THE EXTRACURRICULAR PROJECT

THE MISSING PIECE

'Be a part of something bigger'

Report by:

Asmi Kawatkar
Ananya Navalkar
Abhijit Kamath
Akshay Kamath
Arjun Maheshwari
Medha Agarwal
Suhani Hingar
Siddh Merchant
Siddh Mehra

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DECLARATION OF ACADEMIC INTEGRITY

To whomsoever it may concern,

This Project Report pertains to **the Missing Piece Club**, which was formed and sustained under the **Extracurricular Project Initiative** taken at Podar International School (IB & CAIE) from **4th August 2020 to 1st September 2020**.

We, the Club Co-ordinators, hereby declare that all the material detailed in this project has been researched, compiled and conducted by us as a team. The reports and analysis herewith have been written by us, and improved with the help of peer feedback and guidance. We promise that our work has been held to the highest standards of academic integrity, and our sources have been appropriately accredited and cited wherever necessary.

Sincerely,

The Missing Piece Team:

Asmi Kawatkar

Ananya Navalkar

Akshay Kamath

Abhijit Kamath

Arjun Maheshwari

Medha Agarwal

Suhani Hingar

Siddh Merchant

Siddh Mehra

ABSTRACT

The Missing Piece, was a brainchild of pure speculation and an enthusiasm to make a difference. We all came together, wanting to share our enthusiasm for problem solving with our juniors.

The concept of this club stemmed from a desire to be different, to provide an escape from all the mainstream clubs, and cater to all those who, like us, love learning.

From the very first step (organising the idea and putting a team together) to the very last (submitting this documentation for approval), we all have learnt so much and grown to be more responsible, independent, critical-thinking learners and teachers.

This project contains comprehensive and exhaustive documentation of our entire journey, from the timetable and the timeline, to each individual teaching plan and session report, complete with bibliographies where applicable and finally an acknowledgements section to thank all of the wonderful people who have guided us on this journey.

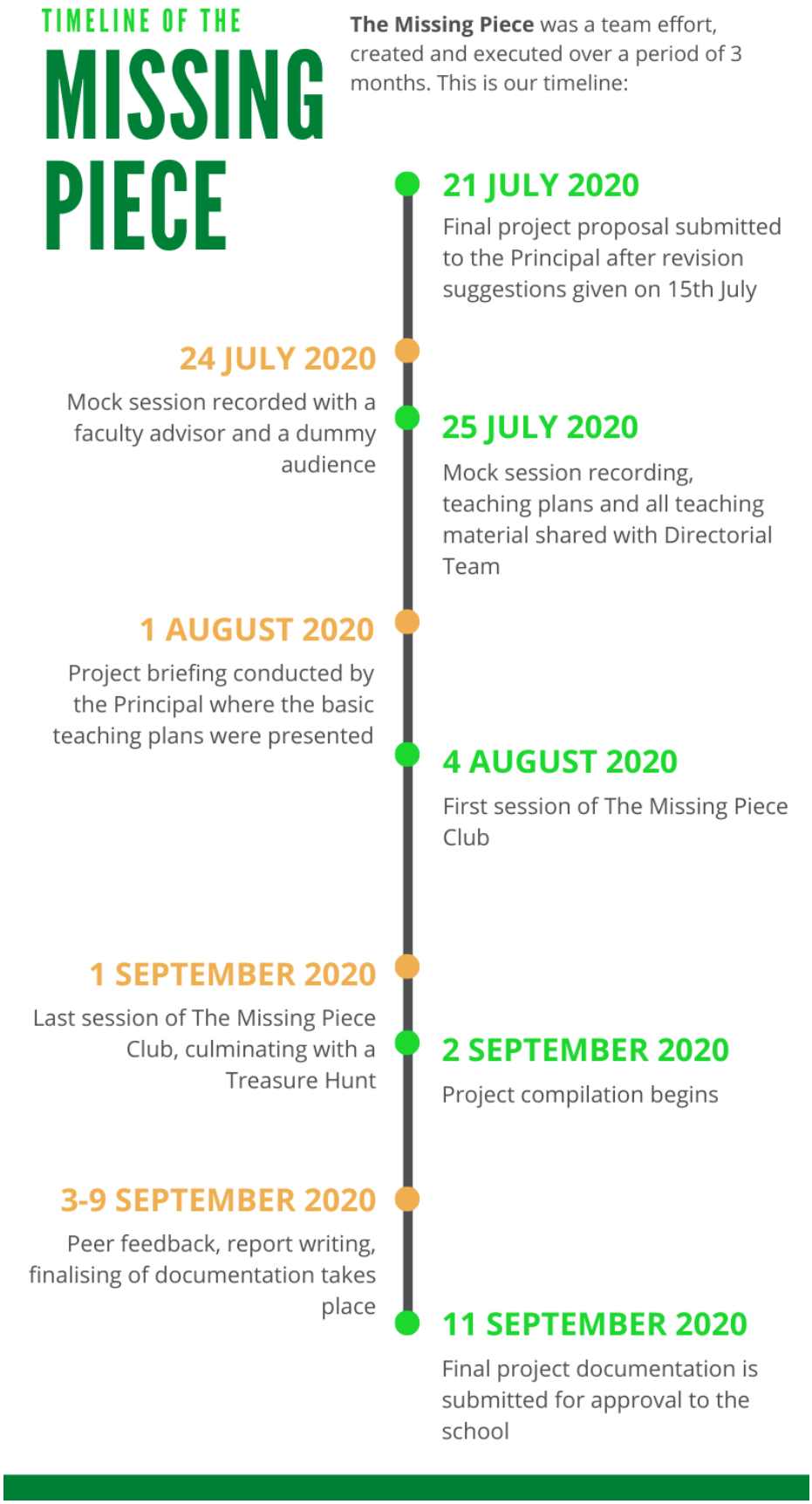
Looking back on this process, we think that it was a huge success, despite any shortcomings and drawbacks. We have tried our level best to provide the highest quality work within this report as well as to our students during the session.

We hope that this documentation is representative of the passion and enthusiasm which we have put into our work, and is also a reminder of all of the new skills that we have acquired along this learning curve.

Happy reading!

The Missing Piece Team

TIMELINE


TIMELINE OF THE
MISSING PIECE
The Missing Piece was a team effort, created and executed over a period of 3 months. This is our timeline:
21 JULY 2020
Final project proposal submitted to the Principal after revision suggestions given on 15th July
24 JULY 2020
Mock session recorded with a faculty advisor and a dummy audience
25 JULY 2020
Mock session recording, teaching plans and all teaching material shared with Directorial Team
1 AUGUST 2020
Project briefing conducted by the Principal where the basic teaching plans were presented
4 AUGUST 2020
First session of The Missing Piece Club
1 SEPTEMBER 2020
Last session of The Missing Piece Club, culminating with a Treasure Hunt
2 SEPTEMBER 2020
Project compilation begins
3-9 SEPTEMBER 2020
Peer feedback, report writing, finalising of documentation takes place
11 SEPTEMBER 2020
Final project documentation is submitted for approval to the school

TIMETABLE

SESSION NUMBER	DATE	SESSION TITLE	TOPIC	SESSION COORDINATOR(S)
1	4th August, Tuesday	Na ravtzngvp ceboyrz	Ciphers & Codes	Asmi Kawatkar
2	5th August, Wednesday	The Hunger Games	Miscellaneous Puzzles	Medha Agarwal, Suhani Hingar
3	11th August, Tuesday	The Game of Life	Game Theory	Ananya Navalkar
4	12th August, Wednesday	Robots, Schwarzenegger and Me	Robotics and STEM	Siddh Merchant
5	18th August, Tuesday	A Paradoxical Reality	Thought Experiments and Paradoxes	Akshay Kamath, Arjun Maheshwari
6	19th August, Wednesday	Cracking the Code	Ciphers & Encryption	Asmi Kawatkar
7	25th August, Tuesday	Exploring Dimensions	Origami & Cubing	Abhijit Kamath, Asmi Kawatkar, Siddh Mehra
8	26th August, Wednesday	A Paradoxical Reality (II)	Thought Experiments and Paradoxes	Akshay Kamath, Abhijit Kamath, Arjun Maheshwari
9	1st September, Tuesday	The Big Picture	Treasure Hunt	Asmi Kawatkar, Ananya Navalkar

4TH AUGUST 2020

Topic: Ciphers and Codes

NA RAVTZNGVP CEBOYRZ

SESSION 1

Session Co-ordinator:
ASMI KAWATKAR

SESSION 1: NA RAVTZNGVP CEBOYRZ

(An enigmatic problem. – Caesar Cipher, Shift 13)

TEACHING PLAN

SUBJECT: Ciphers & Codes

TOPICS COVERED:

1. Substitution ciphers
    a. Caesar cipher
    b. A1Z26 Cipher
    c. Pigpen Cipher/Freemason Cipher
    d. Affine Cipher
    e. Dancing Man cipher
    f. Bacon Cipher

METHODOLOGY:

1. Provide brief introduction into the origin of ciphers and codes (Caesar Cipher example)
2. Guide learners to crack code using Caesar cipher
3. Allow learners to solve puzzles based on A1Z26 cipher, pigpen cipher, affine cipher and dancing man cipher
4. Explain Bacon Cipher
5. Allow learners to attempt cracking the code of Bacon Cipher
6. Discuss the puzzle solution
7. Collect reflections from all learners using a Padlet/Google form

Medium of Presentation:

- Power Point Presentation with puzzles
- Decryption resources online (https://cryptii.com/pipes/caesar-cipher)
- Kahoot/Other quiz to submit their puzzle answers

Time requirement: 60 mins

Sample Puzzles & Material:

SAMPLE PUZZLE #1 – Bacon Cipher

The Baconian cipher was named after its inventor – Sir Francis Bacon. He replaced every letter in the alphabet with a 5-character sequence of 'a' and 'b' as shown:

A	B	C	D	E	F
Aaaaa	*aaaab*	*aaaba.*	*aaabb.*	*aabaa.*	*aabab.*
G	H	I	K	L	M
aabba	*aabbb*	*abaaa.*	*abaab.*	*ababa.*	*ababb.*
N	O	P	Q	R	S
abbaa.	*abbab.*	*abbba.*	*abbbb.*	*baaaa.*	*baaab.*
T	U	W	X	Y	Z
baaba.	*baabb.*	*babaa.*	*babab.*	*babba.*	*babbb.*

Figure 1: The Bacon Cipher

This enabled text to be hidden in plain sight.

