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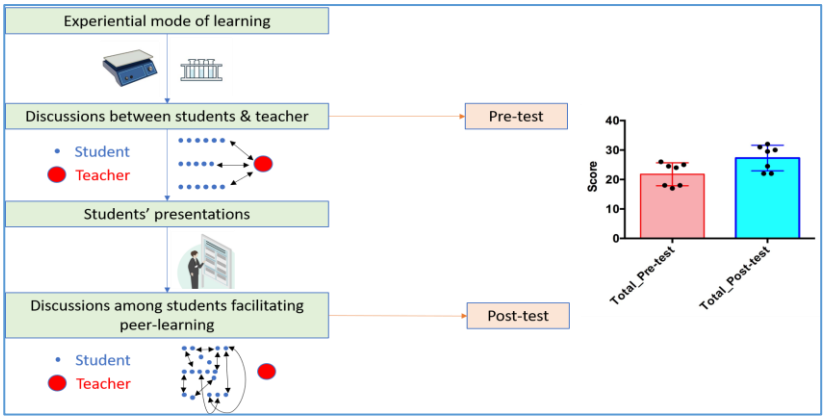
Integrating Students' Presentations with Experiential Learning Pedagogy: A Pilot Study

Subhadip Senapati

Experiential learning has proven to be a powerful pedagogical technique to teach students a wide variety of subjects including the sciences. However, due to its very nature, often it becomes challenging to engage all the students equally due to different reasons. To ensure active participation by all the students, students' presentations were included in the curriculum, following the hands-on activities. Each student presented a sub-topic from the topic "Natural and synthetic materials" and a subsequent interacting session was followed among the students leading to peer learning. The average total scores in the post-test (after the students' presentations and discussion) were found to be higher than that in the pre-test, which was significantly different (*P*-value <0.0001). At the same time, the improvement in the scores in the sub-topics the students presented was found to be greater than in the ones the students did not present (1.52 vs 1.21 times, respectively). Statistical analysis also showed that the total scores of individual students correlated positively with their presentation scores. Overall, students' performances improved after the intervention through the presentations and subsequent interactions among the students. This pedagogy can be implemented for a larger pool of students to ensure efficient learning.

Graphical abstract



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1. Introduction

Too often, science is taught through traditional chalk and board learning or PowerPoint presentations, where teachers play the central role and write about the topic at hand on a board or display it digitally [1,2]. Both of these methods (chalk-board and slide presentation) are teacher-centric learning and have their own advantages or disadvantages over one another [2-4]. However, they frequently lack one critical aspect of learning – active participation by the students. Ideally learning should be student-centric, experiential in nature, and students should be participating actively [5-7]. But often, students' willingness in participating in the learning process is inadequate and is influenced by a variety of factors – their

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personalities and confidence, knowledge and skills of the instructor, their equations with classmates, etc [6]. There are many ways to ensure active and effective participation by the students – such as hands-on activities, interactive learning, demonstrations, individual or group presentations, and encouragement by the teacher, to name a few [7-10]. All these strategies have been used with varying degrees of success.

In this research study, we have combined a couple of these strategies – experiential learning followed by students' presentations. Experiential learning is 'learning by doing' where students first perform activities/experiments by themselves, reflect back on them, and analyse what they observe ensuring an effective learning process [11-14]. Experiential learning has been proven to be much more efficient and impactful than traditional learning which promotes rote learning. Even then sometimes effective learning becomes challenging as not all students get involved equally in group activities [15]. Some students participate actively, while some become mare observers. Moreover, during the discussion sessions, only a handful of students interact with the teachers/facilitators while the majority of them remain silent and do not engage in the discussion. To address this, we employed the students' presentations as a method to engage the students individually.

In this article, we have briefly described the methodologies we used to couple experiential learning with students' presentations to implement student-centric learning and to ensure an active engagement of the students. We discussed our findings from this pilot study in light of the literature data available and how it can be implemented for a larger pool of students in the future.

2. Material and Methods

2.1 Study design

This pilot study was conducted with Grade 7 students (n=7). Students were first taught about 'materials' in an experiential way, where students learned through several hands-on activities. The facilitator made the students aware of proper safety measures and guided them through the activities. Any doubts or questions students had at this point were cleared or answered by the facilitator and that was followed by a pre-test. After this, each student was assigned a sub-topic for the presentation that they presented while the other students were in the audience. Finally, a post-test was conducted, and a comparative study between the pre-test and the post-test was carried out. The study design has been given in Figure 1.

