis from the below keys points clearly showed positive student learning outcomes.

Conceptual understanding

SLLs had numerous benefits as an active learning for large cohorts (in this case n=140) (Table 2B). Many students enjoyed the SLL. The question designed for identifying the extent of conceptual understanding scored high. Students reported an increased sense of content proficiency and fluency especially through the discussion in the SLL. This increase in conceptual understanding derived from active learning has been reported in various studies [2,3,10]. Students also mentioned that using a perspective different from the conventional textbook for the summary section helped stimulate their thinking. Student's interests in the content also increased, which are like a previous study [11]. The survey also revealed that students witnessing their peers as the presenter increased their motivation to study; like the study previously [12]. This increase in conceptual understanding and student's interests proved to be beneficial for students in their assessments and exams.

Confidence and Collaboration

Students gave a moderate score for teamwork and speaking in front of others, showing that many were not comfortable with these tasks. Despite this, many students commented that the summary which they gave in front of peers helped them to improve their confidence. A similar positive effect on social skills have also been reported in 5 other studies [3]. This improvement in confidence can be beneficial in their studies and future life. Students felt that the collaboration with other students when working in groups, and the combination of summaries from different groups also gave them a sense of unity and belonging. This increased sense of belonging can lead to an increase in perceived meaningfulness of life, which can have positive impacts on mental health [13].

Lecture participation

Students have scored easiness of lecture participation as very high (8/10) when the presenter was a peer instead of a lecturer. Comments were also seen that how having a peer as a presenter made many students comfortable and relaxed in the class presentation and discussion, and further motivated teamwork and confidence. Interestingly, unlike in other main Lectures, all students participated in the class rather than only those who always sat in the front.

Integration of knowledge from other sources

The integration of knowledge from other modules allowed students to appreciate the connections between each module. This proved to be particularly beneficial as the cohort were first year students. In addition, this had a positive impact on students to study independently when they link modules together. [3] reported 16 studies utilizing active learning approaches that positively impacted professional skills.

Examples and analogies

The open-ended cohort survey (Table 2B) revealed that an

advantage of having a peer presenter acted as the examples and analogies used in the Lecture. As the presenter was the same age as the cohort, the analogies, examples, and comparisons used by the presenter can be more easily linked to other students. Another active learning exercise involving student production of videotapes [14], reported that as student perspectives differed from staff perspectives, material with examples and discussion produced by the students turned to be more relevant to other students, and this made learning experiences more relevant and meaningful.

Case study

The case study employed in the lecture was beneficial to connect theory with real-life examples, the same as those reported in other studies [15]. This connection of theory to practice has been reported to improve learning effectiveness [14] and to reduce test anxiety and temptation to cheat in exams [16], allowing students to focus more on learning. Students also believed the case study helped them with content proficiency and exam preparation and performance (Table 2).

Reduced level of details

Interestingly, students reported the reduced level of details included in the presentation, particularly in the third section relating to the explanation of acidosis, by the presenter to be a positive (Table 2). Students indicated that for some complicated topics, the presence of extra information and details can slow understanding and may add confusion. The peer presenter with similar levels of understanding to the cohort sometime can explain topics more easily in their own language and ways. More details of lecture contents can then be built on through further independent study and reading.

Exam Grades

The cohort exam grades (Table 2A) showed an increase compared to the previous year, with no students failure in the exam. Similar results of increased exam grades and decreased failure rates were witnessed in other studies [5,17].

As a single SLL Trail with limited selection of the module content, we did not expect it to have a direct impact on the module grade. However, the students survey (Table 2B) indicated a greater understanding of the content due to the SLL. Many students also acknowledged that seeing their peer's way of learning in the SLL motivated them to develop their own. This further improved their independent learning skills and had a positive impact on their exam results. However, further research is needed to clarify this.

Feasibility

The trail SLL proved its feasibility in module teaching. Details of SLL planning has been discussed in the methods section. The module leader also confirmed its feasibility (Table 3C). It is not a burden for the student presenter but brings lots of benefits, such as enhanced understanding of module, reduced revision for the exam (Table 3B) and other transferable skills.