Suppose characters in **bold** were "a" and characters in *italic* were "b",

Message: **Hey**, *ho***w are yo***u d***oing**? *It* **is a *l*ov*e*ly da**y today, isn't it?

Ciphertext: aaabb aaaaa abbaa aabba aabaa baaaa

Plaintext: Danger

SAMPLE #2: Pigpen Cipher:

Figure 2: An encrypted message in Pigpen Cipher

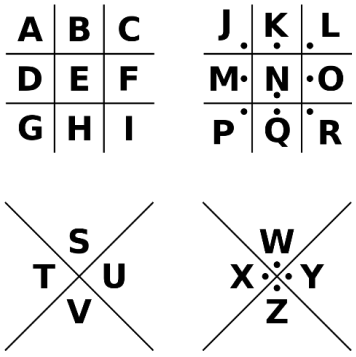


Figure 3: The Piagpen Cipher Grid

SESSION 1: NA RAVTZNGVP CEBOYRZ

SESSION REPORT

LEARNING OBJECTIVES:

Students will be able to:

- Understand the formation of different types of ciphers
- Decrypt and Encrypt basic ciphers
- Write words and phrases in code
- Understand the importance of learning this skill and its real-world application

SESSION SYNOPSIS:

Being the first session of the club, it was imperative that we made this session as interesting as possible. Hence, we chose ciphers and codes to be the topic of the first lecture. This was not only an engaging and fairly comprehensive topic, but also connected to the real world in terms of cryptography, computer encryption etc. Moreover, I think the kids just found it kind of cool because it did feel like they were spies, sending messages in secret code that only they read.

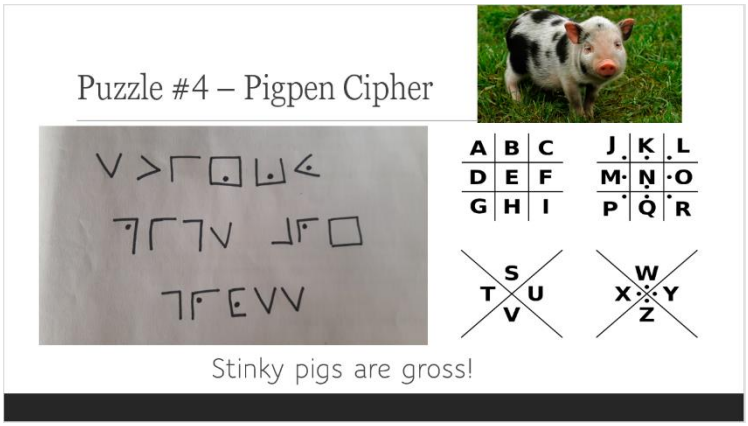


Figure 4: PPT Slide presented during session

I did not divide my session into activities but instead into smaller puzzles of increasing difficulty as I thought this would best capture the flow of the lesson.

I had deliberately encrypted the title of my session in a Caesar cipher, just to add a tinge of drama to the lecture. When I asked the students to try and read the gibberish

ciphertext, one of them guessed that it was a cipher, which honestly left me surprised and rather pleased to have informed students.

To introduce the session, I asked the students why they thought we were learning about ciphers in the first place, or why they thought ciphers were important. A lot of kids were given the opportunity to speak and I was really glad to see them speaking up, voicing innovative and thoughtful ideas. I used some guiding questions to facilitate the discussion for a few minutes before moving onto the introductory slide, which talked about the story of Julius Caesar, who created the first cipher.

Figure 5: Encryption-Decryption Relationship

After that, I flashed a diagram showing the ciphertext encryption, and based on the diagram, the students were asked to interpret and define the concept of a cipher. I was happy to see that they were able to do it and those that weren't, were bold enough to try even though they were unsure of their answers.

Then we launched into the first puzzle, a basic Caesar cipher which I made them decrypt manually before introducing an automated tool called Cryptii.com which is an opensource tool for basic ciphers and codes. This allowed them to solve puzzles much faster and focus more on the logic behind it rather than the actual method, which can easily be automated.

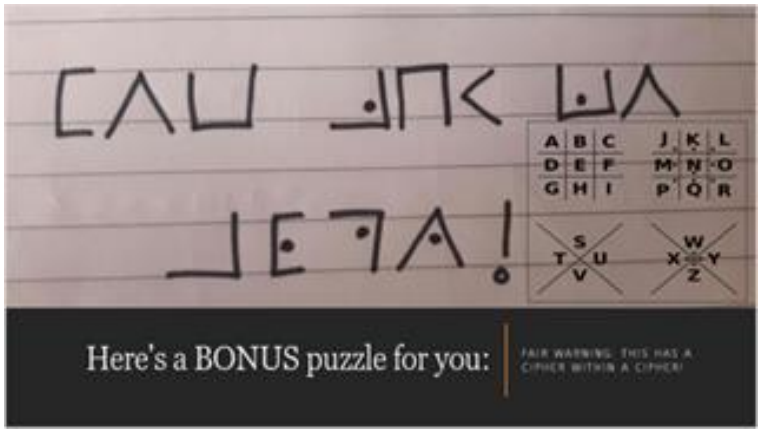


Figure 6: Double-encrypted puzzle

I would flash the puzzle on the board, give them a time limit (e.g: 60 seconds, 30 seconds) and quite often most of them were able to beat the time limit set. One of the students actually surprised me, as I thought I had set an unrealistic deadline of 20 seconds but he beat it in the nick of time!

After that we moved onto more graphical ciphers, including a fun 'Dancing Man cipher' from Sherlock Holmes, and the classic yet elegant 'Pigpen cipher'. Since the students were able to get these quite easily, I found it quite enjoyable to teach them the Bacon cipher, my personal favourite.

I'll admit, at the beginning I thought they might have some trouble understanding the concept of the Bacon cipher. I had to explain it in a couple of different ways as some students were unable to understand it the first time. But eventually, all of them were able to get it.

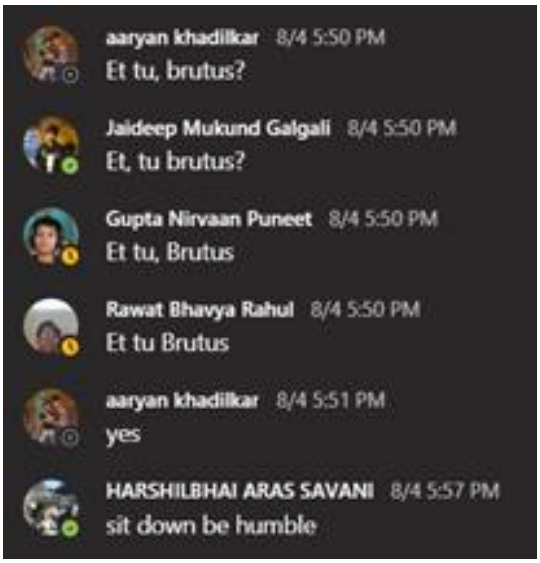


Figure 7: Student Responses

So, to cap off the session, I gave them a double encrypted cipher, a Caesar cipher + Pigpen cipher, just to make them think at a deeper level. Again, they surpassed my expectations and solved it well under the set time.

Some of the students even went a step further to start questioning the strength of the cipher. At the beginning of the session, since we had talked about the applications of ciphers in computer encryption, one of the students brought up an extremely valid

point saying that the ciphers we were dealing with were too easy and could be cracked with a simple method of brute force. This was rather amusing and I told him we were only doing these ciphers to get into the thought process and the ciphers in computer science were actually much more complex algorithms! But it was an extremely deep line of thought, which I really appreciated.

FEEDBACK ANALYSIS:

We asked the learners to rate the session from a scale of 1 to 5 based on enrichment, presentation and interactiveness. I was very happy to see that my average score on enrichment was a perfect 5 as this meant that my content had been interesting and engaging, and that the children were able to rack their brains and enjoy the little thinking exercise.

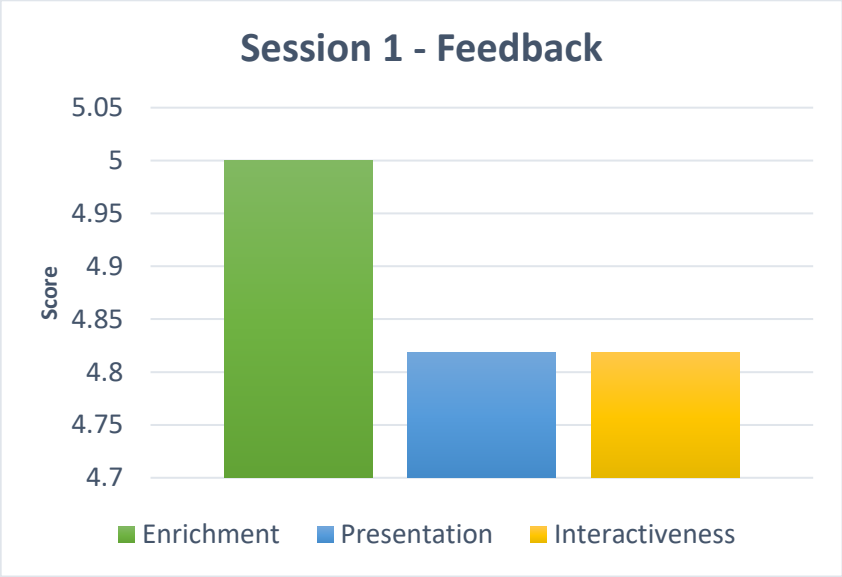


Figure 8: Average scores from student feedback

However, a few students felts that the presentation and interactiveness could have been a little better which is why the average scores for those two were relatively lower. Nonetheless, I was pleased with the high scores and was eager to take all their feedback into consideration. Perhaps I could have asked more questions to each and every child, because for the most part, a certain group of children had dominated the discussion. So, I resolved to call upon the learners by name to ensure inclusivity is maintained. Further, I decided to also use videos/kahoots/other modes of presentation next time.