2.2 Sub-topics and presentations

The topic chosen for this study, 'materials', consisted of two parts – A) Types of materials and their syntheses, and B) Properties of materials. First, students were taught in an experiential way where they learnt about the topic through hands-on activities. They performed the activities, analyzed their observations, reflected back upon them, and learned from their experiences. After the pre-test, the students were asked to prepare and present individually on a topic from the chapter. 7 topics were chosen from the chapter – natural materials, synthetic materials, density, flammability, electrical conductivity, thermal conductivity, and capillary action. 7 minutes were allotted for the presentation and 3 minutes for a subsequent question-answer session. During the presentation, other students also asked questions in case they have any doubts/queries. After the presentations, another test (post-test) was conducted.

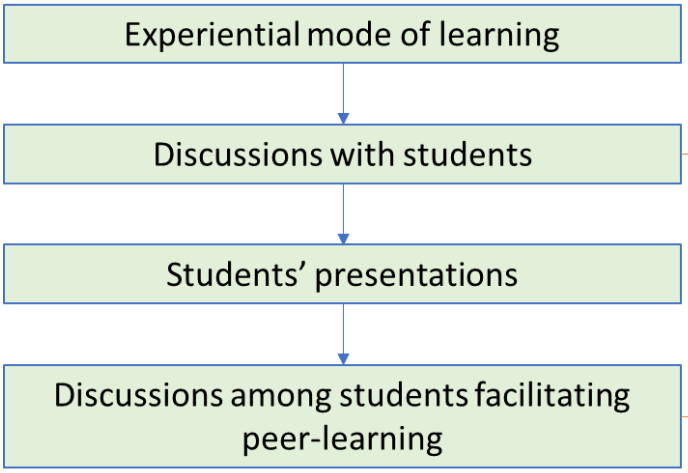

Fig. 1. The study design adopted to implement presentation-based learning coupled with experiential learning pedagogy.

2.3 Tests and analyses

A total of 35 marks were allotted for the tests and 4 different types of questions were included. The test consisted of 7 "True/False", 7 "MCQs", and 7 "Fill in the blanks" types of questions and each of those questions carried 1 mark. Moreover, there were 7 open-ended short-answer type questions and each of those carried 2 marks. The total of 35 marks was distributed in such a way that each of the 7 sub-topics chosen accounts for 5 marks each. To assess students' performances in the topics they presented, scores were calculated only for that topic for an individual (5 marks) and scores were also separately calculated for the rest of the subtopics that they did not present on (30 marks).

2.4 Statistical analysis

Statistical analysis and plotting of graphs were done using the software Prism 6 (GraphPad, San Diego, USA). Paired t-tests were conducted to assess the differences between pre-test and post-test results.

2.5 Ethical guidelines

All the research studies involving human subjects were conducted following ethical guidelines. Prior consent was obtained from the parents of all the students participating in the study.

3. Results and Discussion

3.1 Improvement in students' performances

The analysis was done in two parts – first, the results were assessed as a whole, where the total scores obtained by the students were analyzed and compared. Secondly, special focus was given only on the particular topic a student was presenting and compared the results to the rest of the test (other topics that the students did not present). It was observed that the students performed better after the presentations as the average total score of the class increased from 21.8 ± 3.9 (pre-test) to 27.3 ± 4.3 (post-test) and this increase was statistically significant (P-value <0.0001), as shown by the paired t-test (Table 1, Figure 2). It

was evident from the data that the students' presentations helped them to understand the topic at hand as a whole in a more efficient way and improved their test scores.

Table 1. Average scores of the students in the pre-test and post-test and the corresponding *P*-values.

	Pre-test	Post-test	*P*-value
Average total score	21.8 ± 3.9	27.3 ± 4.3	<0.0001
Average score in the topic of presentation	2.7 ± 1.4	4.1 ± 1.1	0.0282
Average score in the rest of the topics	19.1 ± 3.2	23.2 ± 3.6	0.0006

Experiential learning often plays an impactful role in improving students' understanding of the subject, and sometimes with long-term positive effects [13,14,16]. But at times, it poses a variety of challenges [11,15,17]. It can be challenging to attend to each student individually, as it would require a lot of patience, effort, and time. Moreover, sometimes all the students may not take part in the activities, especially in the case of group activities. To maximize students' engagement, students were asked to present on one sub-topic from the topic 'material'. Other studies have shown that students' presentations can be an effective tool to ensure students' active participation and facilitate the learning process [9,18-20]. During the course of this study, each student first took part in the experiments actively and cleared their doubts through a discussion session. After the pre-test was conducted, students presented on the selected sub-topics, followed by a discussion/question-answer session where the other students also participated actively. This facilitated 'peer learning' among the students where they learnt from each other. Peer learning is an effective pedagogical methodology and has been shown to improve students' understanding of the subject and academic performance [21,22]. As the post-test scores suggested, the students developed a better understanding of the sub-topics by learning from their peers during the presentations (Figure 2-A and 2-B).