Table 3: Presenter exam results and surveys of presenter and the module leader.

A: Presenter Exam Grades	First semester exam grade: 82%
	Second semester exam grade: 95%
	Increase in grade of 13%
B: Presenter Survey	Human Physiology was the highest exam grade compared with other modules
	Least amount of preparation needed for the exam. and was the easiest exam
	Preparation for lecture was spread over several weeks, the task was not very demanding
	"Preparing for a lecture is the easiest way of reviewing for a module and becoming fluent in its content"
	"I feel my grade increase was a direct impact from preparing for the lecture"
	"Presenting in front of my peers helped me increase my confidence, presentation and public speaking abilities; greatly helped my other activities. e.g., assignments"
	"Having peers as audience was less stressful than if it were other people"
C: Module leader survey	To subsequent years, lectures should focus more on problematic and complicated topics chosen by students in pre-lecture surveys
	More students were interested in the self-learning process and developed their own learning patterns, which is important for their study in general
	It is good to see that many students participated in the class-wide discussion, making the lecture interactive, and they learned from each other: Also, all student participated but not limited to few who always sit in the front
	Lecture acted as unofficial feedback for the module from the student presenter
	Lecture planning went efficiently; Plausible method of implementation was used which can be implemented in module timetable; SLLs are feasible

A: Presenter exam grades for Human Physiology module: Key points on open-ended survey from the presenter (B) and the module leader (C)

SLL planning can be easily integrated into the module timetable according to the Table 1. The detailed implementation can be modified to adapt to the needs of individual students and cohorts.

As SLLs are used as supplementary Lecture, the presented material is non-examinable. Therefore, there are no potential pressures for students. SLLs can also be used as module summaries at different stages throughout the module and be delivered to act as peer-assisted learning to students who are in lower years. Collectively, SLLs as a feasible active learning approach can be used at different frequencies throughout the academic year.

Benefits to student independent learning skills

Independent learning is an important feature of higher education. Usually, 70-80% of module learning hours are allocated to self-directed (independent) study. This requires students to develop independent learning skills, and these are essential for improving the learning outcomes. These skills would also be important after graduation. Active learning has been reported to lead to an improvement in self-learning autonomy and independent learning [15]; and to improve important professional skills [3].

In this study, we also investigated how effective SLLs can help students to improve their independent learning skills. Questions 10-14 in the survey (Supplementary document) were regarding patterns of learning and independent learning skills.

During the third section of the lecture, the presenter explained how he learned the topic. Although students gave a moderate score for utilizing the presenter pattern of learning, students indicated that they were motivated to develop their own individual learning patterns, benefited from peers' learning styles, and their conceptual understanding and their exam preparation and performance were greatly enhanced after the SLL (all scored high in the survey).

This finding was encouraging as it showed that students took more responsibility for their own learning, like the finding from other active learning exercises [15]. Increased responsibility for learning is one of the 5 main characteristics of student-centered learning approaches [16]. This is coincident to our own teaching philosophy, i.e., the students must contribute to the three-way relationship with lecturers and source material (see above, personal communication with Prof Shang). This responsibility was also shown on the student's pre-exam survey. Students commented that their improved understanding, exam preparation and performance due to their developed independent learning was not limited to this module, but also extended to other modules as well.

The case study aided students with independent learning skills. Students reported that using the skills and a combination of views from lecturers, sources (e.g., books), and the student presenter (first section) motivated them to utilize this strategy of multi-perspective views in their independent study. Students felt that these enhanced conceptual understanding and aided their exam preparation and performance. Interactions during the lecture collectively led to an increase in their motivation and enthusiasm for study (Table 2).

Students mentioned their increased understanding of topics due to the SLL compared to other topics which were not included in the lecture. This provided further evidence of the effectiveness of SLL as an active learning approach in large cohorts. SLLs have the potential to improve student independent learning skills. Future studies involving more SLLs throughout the module will help to validate it. Different students have different patterns of learning and can certainly learn and benefit from others through SLLs.