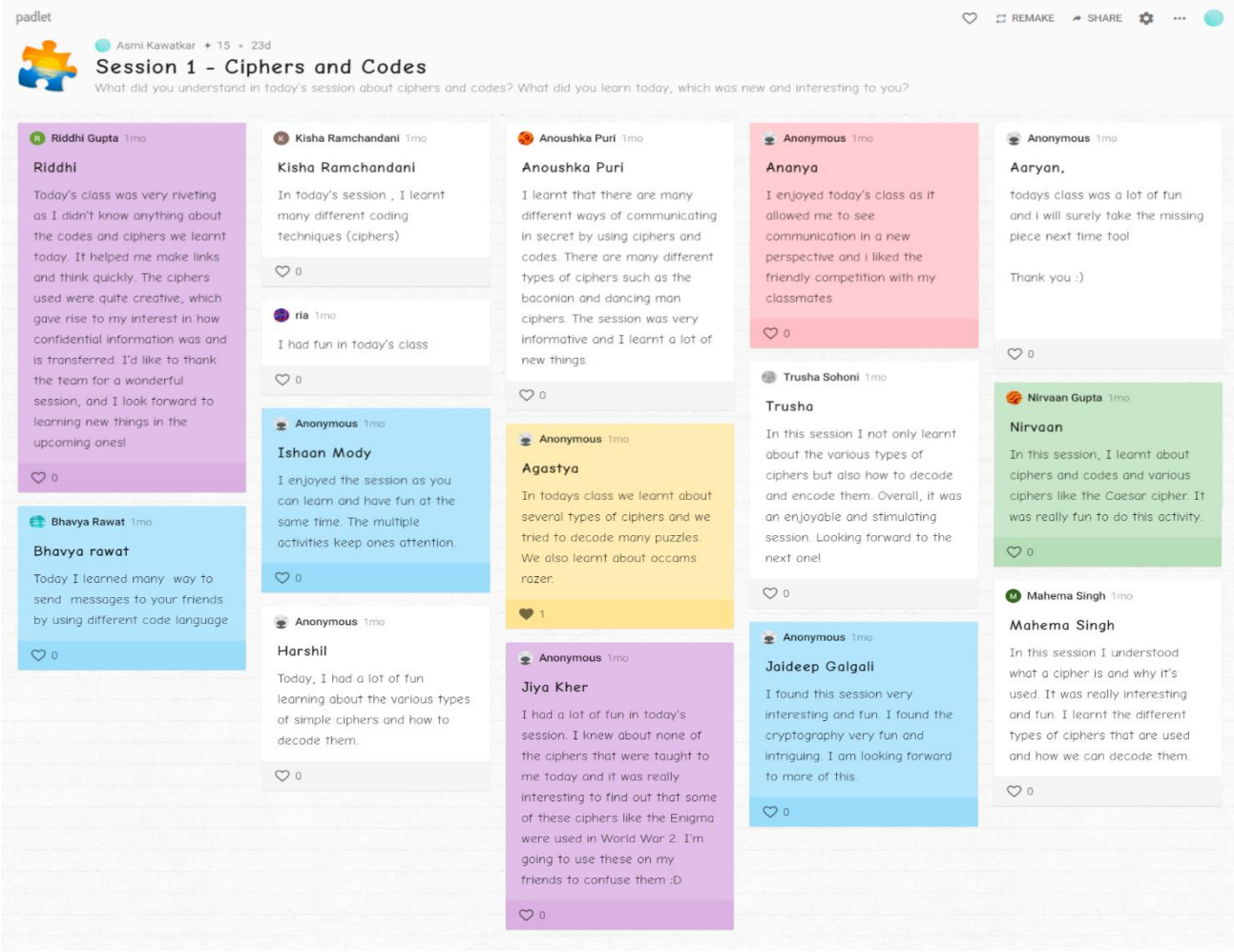


Figure 9: Padlet of student responses

The padlet reflected a whole host of positive opinions, and I was glad to see that the learners were indeed able to identify their learnings and to clearly state their favourite aspects of the lesson, indicating that they had indeed enjoyed it!

REFLECTION:

Prior to planning my session, I had to work through a lot of research in order to find credible sources and fun puzzles which the students would be able to relate to. I created a lot of the puzzles myself and I tried to make them as interesting as possible. Even so, I had this nagging doubt of whether they would find the puzzles too interesting or too boring.

I have no experience in teaching my juniors, and so this was very new to me. I tried my best to make all of them feel comfortable with me and to encourage them to speak up

during the session. I was happy to see that most of the students were able to speak up and did participate actively in the session. However, I do feel like I could have done a better job with engaging the class by planning a larger variety of activities.

I am so thankful for my team because they assisted me by taking the attendance, making sure decorum was maintained and even helping me with the presentation and the changing of slides. Over the course of the whole process of co-ordination, I learnt to be a good team player and take criticism when it was aimed constructively at my work.

When we did a mock session as evidence and practice, I had presented my session to a dummy audience. I received a feedback saying I was talking too much, and that the session was not engaging enough. By then, we were at the very ends of our planning and everything was being finalised so this really made me worried and concerned because already the pressure was on to make the session interesting as it was the first one. So, I went back to the drawing board, my team and I had multiple meetings wherein we discussed methods to engage the students, methods to keep our lessons enthralling. We changed quite a bit of my PPT and we came up with plans and more backup plans in case something went wrong.

On the day of our session, the weather was terrible, and I was experiencing extreme connectivity issues. This made me extremely worried and anxious as I was the sole session co-ordinator for my session. Even so, I briefed my team on how to go about my PPT and all of them were present during the entirety of my session, just in case I lost connection, for backup. I am honestly grateful to have such a supportive team.

Overall, this session taught me not to underestimate my students, and I learnt the importance and impact of engaging education. It was an extremely enriching

experience which made me a better communicator, a good listener and definitely a better leader.

5TH AUGUST 2020

Topic: Miscellaneous Puzzles

THE HUNGER GAMES

SESSION 2

Session Co-ordinators:
MEDHA AGARWAL &
SUHANI HINGAR

SESSION 2: THE HUNGER GAMES

TEACHING PLAN

SESSION COORDINATOR: Medha Agarwal; Suhani Hingar

SUBJECT: Miscellaneous Puzzles

TOPICS COVERED:

1. Magic squares
2. 4 pic 1 word
3. Financial activity with learning (Savings etc.)
    a. Introduction to savings
    b. Activity (3 jars: Spend, Save and Share)
    c. Forms of Savings
    d. Importance of Savings
    e. Opening a bank account
4. Flashcard Riddles
5. Anagrams
6. Wuzzles

METHODOLOGY:

1. Provide a brief introduction about the session and what activities will be conducted.
2. Flash the rules and regulations for the games.
3. Provide a question to help them resolve the magic square by uploading a picture in the chat box.
4. 4 pics 1 word with the first word of each question forming the word 'SAVINGS'(example given below)
5. Introducing learners to savings followed by an activity on financial aspects.

6. The activity will cover various aspects of money, including: Spending, Saving and Sharing. Learners will be chosen and asked questions, further they will be given a specific amount of money and asked how they are going to distribute the amount into each of the jars.
7. Explain the different forms of savings.
8. Inform them about the importance of savings in real life.
9. Flash the rules and regulations for the games that follow.
10. Present riddles in the form of flashcards.
11. Anagrams on classic movies and books covering different aspects of learning.
12. Write up and images to explain phrases in a unique way. (example provided below)
13. Learning outcome and the use of these activities in real life.
14. Question and Answer session along with reflection on Padlet.

Medium of presentation:

1. Power point presentation
2. Presentation on Prezi
3. Padlet

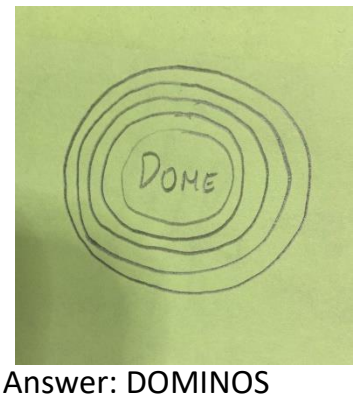
Time required: 60 mins

Sample Puzzles & Material:

SAMPLE #1 - 4 pics 1 word:

Answer: RUBBER

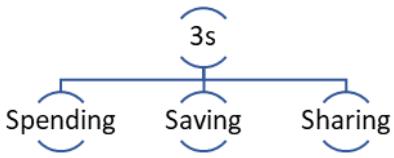
SAMPLE #2 – Wuzzles:



Answer: DOMINOS

SAMPLE #3

- Introduction to 3s



Savings: is an income that is not spent.

Spending: giving money to pay for goods, services, or so as to benefit someone (borrow)

Sharing: a process of dividing or substituting your income

Why do we save?

1. it helps protect you in the event of a financial emergency
2. large purchases
3. Target Savers
4. avoid debt
5. Children's future education
6. Have an easy retirement
7. To increase your current income

Questions that will be asked in the activity:

- What will you buy if you unlimited money?
- If you are given a certain amount how will you Spend, Save and Share

SESSION 2: THE HUNGER GAMES

SESSION REPORT

LEARNING OBJECTIVES:

The students will be able to:

- Discuss the application of these puzzles in real life
- Improve their logical thinking
- Emphasis on thinking out of the box
- Understand the importance of critical thinking and apply that to savings
- Able to apply the skills learned to Kahoot

SESSION SYNOPSIS:

The Hunger Games Session was based on Logical Reasoning, Critical Thinking, and Interpretation of Complex Information.

In our session, we met with all our learning objectives. The session was interactive and lively, the students were interactive and ready to take part. The students thoroughly enjoyed all the puzzles but the Kahoot was the show stealer!

We tried to make the session interactive by asking them questions every now and then like what are magic squares and how they help us in real life? Why do we save? What are anagrams? The students were asked to explain their understanding of each aspect of the 3s theory(spend, save, share). The chat box was flooded with answers and students participated very well in the session.

We covered the following activities:-

Magic squares:

A square where the horizontal, vertical, and diagonal must add up to the same number.

For magic squares we gave them 2 squares: a 3x3 and a 4x4 and they had to fill the numbers. It was very astonishing to see how everyone could solve the squares way under the time limit provided. We taught them another method to solve these squares instead of just a trial and error approach, where we recommended them to solve magic squares by filling the 4 corners of the square and the 4 middles squares, this makes it very easy for them to approach and find the rest of the numbers. After that they should either choose one set: odd or even numbers and fill the rest of the squares. This helps them to build on their mathematical and logical learning.