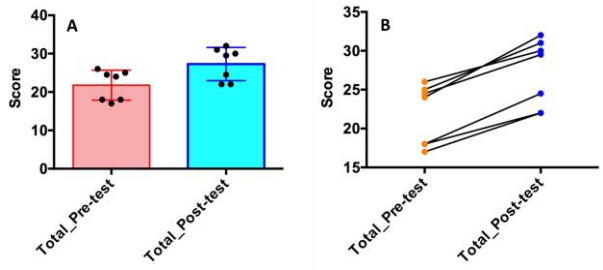

Fig. 2. A) Bar diagrams showing the average total scores obtained by the students. The scattered dots represent the individual scores of the students. The error bars represent the standard deviations. B) The changes in the total scores for individual students can be tracked that showed improvement for all the students involved in the study.

As the next step, we decided to separate the scores a student obtained in the topic they presented and compared that to the scores they obtained in the rest of the questions (from the topics that they did not present). It was found that the scores of the students in the topic they presented improved from 2.7 ± 1.4 to 4.1 ± 1.1 after the presentation. At the same time, the scores of the students on topics that they did not present also improved, but to a slightly lesser extent, from 19.1 ± 3.2 to 23.2 ± 3.6 (Table 1). The increase in students' scores in both cases was found to be statistically significant (P-values 0.0282 and 0.0006, respectively.)

Further analysis showed that the increase in the total scores from the pre-test to the post-test was 1.25 times. At the same time, the increase in the topics the students presented and the ones they did not, were found to be 1.52 and 1.21 times, respectively. Clearly, the improvement in students' performances for the topics they presented was reflected in their scores. The average increase in the scores for the topics they presented was higher than that for the topics they did not, underlying the potential impact students' presentations might have on students' performances.

3.2 Presentation skills and students' performances

Presentation skill is one of the most essential skills in today's world. To augment our findings on the effectiveness of presentations on science learning, we also assessed the oral presentations of individual students using a scoring rubric. The scores obtained by the students were in the range of 62-91. One interesting finding that came out of it was the positive correlation between the students' presentation scores and the post-test scores, for which the Pearson correlation coefficient (r) was 0.5886 (Figure 3-A). The analysis also showed that the post-test scores were correlating positively with the presentation scores, barring one potential outlier. The student who scored the maximum in the post-test and had shown 1.33 times improvement in total score, was among the lowest scorers in presentation. Ignoring this anomaly, the Pearson correlation coefficient (r) was even higher (r = 0.8405) (Figure 3-B). However, it must be noted that a major contributor to that low score for the presentation was the general presentation skills such as eye contact, audibility, delivery, language skills, etc, and not just the content knowledge. So, our data seemed to suggest that there could be a positive correlation between the students' presentations and their academic performances.

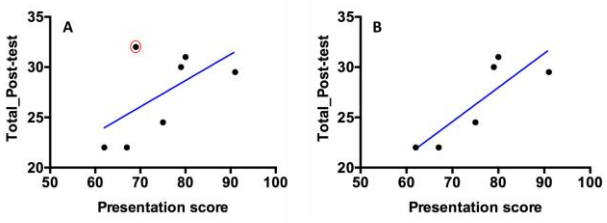

Fig. 3. A) Correlation diagram between the total individual scores of the students in the post-test and their scores in the presentations. As can be seen, a positive correlation was observed despite an obvious outlier data point (circled in red). B) The same ignoring the outlier, resulting in an even stronger correlation.

3.3 Feedback from the students

Finally, to understand the students' perceptions regarding the presentation and how they felt about it, we conducted a feedback survey. The students were provided with 12 statements and they were asked to evaluate them on a scale of 1-5. Out of these 12 questions, 2 were negative in nature to ensure that the students were paying attention and were not just answering randomly. The students' responses have been

depicted in Table 2. It could be seen that students mostly felt positive about the presentation methodology (the average feedback score was around 4 or higher) and felt it was useful to them. Not only they felt that they benefited from their own presentations, but also from listening to other students, leading to an efficient peer learning process. Also, the average score for the questions with negative connotations was low (below 2), confirming students were paying attention to the survey questions. The question 'The presentation increased my confidence in speaking in front of an audience' received an average score of 3.86. This perhaps implied that even though some students felt that their confidence in public speaking improved due to the exercise, some were still lacking it, possibly due to the presence of a relatively small audience in this case. Taking into account the statements with negative connotations and reversing the score, the Cronbach alpha value was computed. A Cronbach alpha value of 0.8266 showed the consistency in responses for these questions.