Benefits to the student presenter

The presenter achieved an increase in exam grade (Table 3A) which was the highest in all modules he took. The survey (Table 3B) confirmed there was a direct link between the Lecture and exam grade and the presenter found the exam to be the easiest one and needed the least preparation. The student spent a great amount of time preparing the lecture which subsequently benefited him in the exam. Preparing and delivering the lecture also increased his confidence and creativity, which acted as a huge booster for his university studies. Two other SLL trails (unpublished) were delivered by the same student after he moved to another university. One was in Gene cloning and Expression B and another was Principles of Bioinformatics modules, Year 2 (Level 5), Biomedical Science Program in the following academic year. These trails were conducted in one large and one medium-sized cohorts, with aims similar to the current study. They resulted similar conclusion mentioned above. The impact on both the student presenter and his peers are positive and huge.

Benefits to the module leader

The cohort surveys (Table 2) identified independent learning techniques and abilities derived directly or indirectly from this SLL. This was also reflected as students took more responsibility for their learning (Table 3C). The module leader's survey showed that SLL can act as unofficial feedback on the module such as identifying topics to be improved in subsequent years.

Although the module leader did not present the lecture, active learning approaches have been reported to renew lecturers' enjoyment and commitment to teaching [18]. This approach may have a similar impact as the module leader actively endeavors to improve student learning experience.

Limitations, future studies, and other trails

The limitation of this study is that only a single SLL was delivered. To gain subject-related knowledge or other skills utilizing an active learning approach normally need an entire semester. The study nevertheless showed that SLL is an effective and feasible active learning approach in large cohorts, with potential to impact on students' independent learning skills. Increasing the frequency of SLLs within a module in future would provide more insight. We have expanded this Trail to the whole module and across the campus on different subjects by colleagues since we presented this study at the university learning and teaching annual conference.

Additionally, evaluation of SLL in this study were limited to the exam grades and surveys. Although they provided an initial picture of how effective this initiative was, it did not specify its exact impact, e.g., on exam grades and performance. Further studies with improved methods of measuring outcomes are required. Increased frequency of SLLs can increase sample sizes allowing statistical analysis and quantification of student outcomes and exam grades to be performed.

Last, students should be made very clear from the very beginning that SLL is supplementary learning activity, and the included content and details are not sufficient for the exam. This was evidenced from 5 open-ended student surveys where students' mis-regarded the summary section of the SLL to contain "all the material" they would need to know for assessments. Similarly, 11 students expressed worry in their surveys about the quality of the presented SL. Students were assured that the SLL was a supplementary lecture and didn't replace any of the officially scheduled module teaching by module team and extra material presented in the SLL would be non-examinable.

In conclusion, an innovative "student-led lecture" was delivered by a student to a large cohort studying Human Physiology. The assessment results showed that SLLs can be used as an active learning approach in a large cohort and have the potential to help students improve their independent learning skills. Students were generally content with the initiative and expressed the desire to be a part of it in the future.

Supplementary Document: Cohort Survey

Questions appearing on the second shorter survey are in italic

Please rate the following Likert scales from 1-10, 1 being not at all, and 10 being a lot. There is an open-ended section at the end, where you can write any comments you may have. This can be further elaboration of a question, or a general comment.

1. How much were you satisfied by the student-led lecture?

2. How much do you think this approach should be used more often in the future?

3. How beneficial do you think the class-wide discussion was in the summary section of the lecture (the first section) in understanding major concepts of the second semester of the module?

4. During the revision section of the lecture, the topics are summarized from a specific perspective, that of the regulation mechanisms used by the different organ systems. To what extent do you think this alternative perspective aided understanding of topics?

5. How comfortable were you in speaking out loud in front of your peers?

6. Do you think having a peer as the presenter made class discussions easier than if The lecturer was the presenter.

7. To what extent were you comfortable working in groups during the summary section of the module?

8. *Knowledge from other modules, Human Development and Genetics, and Introductory Biochemistry were also utilized in the lecture. By observing how the presenter integrated the knowledge and used it in the context of this module, to what extent do you believe this improved your ability to do the same with other sources or information?*

9. *How beneficial do you think the case study (the second section) was in connecting concepts learned during the module with a real-life practical example?*

10. During the third part of the lecture, where the presenter explains acidosis, the method by which he had learned the topic and the steps he needed to take to understand it had been explicitly explained. To what extent do you think you understood the presenter's pattern of learning?