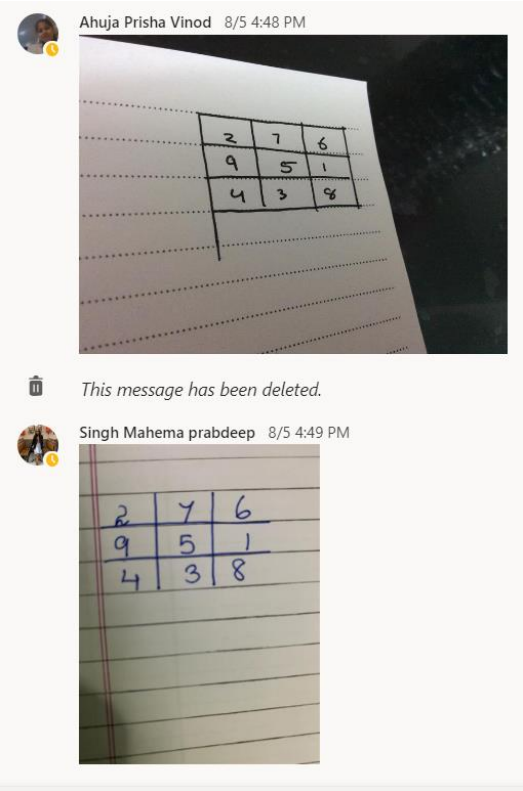


Figure 10: Student Work

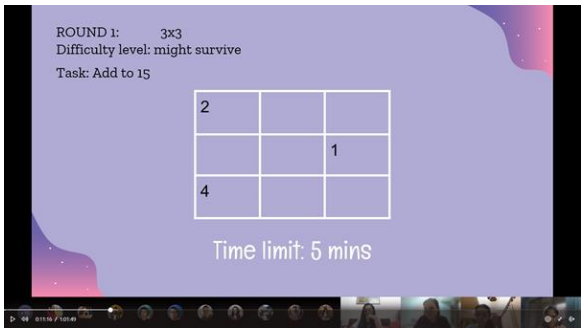


Figure 11: Magic Square Puzzle

4Pic 1Word:

4 pictures were provided from which the students had to derive one word. We conducted 7 rounds for this activity and the first letter of each word would lead to a 7 letter word: ‘savings’.

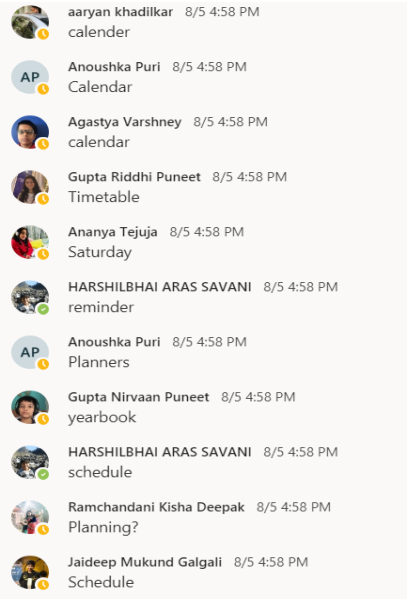


Figure 12: Student Responses

This was done to connect the financial activity to the rest of the activities and session and maintain a link with the other activities in the session. We believed their age was ideal to be educated about financial learning and its importance in the coming future. Though it was a fun, easy looking game, it forced them to focus on small details in the image and come up with one word for all the provided images.

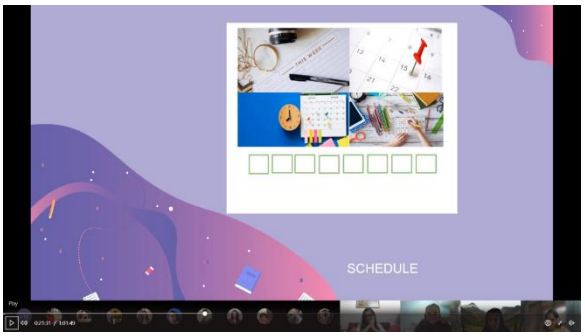


Figure 13: 4Pics1Word Puzzle

Financial Activity:

For any teenager, it is very important to know about the 3s theory- Spend, Save & Share, this is because they will be soon dealing with money and teaching them certain skills about investing can help them to be more responsible. This helps kids to relate to critical thinking and logical reasoning because whenever a business situation is given to them their thinking analogy changes and they start thinking of a macro topic instead of micro.

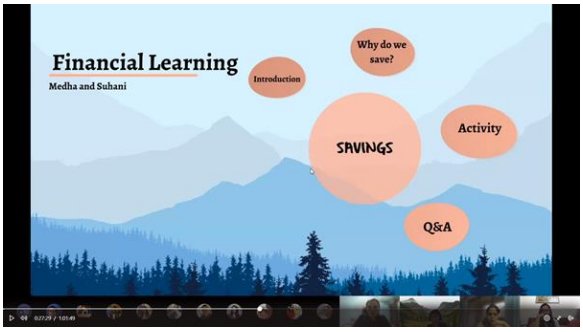


Figure 14: Financial Learning Prezi

This is why we had a short lesson on Savings. The aim of this activity was to teach them about various aspects of savings including; Why and How do we save, the importance of savings, spending and sharing in real life, opening different types of bank accounts (pension, child saving, investment, etc.) We also told them about the negative effects of cryptocurrency and how investing in bitcoin will not double your money.

We planned a short offline activity for the kids where at the start, we asked them "What would they buy if they had unlimited money?" further we gave them a particular sum of money- Rs 4900 and placed 3 jars (SPEND SAVE SHARE) and we asked them to distribute the Rs 4900 in each of the jars in order to reach our goal. This was done to check their thinking strategy.

After each of them had a specific pattern, we explained to them how they could modify their pattern in order to aim for the goal they wished for. This activity helped them to understand how different savings patterns can help them in future!

Riddles:

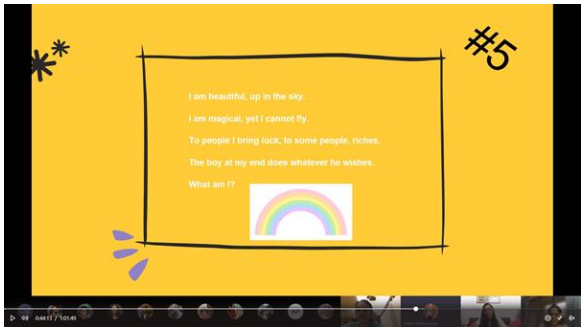


Figure 15: Riddles

We provided them with eight perplexing yet interesting riddles based on murder mysteries, who am I, For example:

Confusing them was our main strategy in riddles, so we distracted them by giving them a long murder mystery where we tried to increase the number of suspects in order to increase the difficulty level and also added more sticky notes to distract them from the main clue but they were able to crack them no matter what.

Figure 16: Murder Mystery

Anagrams:

An anagram is a word, phrase, or name formed by rearranging the letters. For this round, we had three sub rounds each with

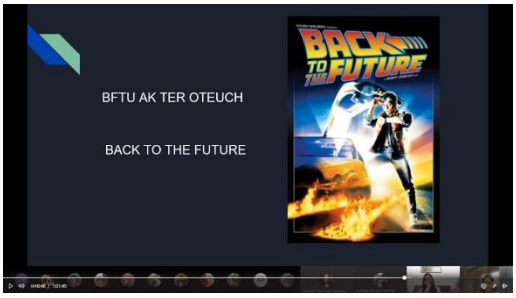


Figure 17: Anagrams

different categories. For the first round, the students had to unscramble the name of famous Sci-Fi movies.

The second round had a brief description of a career that would help them guess which one it was. And last round had synonyms of random words like a basketball or a book like Rich Dad Poor Dad. This round forced them to think out of the box and focus more as compared to the other rounds because in this part of the session, the words were either jumbled or the synonyms we picked were most unheard of.

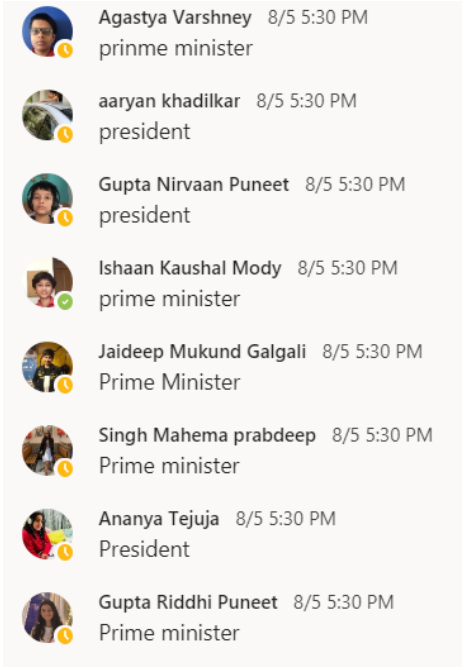
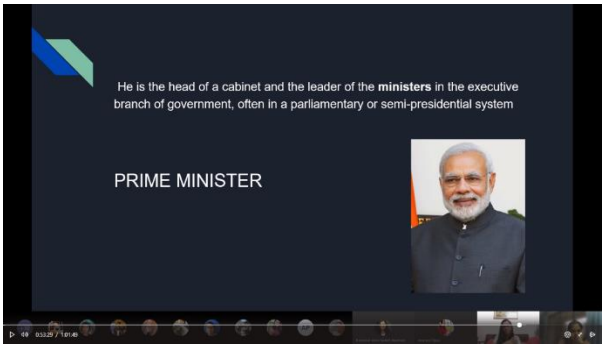


Figure 18: The chatbox was flooded with student responses



FEEDBACK ANALYSIS:

Kahoot:

We ended the session with a fun Kahoot. Although we ran out of time and couldn't complete a small part of the session, Kahoot being the crowd pleaser and the most demanding, the students requested us to conduct one despite crossing the time. The students got very competitive and wanted to see their name on the podium. The Kahoot included a mix of everything that was done in

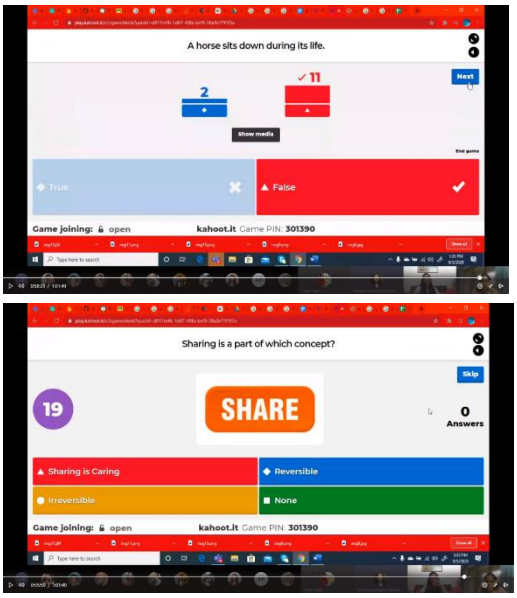


Figure 19: Kahoot, by popular demand

the session along with a few fun facts. Throughout the ten-round Kahoot, the students were thrilled and enjoyed it a lot.