Table 2. Feedback questions and the corresponding average scores.

Feedback questions	Average score (5)
I learned a lot of new information about natural and synthetic materials.	4.14 ± 0.69
I understood the importance and disadvantages of natural and synthetic materials.	4.57 ± 0.53
The hands-on activities made the topic very interesting.	4.57 ± 0.79
Proper safety protocol was communicated during some of the activities involving fire and flammable substances.	4.71 ± 0.49
Presenting a sub-topic from 'materials' made me understand that concept in a more effective way.	4.00 ± 1.00
Listening to the other topics presented by my peers helped me understand those topics better.	4.86 ± 0.38
The presentations did not at all improve my understanding of the topics.	1.29 ± 0.76
My presentation helped me answer the post-test questions on that topic in a much better way.	4.14 ± 0.69
Presentations by my peers helped me answer the post-test questions on those topics in a much better way.	4.14 ± 0.90
I would not prefer presentations for any of the other chapters.	1.86 ± 0.90
Discussion sessions during and after the presentations helped me clear a few misconceptions.	4.29 ± 0.95
The presentation increased my confidence in speaking in front of an audience.	3.86 ± 0.90

The first of the two open-ended questions in the feedback survey was "Did presenting on a particular topic and listening to the others have any impact (positive/negative/neutral) on your understanding of that topic? Discuss in a few sentences." Except for one student who remained "neutral", all the other students felt that presenting a topic and listening to their peers had a "positive" impact on their learning. One student wrote, "*It had a positive impact. Since we were presenting the topic, some of us had questions, which cleared a lot of doubts. I had some misconceptions, which were cleared*." Another student felt, "*Yes, the discussion session after each presentation by my peers helped me understand the concepts much better – overall, a positive impact on my understanding of the topics*." The student who was "neutral" wrote, "*neutral, since I had (already) understood the topic but the extra information I collected and presented was nice*."

The second open-ended question asked "What presentation strategies can be adopted to make it more effective for learning?" In general, the students felt that the presentations could have been more interactive in nature. One student wrote, "*The presentation could be more interactive to make the students pay more attention…*". Another student suggested, "*Don't read what you've written in the presentation, explain that (using) your words. This makes the presentation much more effective."* Overall, students felt positive about presenting a topic during the course of learning and were willing to adopt the same for other chapters as well.

4. Conclusions

We conducted a pilot study to assess the potential impact of students' presentations on their learning skills for the topic "materials". Our data suggested that integrating students' presentations with the teaching pedagogy have the potential to induce effective learning among the students. It ensures that the students are more engaged, making them actively participate in the learning process. The average total score in the post-test improved significantly from the pre-test, and the average increase in the sub-topics students presented improved by an even larger extent. Students' oral presentations were also graded and scores appeared to correlate positively with their post-test scores, implying a positive impact of the act on students' learning. The students also welcomed the incorporation of the presentation in the pedagogy as they felt it helped them learn and understand the topic in a better way and would like to see it implemented for other topics as well.

There are a few limitations of the study. First, the sample size is small. As our aim was to assess the impact of students' presentations, we focused on the 'research design' part to ensure a smooth implementation and minimize/remove any potential 'errors' from our end. The small-scale pilot study next will be extended to large-scale research work. Secondly, a bigger pool of students might make it challenging to implement presentations for each individual student and it would be time-consuming. One potential solution could be arranging for a group presentation where each student will contribute briefly. Another issue could be finding several sub-topics for the presentation for certain topics. In that case, the same sub-topic could be presented by multiple individuals/groups.

As mentioned earlier, the obvious next step of this study is to extend it to a bigger pool of students, preferably across different schools. In addition to the topic used here (materials), the study would be extended to other major topics as well to check the consistency. Finally, we would also like to explore if/how the language barrier among the students influences the outcome of the study in near future.

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Author Contributions

Subhadip Senapati: Conceptualization, Methodology, Investigation, Formal analysis, Project administration, Writing – original draft, Writing – review & editing

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