11. *To what extent do you think this pattern of learning will help your own independent study skills, in terms of using that same pattern for other topics?*

12. *To what extent do you think the presenter's pattern of learning motivated you to develop your own pattern of learning?*

13. *To what extent do you believe exposure to the presenter's pattern of learning helped your exam preparation?*

14. To what extent do you believe exposure to the presenter's pattern of learning improved your exam performance?

15. After observing the different study elements described above in the lecture, how much more motivated are you to study?

Authors' Contributions

All authors contribute to the research, draft, and finalize the paper.

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Conflicts of Interest

No conflicts of interest.

References

1. Prince M (2004) Does Active Learning Work? A Review of the Research. Journal of Engineering Education 93(3): 223-231.

2. Hake R (1996) Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. American Journal of Physics 66(1): 64-74.

3. Hartikainen S, Rintala H, Pylväs L, Nokelainen P (2019) The Concept of Active Learning and the Measurement of Learning Outcomes: A Review of Research in Engineering Higher Education. Education Sciences 9(4): 276.

4. de Justo E, Delgado A (2015) Change to Competence-Based Education in Structural Engineering. Journal of Professional Issues in Engineering Education and Practice 141(3).

5. Freeman S, Eddy S, McDonough M, Smith M, Okoroafor N, et al. (2014) Active learning increases student performance in science, engineering, and mathematics. Proceedings of the National Academy of Sciences 111(23): 8410-8415.

6. Haak D, HilleRisLambers J, Pitre E, Freeman S (2011) Increased Structure and Active Learning Reduce the Achievement Gap in Introductory Biology. Science 332(6034): 1213-1216.

7. Aksit F, Niemi H, Nevgi A (2016) Why is active learning so difficult to implement: The Turkish case? Australian Journal of Teacher Education 41(4): 94-109.

8. MacDonald K, Frank MC (2016) When does passive learning improve the effectiveness of active learning? In: Papafragou A, et al. (eds), Proceedings of the 38th annual conference of the Cognitive Science Society 2459-2464.

9. Likert R (1932) A Technique for the Measurement of Attitudes. Archives of Psychology 140: 1-55.

10. Hoellwarth C, Moelter M, Knight R (2005) A direct comparison of conceptual learning and problem-solving ability in traditional and studio style classrooms. American Journal of Physics 73(5): 459-462.

11. Anderson PH, Lawton L (2005) The Effectiveness of a Simulation Exercise for Integrating Problem-Based Learning in Management Education. Developments in Business Simulation and Experiential Learning 32: 10-18.

12. Bonwell CC, Eison JA (1991) Active Learning: Creating Excitement in the Classroom, ASHE-ERIC Higher Education Report No. 1; School of Education and Human Development, The George Washington University, USA.

13. Lambert N, Stillman T, Hicks J, Kamble S, Baumeister R, et al. (2013) To Belong Is to Matter. Personality and Social Psychology Bulletin 39(11): 1418-1427.

14. Stock J, Hughes M, Wahl L (1990) Use of a High Involvement Instructional Method to Enhance Students' Learning of Distribution Concepts. Journal of Marketing Education 12(3): 22-29.

15. de Novais AS, Silva MB, Muniz Jr J (2017) Strengths, Limitations and Challenges in the Implementation of Active Learning in an Undergraduate Course of Logistics Technology. International Journal of Engineering Education 33(3): 1060-1069.

16. Weimer M (2013) Learner-Centered Teaching. Hoboken NJ, Wiley.

17. Mello D, Less CA (2013) Effectiveness of active learning in the arts and sciences. Humanities Department Faculty Publications & Research. Paper 45.

18. Wright R, Boggs J (2002) Learning Cell Biology as a Team: A Project-Based Approach to Upper-Division Cell Biology. Cell Biology Education 1(4): 145-153.