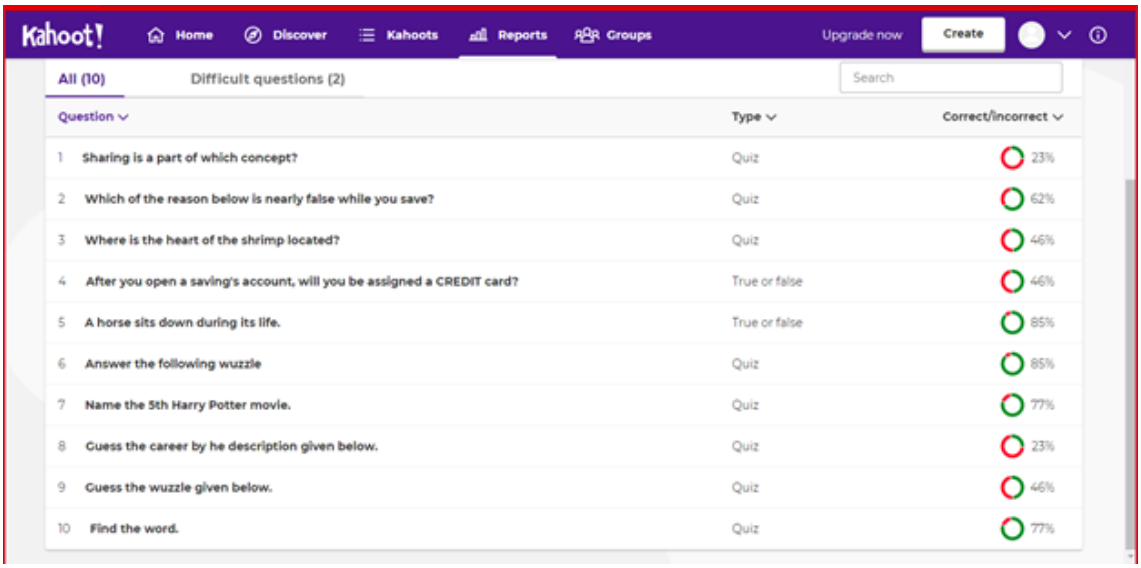


Figure 20: Kahoot Response Analysis

On doing an analysis for Kahoot, we were pleased to see that students were able to come with the correct answer for most of the questions. Since the Kahoot was based on understanding their learnings from our question, their report clearly indicated that we had accomplished our task and taught them something new.

Padlet:

The students were also asked to write down their views on a Padlet that asked them what they learned from our session and what they think about it.

The feedback clearly showed how much they loved the session especially the kahoot. It was our honour that we were able to give them a good experience learning

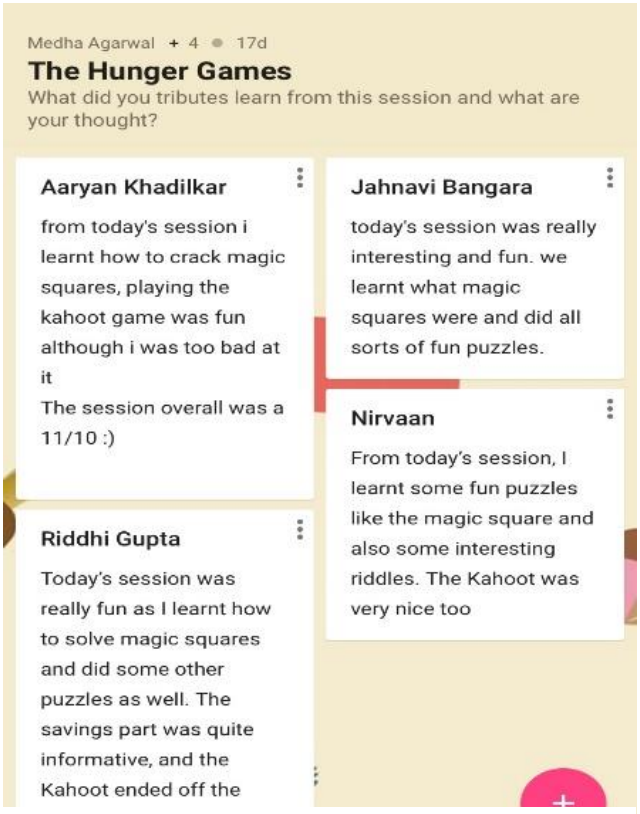


Figure 21: Padlet of Student Reflection

with us and that they liked and appreciated our session overall. But there were a few people who thought we could have managed time better and we totally agree with them. We would have loved to complete the session in time and improved their experience.

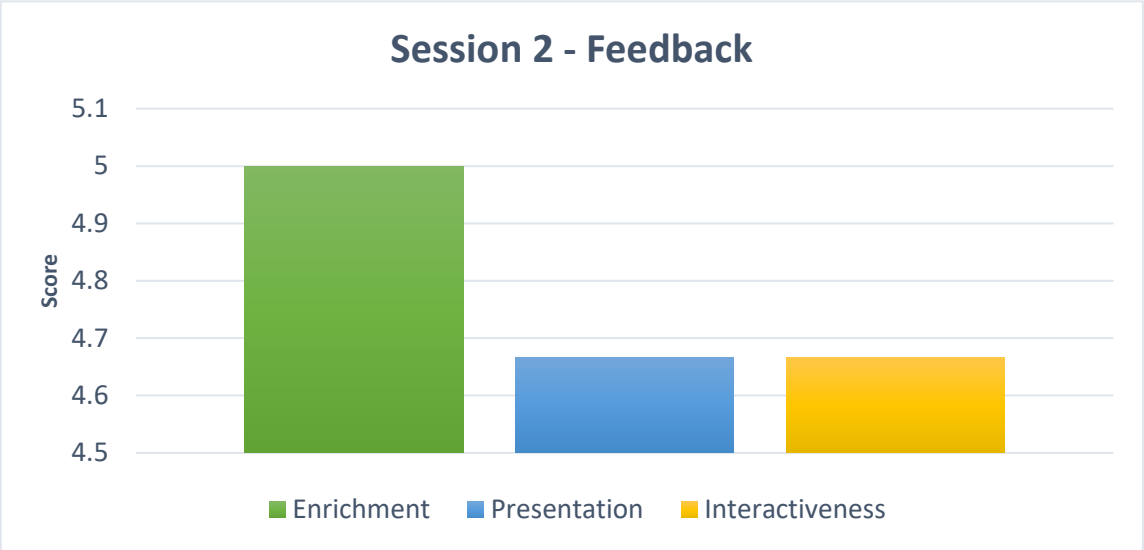


Figure 22: Scores based on student responses

We asked the learners to rate us on 3 criteria on a scale of 1 to 5. We were glad to see that average for our session was a perfect 5, however our presentation was rated lower and so was interactiveness. We took their feedback the positive way and believed that we could have improved the way of our presentation and would have loved to make the session even more interactive to make the learners experience with us much better.

REFLECTION:

Suhani: When I heard from my team that I had to teach our juniors, I was very scared because I thought that I wouldn't be able to engage with them or they are going to make fun of me and like me at all, I still tried to calm down my nervousness down and gathered all my courage and joined the meeting. As soon as the kids started entering the meeting, they were all so energetic and funny. They listened to every instruction

we gave them and slowly as we proceeded with our session all of us became very comfortable with each other.

It took a great amount of research to find different kinds of puzzles and quizzes that make them think and they get to learn something new except from their studies. Making the presentation and changing the formatting again and again, coping up with my partner (Medha) was very challenging because coming up with different ways of doing the same thing in order to make it fun loving was difficult. I learnt how to communicate more effectively and realised how difficult it is to take the place of a teacher for one day and the amount of hard work that goes into creating material for the students. We told them to turn their videos on and some of them actually did it, also the way they started to communicate and give answers with confidence, it was mind boggling to watch them do this.

From our side, we could have taken care of time and managed the session so that all the activities could have been covered. Apart from that, the session overall was very energetic and the students were very enthusiastic and joyous, we loved that all of them participated. I personally feel this session has made me learn a lot of new things. Firstly team work, this session would not have been made possible without my colleagues this session would not have been a success, they helped me in presenting and they also took over when I lagged out due to poor connection. Secondly my communications have improved after engaging with kids and speaking up with even more confidence are some of the changes that have improved me. And last but not the least, because this was a new experience for me it has given me the motivation to teach and present even more professionally according to the audience.

Our main aim was to give the kids a new experience of all the possible virtual activities we can do and they spend some fun time with us rather than just studies!

Medha: It was pretty challenging to come up with puzzles that were not very common or unknown. Being a miscellaneous category, the choices were vast but narrowing it

down to the best ones was a tough yet interesting process we came across puzzles that were never heard of but didn't fit the theme so had to be excluded.

Apart from listing down our choices, one of our main concerts was to include some kind of seriousness in a fulfilled session. Our session revolved around puzzles. We wanted to include something that was fun to teach and could be incorporated in the best way possible along with the puzzles. We ended up choosing puzzles which made the perfect match to our session.

The first two puzzles were linked to the savings prezi. We thought savings was the perfect match because it was the right age for the learners to be aware of savings and know a little about it.

Since we have all been schooling online for the past couple months, it had become an integral part of our planning to change the theme of our ppt. Almost all themes had been exposed to the students and this being a unique club, we thought it would be best to choose a unique theme.

The session was great and interactive. It was not my first-time teaching kids but it definitely was different online. I realized the struggle of teachers and the importance of time management. We did run out of time in our session and were unable to complete a fun chunk of our session. In fact, we had to overshoot by fifteen minutes to fulfil the crowd demand and conduct the Kahoot.

The students had been very cooperative throughout and took part whole heartedly. There were internet issues due to the terrible weather but we were able to pull off a good session and have the students learn something and enjoy.

Apart from all this, the biggest support throughout this club was the team members. We all were helping each other present our ppts and prezis, take attendance, send across praise and what not. The members had also been the best critics and made sure that our presentation was on point.

Overall, it was a fun learning experience for me as well. I learned the need and right way for time management along with a lot of new things through the course of this club. It was definitely a fun learning experience for me as well.

