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Hybrid Approach - A 21st Century Skill in Science Education

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Abstract

Research Objectives: Students showed a fair amount of interest in discussing the topics of their choice. However, in the science class they seem to lose interest as it doesn't match with their interest, and it slowly becomes a heavy subject as per school curriculum. The idea behind such activity was to improve their self-confidence and to eliminate the fear of the science subject.

Material and Methods: Students were allowed to prepare a formal presentation to discuss their choice of subject (science related). This was followed by the introduction of flipped classrooms. Concept of matter was introduced to students via flipped classroom approach. The results were analysed using 5-point rubric.

Result and Discussion: In this work, a study was conducted wherein the students presented the topic of their choice which was followed by Q&A sessions. Students were quite through with their topic of interest and presentation in the classroom allowed them to share their ideas and thoughts within the classroom. This increase in confidence within students and presentation approach was extrapolated to flipped classrooms to cover the concept of "Matter" which is part of the school curriculum.

Conclusion: Through this planned activity, the interaction among students was quite extraordinary and hence helped in

eliminating their hesitance to some extent. As facilitators we got ourselves involved in the discussion and their promptness in answering depicted their interest in learning the Matter module as part of their science curriculum.

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Introduction

Learning beyond content for school students mainly refers to educational experiences that go beyond the traditional classroom curriculum and focus on developing skills and attributes that will be valuable to the students in the long-term (Mishra & Kereluik, 2011; Singh & Manjaly, 2022). Some key examples of learning beyond content are summarized in **Table 1**.

Table 1.

Critical thinking and problem-solving ability	Developing the ability to think critically and solve problems is essential for success in school and in the workplace. Teachers can incorporate activities and projects that challenge students to think critically and solve problems to develop these skills.
Creativity and innovation	Encouraging students to think creatively and try new things can help them develop the skills and mindset necessary to be successful in an ever-changing world.
Emotional intelligence	Developing emotional intelligence is important for students to be able to understand and manage their own emotions, as well as those of others. This can be done through activities such as mindfulness, social and emotional learning, and character education.
Leadership and teamwork	Leadership and teamwork are essential skills for success in school and in the workplace. Teachers can provide opportunities for students to work in teams and develop leadership skills through projects and group activities.
Entrepreneurship and financial literacy	Entrepreneurship and financial literacy are important skills for students to learn to be able to navigate the global economy and make informed decisions about their finances.
Digital literacy and technology skills	With technology playing an increasingly important role in our lives, it is important for students to be proficient in its use and understand the impact of technology on society.

The traditional classroom or rote learning is an outdated way to educate students. In recent years, the blended learning approach seems to have gained significant momentum along with flipped classrooms. “Blended learning” is a pedagogy that combines traditional teaching with eLearning and in “flipped classroom” students watch lectures at home and do

homework in the classroom (Athavan Alias Anand, 2021; Hrastinski, 2019). This seems to be an approach for higher classes, especially in teaching science as science learning is mainly driven by curiosity and inquisitive learning (Barlis et al., 2023; Bocconi et al., 2012; El Miedany, 2019; Gündüz & Akkoyunlu, 2019). These two concepts are closely related, as they both involve a desire to learn and understand new information. One strategy for fostering inquisitive learning among students is to provide opportunities for them to explore and discover new information on their own. For example, teachers can provide students with open-ended questions or problems to solve, rather than giving them all the information upfront. This allows students to use their own curiosity and problem-solving skills to find the answers. Another strategy is to provide students with access to a variety of resources and tools, such as books, websites, and other materials, that can help them learn about a topic in greater depth. Teachers can also incorporate hands-on activities and projects into the curriculum to give students a chance to apply what they've learned in real-world settings. In addition, teachers can create a classroom environment that encourages curiosity and inquiry by encouraging students to ask questions, providing positive feedback for their efforts, and promoting a growth mindset (Barlis et al., 2023). Encouraging students to think critically and creatively and to take risks will help to build the students' confidence in their own abilities to learn and explore new information (Mahmoodzadeh & Khajavy, 2019; Zion & Sadeh, 2007). National Education Policy (NEP) 2020 has further proposed a curriculum that will promote curiosity, creativity and critical thinking skills among students. This policy also aims to make education more student-centric, giving them more autonomy and choice in their learning, which can foster curiosity and engagement (Senapati et al., 2022; Singh & Manjaly, 2022).