EVALUATION AND DEVELOPMENT OF MATERIAL:

Our session was based on games and activities so we changed the formatting to make it livelier and more interesting. We also added a lot of pictures to our new presentation so that we can grab the attention of the students. One more reason we chose a different theme was to catch the attention of the students since it was online and not everything could be under control.

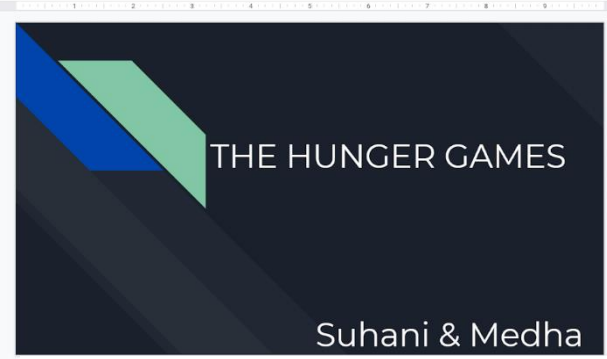


Figure 24: Before the Sessions

Figure 23: After editing to meet student preferences

BIBLIOGRAPHY:

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http://www.briddles.com/riddles/long

https://www.hdfcbank.com/personal/resources/learning-centre/save/how-to-open-a-bank-account-for-a-minor

11TH AUGUST 2020

Topic: Game Theory

THE GAME OF LIFE

SESSION 3

Session Co-ordinator:
ANANYA NAVALKAR

SESSION 3: THE GAME OF LIFE

TEACHING PLAN

SESSION COORDINATOR: Ananya Navalkar

SUBJECT: Famous Problems & Game Theory

TOPICS COVERED:

1. What is Game theory?
2. Types of games-
    a. Simultaneous games & Sequential games
    b. Perfect information games & Imperfect information games
    c. Constant sum games & Variable sum games
3. Playoff matrix
4. Strategies for a 2-player game
    a. Minimax Strategy
    b. Dominant Strategy
    c. Nash's equilibrium
5. Prisoners' Dilemma

METHODOLOGY:

1. Give an introduction on game theory. (3 mins)
2. Explain the types of games. (7 mins)
3. Explain how to solve a 2 player game using an example. (10 mins)
4. Allow learners to attempt a problem. (5 mins)
5. Explain how to solve the problem. (3 mins)
6. Explain the Nash equilibrium. (5 mins)
7. Allow learners to attempt the Prisoners' Dilemma (5 mins)
8. Explain how to solve the Prisoner's Dilemma (Video- 9.22 mins)

Medium Of Presentation:

- Powerpoint Presentation
- Videos on YouTube

Time requirement: 45 mins

Sample Material:

What is game theory?

The branch of mathematics concerned with the analysis of strategies for dealing with competitive situations where the outcome of a participant's choice of action depends critically on the actions of other participants. It shows a player how to best achieve their goal.

What is a playoff matrix?

The game is represented by a payoff matrix, wherein each row describes the strategy of one player and

each column describes the strategy of the other player. Each box gives the outcome of each

player choosing the corresponding strategy.

What is Nash's equilibrium?

The Nash equilibrium, is a solution of a non-cooperative game involving two or more players in which each player is assumed to know the equilibrium strategies of the other players, and no player has anything to gain by changing only their own strategy.

Cake problem

Amy and Bob are a pair of young twins who, like siblings everywhere, fight a lot and love cake. Their mother frequently bakes a cake that she distributes to them in the following way. She talks independently to each twin and asks about the other twin's behavior. If neither of them has any complaints, each of them gets half the cake. If only one of them reports a valid infraction by the other, that person gets three-quarters of the cake, the other gets none, and Mom gets the remaining quarter. If both of them report valid infractions, they each get only one-quarter of the cake and Mom gets the remaining half.

1. What is the best strategy for Amy and Bob if they do not trust each other?
2. What is the best strategy for them if, on the other hand, they do trust each other?

Solution

1. If the twins distrust each other, each knows that the other will rat them out on the slightest pretext. Therefore, each one should complain about the other. Both will get only one-quarter of the cake, but that will avoid the worst-case scenario of not complaining and getting nothing. It becomes a competitive game, and this solution is the Nash equilibrium.

2. If the twins trust each other, their best policy is to overlook the other's infractions, if any, and not complain. That way they both get half the cake.

SESSION 3: THE GAME OF LIFE

SESSION REPORT

LEARNING OBJECTIVES:

Students will be able to:

- Understand what is game theory and some of the types of games
- Understand and apply how to find the strategies to solve a game
- Understand and discuss the Prisoner's Dilemma and it's strategies
- Solve problems in game theory
- Apply logical reasoning
- Improve their critical thinking skills

SESSION SYNOPSIS:

The session started with the introduction puzzle which was posted on the general channel on teams a few hours before the session to evoke interest in the session. Only one student had been able to solve it, so we let him explain his answer. After that, my team mate explained the answer to the students and I took over.

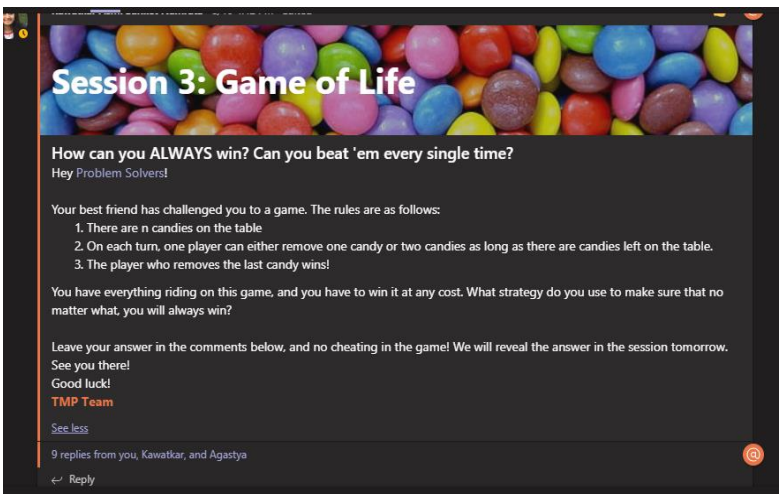


Figure 25: Pre-session Announcement

I started by asking them if they had heard the term game theory before. One student had a vague idea about it, which surprised me as I had not expected that any of them would know this. I then explained what it was and what a game was. I spoke about the types of games next. The students told me what they thought simultaneous and sequential games meant based on the pictures in the slide. They gave correct interpretations of the pictures which was great.

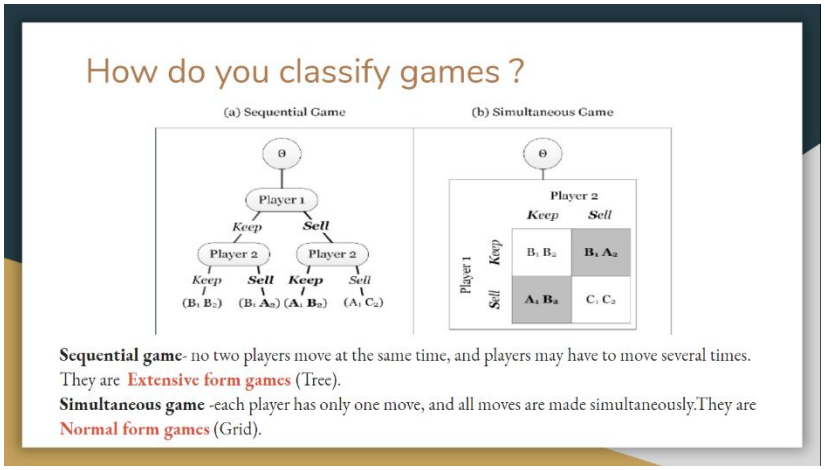


Figure 26: PPT Slides used in Session

We then moved on to games of imperfect and perfect information. Here, the students easily explained how the examples of chess and poker applied to each type of game. Zero sum and non-zero-sum games were an interesting conversation as I had asked them to categorise the game Rock, Paper, Scissors. I received different answers, but each student had an interesting thought process. One could conclude from the discussion that the answer would change based on the number of players. After this we looked at a problem.

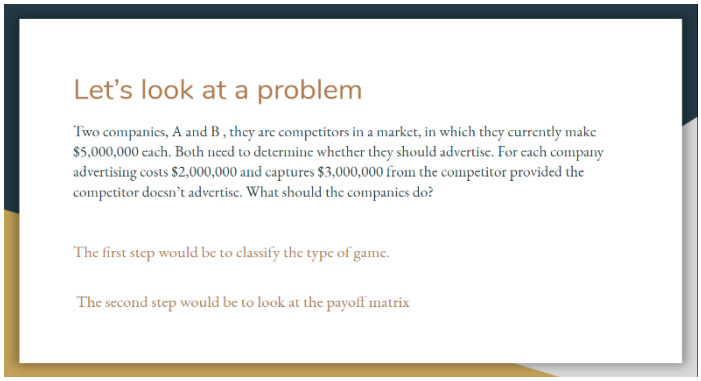


Figure 27: Sample Problem

I asked the students to classify the game. Unfortunately, only some of them were correct about the fact that it would be a non-zero-sum game. This was disappointing but they understood why it wasn't pretty quickly.

I then explained what a payoff matrix was. To my delight a student was able to explain the payoff matrix of the problem. However, some students didn't understand it and I had to explain it.