Overall, fostering inquisitive learning among students requires creating an environment that nurtures their natural curiosity and encourages them to take an active role in their own learning. In the current report, we provided students with an opportunity to choose their topic of interest as this generates interest and encourages them towards learning science. This seemed to be an effective way to engage students in science and inspire them to explore the subject further. Further, we extrapolated the study using a flipped classroom and blended teaching approach (El Miedany, 2019; González-Zamar & Abad-Segura, 2022; Ng, 2014). Flipped classroom approach has been highly used for higher education and there are very few reports about it for school classroom (Gündüz & Akkoyunlu, 2019; Khanova et al., 2015; Lin & Hwang, 2019; Zain & Sailin, 2020). Herein, we tried to use a similar approach (compared to one used for higher education). To implement and make students understand the concepts of science learning we provided them with the topic of their choice, so that makes it easier for them to present and then extrapolate the study to the subject.

Specification and Activity (Methodology)

The study was conducted at Prayoga Institute of Education Research (PIER) in two phases. In the first phase, the students were allowed to choose the topic of their choice whereas in the second case the "Matter" module was introduced to them, and a similar implementation strategy was approached as in the first case. The total time for the discussion was 70 minutes and 90 minutes for both cases respectively. Witnessing their interest, we proposed that why not provide them with an opportunity to discuss this in a more formal way. Therefore, we requested them to explore the topic of their choice and make a presentation using the information they gathered. Each student was given 15 mins to explain the

understanding of the subject followed by 10 mins of brainstorming discussion among students (we as facilitators were also curious about a few things and even participated in the discussion).

In total 4 students participated, each one with their unique interest. Student A chose “Black Holes” as the topic of his interest. The entire presentation revolved around answering the following questions:

1. What are they?
2. How do they form?
3. How are they found?
4. Parts of Black Hole
5. Types of Black Holes.
6. Falling into a Black Hole
7. Getting out of a Black Hole

Student B went ahead and chose “Aliens (and UFOs)” as a topic of interest. The student covered a few facts about the respective topic which also included time travellers. A comparison of UFOs and time travellers was made during the talk.

Student C chose “Oceans” as the topic of choice. Student made a significant effort to explain the following details about the oceans:

1. What is an ocean?
2. How many types of oceans are there?
3. How are oceans created/formed?
4. Why are oceans important?
5. The Mariana Trench and the Bermuda Triangle were also included along with a few extra facts about oceans.

Student D chose “Tigers” as the topic of choice. The student tried to explain.

1. Tiger’s evolution
2. Types of Tigers and their habitat
3. Endangered species and poaching
4. Why should we save the Tigers?
5. India’s success story in Tiger Conservation.

Figure 1. Class scenario during the presentation and discussion

As part of the next phase, students were asked to choose the sub-section in matter module as listed below:

- Student A: Matter and states of matter
- Student B: Physical properties (compressibility, density, viscosity, fluidity, intermolecular forces and intermolecular distance) of states of matter
- Student C: Interconversion of states of matter
- Student D: Separation of different types of solid-solid mixtures

Each student was given 20 mins to explain the understanding of the subject followed by 15 mins of brainstorming discussion among students (we as facilitators were also curious about a few things and even participated in the discussion) The presentation was evaluated using a 5-point rubric and evaluation was done based on the scores of each student (Michael et al., 2010; Van Ginkel et al., 2017).

Results and Discussion

Teaching science to Grade 6 is quite challenging as they are introduced to the subject for the first time. The students showed motivation for understanding the concept of matter. As facilitators, we introduced the concept of mass and space *via* activity-based learning (Anwer, 2019; Barlis et al., 2023). During the course, the terminology of “atom” was introduced. To our surprise, they were already familiar with the word “atom”. However, the introduction was not enough to satisfy their curiosity. So, we carried out a general discussion by the end of the class and the world of microscopic (discussion on atoms) went on to that of macroscopic (wherein universe and galaxy) were discussed. Witnessing this inquisitive classroom discussion, the students enthusiastically participated in all the topics discussed. Based on their interest, we as facilitators proposed to them to choose a topic of their interest and proceed with the presentation (one week was given for the preparation). Among all the presentations, the one with “Black Hole” was found to gain maximum attention and several questions poured in which required high knowledge of physics concepts. It was quite satisfying to see the interactions the presenter had with the audience (facilitators and grade 7 students). The learning was quite evident. The presenter was able to explain concepts like dark matter, quantum, merging singularities etc. The second presentation on “Aliens” seems to get a fair amount of attention from the audience. Due to the lack of evidence on this topic, the number of questions raised was not as high as in the case of the previous presentation. The third and fourth presentations were related to earth i.e., tigers and oceans. The presenters were quite clear about the pros and cons of the chosen topic. Students were quite clear with the concerns of the forest department. It was quite phenomenal to witness the curiosity among the presenters and the effort they made to understand the seriousness of the decreasing population of tigers. In the last presentation, oceans were discussed. The presenter explained the geographical variation from the North Pole to the South Pole. Their enthusiasm was quite evident as they presented their choice of topic. **Table 2** enlists some of the questions asked as part of the question-and-answer session after the presentation.