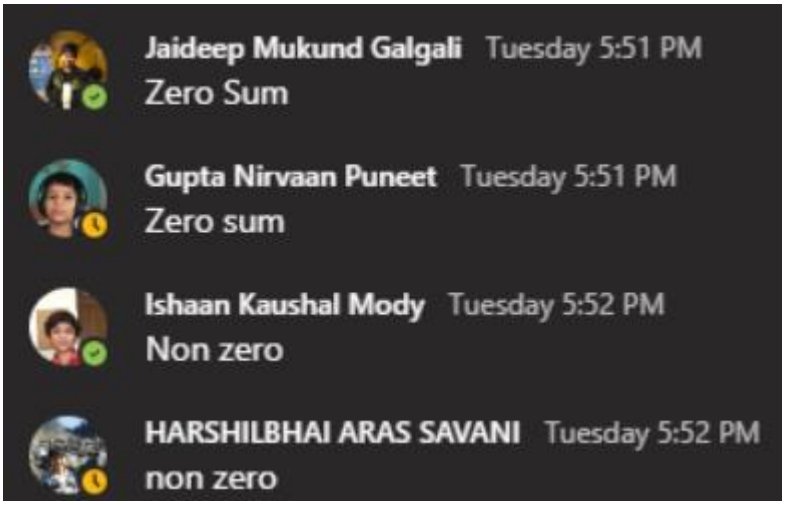


Figure 28: Student Responses

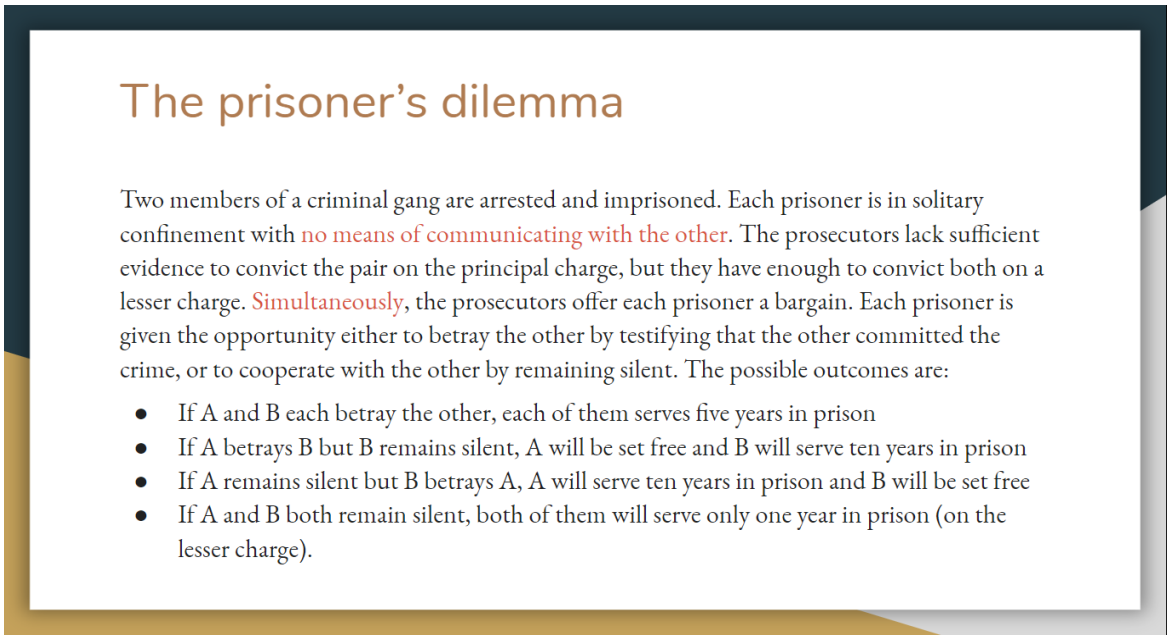
We then looked at ways to solve the problem. The Maximin strategy was understood by the majority of the students despite an error on the slide. The others understood it pretty quickly after I explained it again. To my delight, the students managed to correctly identify the maximin strategy for company A.

The Dominant strategy was next. Surprisingly, this seemed to be a difficult concept for the students to understand as I had to explain it thrice. Luckily, some of the students were able to identify the dominant strategy for company A correctly.

We then looked at the Nash equilibrium which most students understood more easily than the dominant strategy. This was particularly surprising as it is known to be a slightly complex concept. By now we had exceeded the time limit, so we tried to finish as quickly as I could.

After which, I told them about the Prisoner's dilemma. Again, I heard many strategies the prisoners could use from the students. Though all the strategies were based on the prisoners saving themselves despite the collective good.

I had planned a video to explain the solution to the students. Due to technical difficulties we had to wait to play the video. This wasn't a great thing as I didn't want to stretch the session further than it had already gone. Nevertheless, during this time



we went ahead and looked at one of the problems I had planned for the students to solve after the video.

The students were able to solve the questions quickly. Thankfully, by the time they answered the questions, the video could be played. After the video the session had ended. Unfortunately, we spent 15 minutes more than the allotted time.

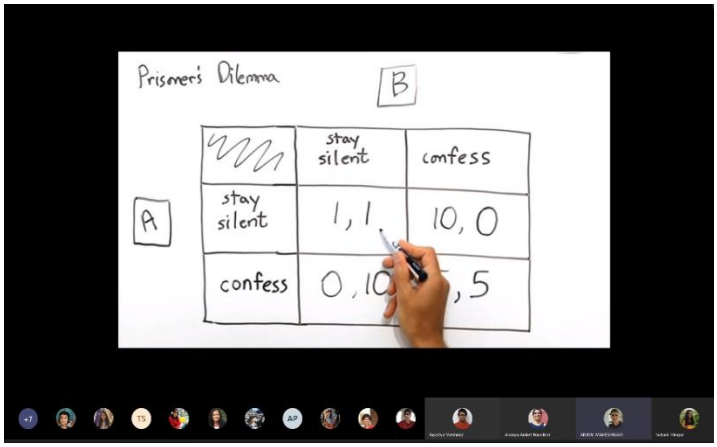


Figure 29: Video shown to clarify explanation for students

FEEDBACK ANSLYSIS:

From the supervising teacher: There was too much talking on my part and the session wasn't very interactive. My tone wasn't lively, so there was a huge chance of students losing track during the explanation.

I didn't receive any feedback from the students despite repeated reminders. I believe that this is a sign that it wasn't an interesting session.

REFLECTION:

This was without a doubt an ambitious topic to explain to 12-14 year olds which posed questions while deciding what to talk about. I had clearly overestimated the students based on their participation in the previous sessions, so I believed that they would understand what I planned to talk about. As this session was about a complex theory, while preparing for it, I struggled to find methods to make it more interactive than just asking questions. If I had found better ways to make the session interactive, it would have been easier for the students to understand. Next time, I'd definitely talk about a topic in which I could make the students do more activities.

I was also extremely nervous about my abilities, which impeded my ability to explain the topics to the students. Having more confidence would have helped to make me completely present in the session, which would have made it easier to understand the parts the students didn't understand and explain the concept accordingly.

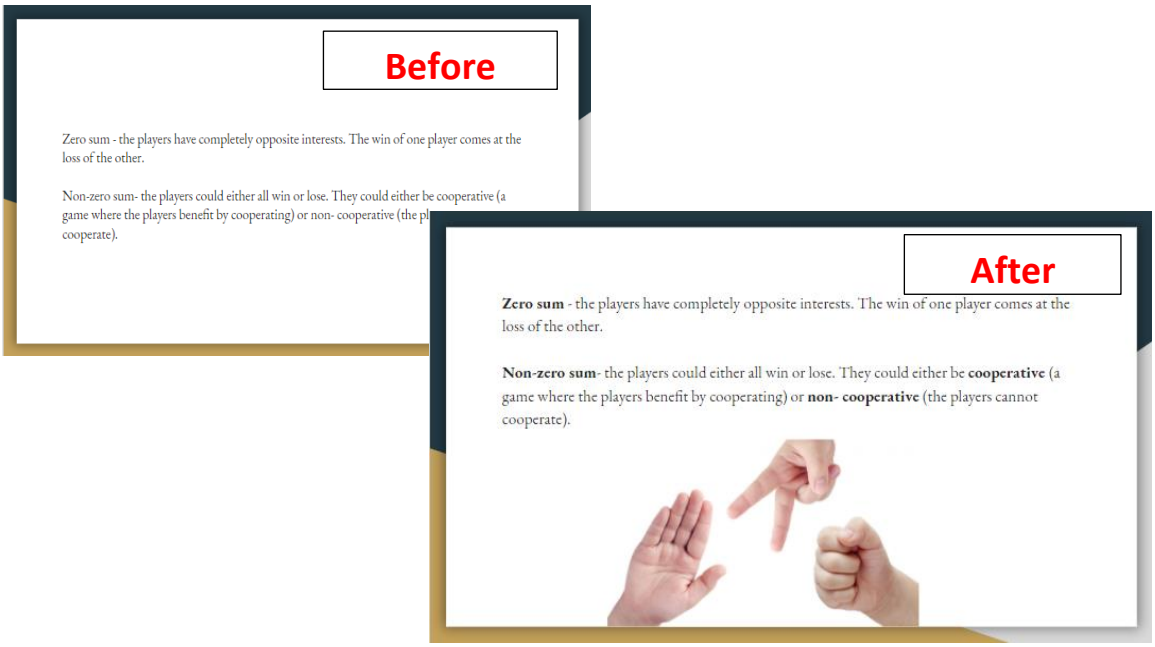
Before the session in a rush to calm myself down, I sent the presentation with the incorrect slide about the maximin strategy to the person presenting. Obviously, I should have double checked to see which presentation I was sending. Thankfully, it didn't cause a huge issue as the students still understood the concept, but next time I will definitely double check.

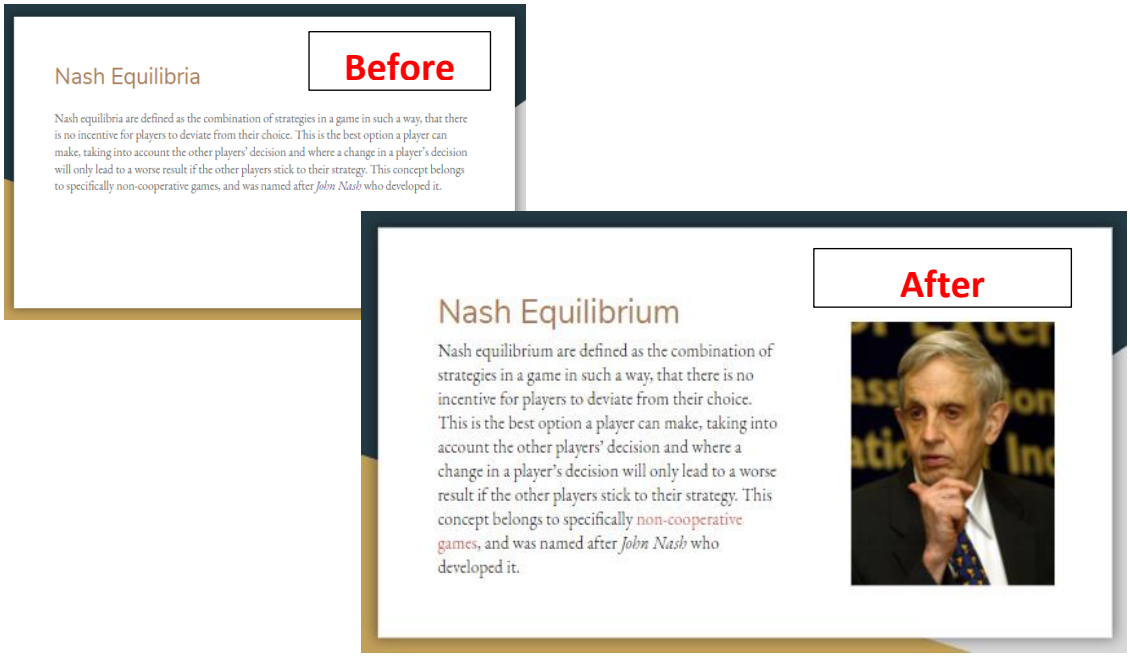
I believe that the teacher's feedback about my tone could also be addressed by having more confidence and practice with public speaking. I believe that some students did learn about game theory through the session based on their response during the session. However, the lack of feedback is confusing and as I mentioned I believe the students didn't find the session interesting. Since whether or not students would learn something is dependent on how interested they are, I believe that only a few learnt something.