Table 2. Section-wise questions posed by the audience to the presenters.

Presenter 1	
1. What are the 3 types of black holes? 2. Why can’t you consider black holes as dark matter? 3. How can a black hole be constructed? 4. Do black holes emit light? 5. How far is the nearest black hole in the Milky Way? 6. Which is the smallest black hole? 7. Isn’t the Big Bang just a theory? 8. Which type of star turns into a Black hole? 9. How much time does it take to come out of a Black hole? 10. If matter goes into a black hole, how does it come out in the form of energy? 11. Do black holes have unlimited space? 12. What happens when one black hole comes near another black	The presenter was able to defend the questions raised by the audience. This can be seen with the increased number of questions.

hole comes near another black hole? 13. What happens when singularities merge together? 14. What is quantum? 15. Is it quantum matter or energy?	
Presenter 2	
1. What is a UFO? 2. Why can't we travel back to the past? 3. How do you know these stories of aliens are true?	The presenter was quite clear with the topic. However, due to a lack of scientific evidence, not many questions were raised.
Presenter 3	
1. What do you mean by 'folk remedies'? 2. How do tigers help in maintaining vegetation? 3. Since we are not allowed to hunt tigers, how are they becoming extinct?	The presenter has concrete knowledge of tigers, their species and the challenges that are faced by the government to stop hunting. The student was quite aware of the scientific as well as political scenario.
Presenter 4	
1. What is the midnight zone? 2. What is the difference between ocean and sea? 3. How can the ocean part into North and South? 4. How does the ocean give oxygen? 5. How can the ocean be the main source of water? 6. The Pacific is shrinking while the Atlantic is growing, why or how? 7. Why don't polar bears eat penguins?	The presenter is quite well-versed with the ocean and the life that exists within it. It was evident during the presentation that the student was well connected with the variations that exist geographically from the North Pole to the South Pole including the Bermuda Triangle.

Everyone seems to have enjoyed this mode of discussion (apart from the presenters). Most of the questions were asked for the "Black Hole" presentation. It seems to have drawn maximum attention. Students of grade 6 were able to describe and explain 'quantum'. This depicts their enthusiasm for learning science.

Followed by this each student was separately provided with the reading material for the matter module (divided the entire section into 4 parts). Each student was then given a significant time to understand the concept and then at the appropriate time explain it to the audience in the classroom using different audio/visual aids. All the students used presentation as the mode of communication in delivering the topic. The skills depicted by them during the presentation were evaluated using rubrics as shown in **Table 3**.

Table 3. Rubrics to measure the presentation skills among students.

Criteria	Excellent (5)	Good (4)	Satisfactory (3)	Fair (2)	Poor (1)
Content	Comprehensive, and covers all required information	Covers most of the required/relevant information	Covers some of the relevant information	Covers little relevant information	Lacks content
Organization	Nicely organized and easy to follow	Organized and mostly easy to follow	Somewhat organized and difficult to follow at times	Poorly organized and difficult to follow	Not organized and impossible to follow
Delivery	The presenter speaks clearly, confidently and completed on time	The presenter speaks clearly but lacks confidence. Took extra time to complete	The presenter speaks with difficulty but understandable	The presenter speaks unclearly and difficult to understand	The presenter does not speak clearly and is impossible to understand
Visual Aids	Well-designed, and relevant	Fairly designed and relevant to some extent	Poorly designed and relevant	Poorly designed and irrelevant	No visual aids
Engagement	Active engagement by fairly maintaining eye contact with the audience	Fair engagement using some eye contact with the audience	Fair engagement using no eye contact with the audience	No proper engagement with little eye contact with the audience	No engagement and no eye contact with the audience

Students showed significant progress in showing interest in learning science. Among all the 4 students, student A (similar to the earlier activity) showed much better skills compared to other students. **Table 4** summarizes the skill set shown by students.

Table 4. Presentation grading for the students

Student	A	B	C	D
Content	5	4	3	4
Organization	4	4	3	4
Delivery	5	3	4	3
Visual Aids	4	3	3	4
Engagement	5	4	3	3
Total	23	18	16	18

Conclusion

Through this one-day planned activity, students got an opportunity to deliver a topic of their choice to each other, the interaction among themselves was quite extraordinary. They enjoyed the session so much that they even proposed to include such activities even with the course content. This enthusiasm among them reduced the hesitance to some extent among themselves. Even as facilitators, we got ourselves involved in the discussion, allowing them to answer questions raised by us. Their promptness in answering depicted their interest in learning science. As facilitators, we were not prepared for the children to respond so positively or for them to take the opportunity to stand in front of a large audience. These findings suggest that a rigorous and more robust similar approach must be done with a higher sample size, which will be part of future research.

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