Therefore, I believe that I partially achieved my objective as all students were supposed to learn about the topic. Overall, I believe that the session was decent,

although I believe that it could have gone better. I learnt a lot from the session about public speaking and teaching people.

EVALUATION AND DEVELOPMENT OF MATERIAL:





12TH AUGUST 2020

Topic: Robotics and STEM

ROBOTS, SCHWARZENEGGER AND ME

SESSION 4

Session Co-ordinator:
SIDDH MERCHANT

SESSION 4 - ROBOTS, SCHWARZENEGGER AND ME

TEACHING PLAN

SESSION COORDINATOR: Siddh Merchant

SUBJECT: Introduction to STEM and Robotics.

TOPICS COVERED:

1. My experience with robotics
2. My passion for robotics
3. Introduction to FIRST
4. Types of competitions
5. My personal experience at a FIRST competition
6. What FIRST emphasizes on and gives importance too
7. Skills that are sharpened by robotics
8. Electrical circuits and coding (basic)
9. How it allows the theory in your head to transform into practical knowledge
10. How it places your skills and strengths into a perspective
11. It's not all only robotics
12. How it contributes to the expansion of knowledge
13. What am I currently doing?
14. Students experiences

METHODOLOGY:

1. Introduction: My name, My class, My aim and my past experiences: Time: Roughly 10-15 minutes
2. FIRST and me: My experience with FIRST and robotics and how it built my interests in the sciences. + Projects I have worked on (Water-geek to seek the leak, Animal allies project, depression analysis project) working time on each project - 6 months on average. Time: Roughly 10-15 minutes

3. Robotics, STEM and FIRST; The triangle of fun learning: Time: Roughly 20 minutes
4. Ask the students familiar with first to speak up and share their experiences: Time: Roughly: 5-10 minutes

Medium of presentation:

- Power point presentation
- Camera to show the kind of things that can be built.

Time requirement: 60 minutes

Sample Material & Projects:

Water-Geek to seek the leak:

This project won us the best research prize at the international level. We made use of Lego, Arduino and other components to make this bot. The concept was that a robot would be put down into the sewage system and detect pressure fluctuations to detect holes inside the sewage system. We proposed this idea to the BMC and met with BMC officials to discuss its effectiveness. Presently we still make use of primitive

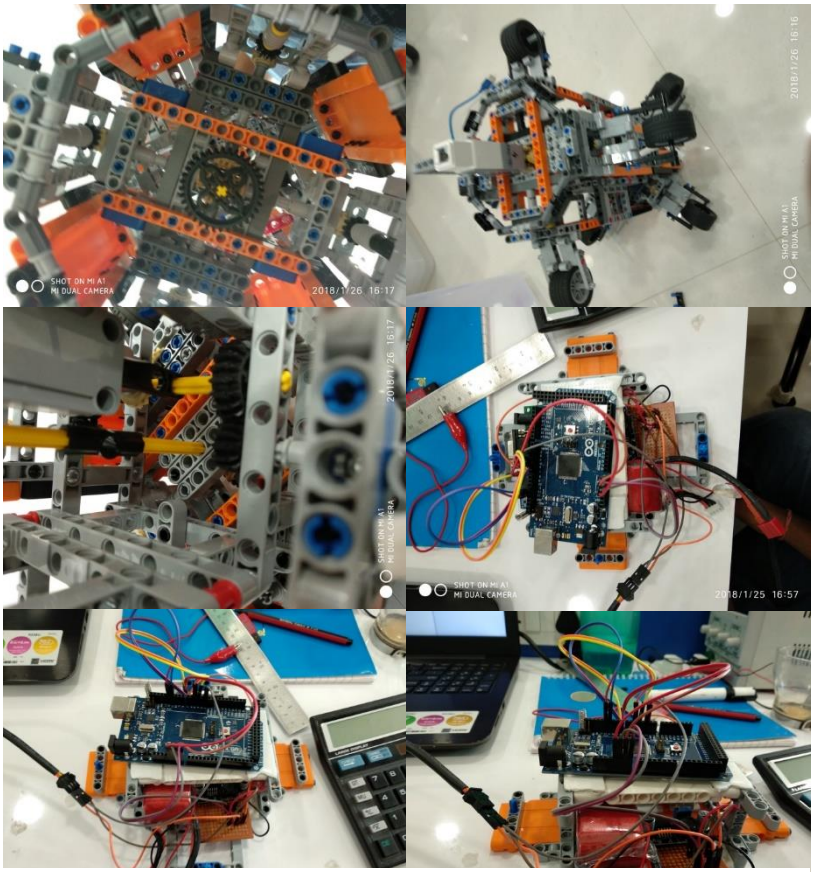


Figure 30: Some pictures of the STEM Project

technology to detect potholes. Using this system we would be able to detect potholes quickly and prevent serious leakages from taking place. We had made two models one using an EV3 module and the other using an Arduino module. Here are some pictures of the Lego and Arduino model:

Animal Allies:

Unfortunately, this project was long back and I only remember bits and parts of it. The whole concept revolved around saving animals from speeding cars. So, we had an ultrasonic sensor placed in two places: one to detect an oncoming car (placed roughly 200 meters before the warning siren) and the other inside the forest. If a car was detected and crossed a certain expected speed and wasn't slowing down, an input would be sent across to the siren which would play sounds at a frequency that doesn't bother the human but irritates any animal close to the road. This means that when a speeding car would come any animal close to a road will move away from it. Unfortunately, I have no pictures to show you'll. This project won us the regional prize for best project.

I also have a car designed by me to show them on camera. I will explain the concepts of physics using this and also explain how science relates to art, creativity and imagination.

Above all though I would love to share my experience with first and stem and why anyone can participate in it (You don't have to be amazing at science or programming. It's never too late to start either)

After the students have settled in, I will teach them basic concepts of electrical circuits and coding

SESSION 4: ROBOTS SCHWARZENEGGER AND ME

SESSION REPORT

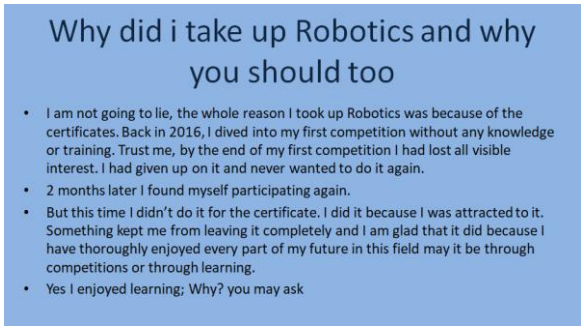
LEARNING OBJECTIVES:

Students will be able to:

- make a circuit
- make use of an arduino
- be introduced to robotics and stem
- gain an idea about competitions in robotics
- understand how robotics is applicable in the real world.

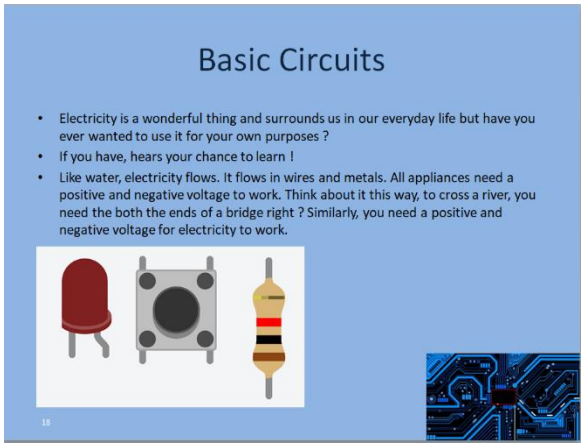
SESSION SYNOPSIS:

I initially talked about myself and gave an introduction, explaining in detail every step I took in robotics and how I overcame the challenges. I also explained to them the benefits of it and how I got into it. I then went on to explain the objective of First and its importance and activeness in the world of STEM, emphasizing the fact that you don't need to be great at science to become an active member of STEM. I made sure to drill that fact into their heads because, along with the knack of solving problems; creativity, communication skills, activeness, and interest all play crucial roles in not only FIRST competitions but in robotics and the working world.



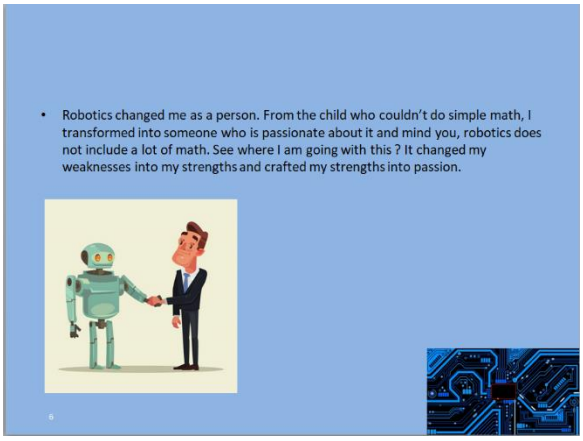
Moving on, I described the projects I have worked on in the past four years briefly so that they gained some knowledge about not only the intensity of robotics but the

interest it instils in an active young mind. I even made use of myself as an example and included all the barriers I faced, mentally, emotionally, and physically to give them a picture of how they would proceed if they took Robotics up. I did this to establish clarity in their minds and smudge of any stains of confusion.



After all this important talk I moved on to the practical part of the session-circuit building.

I taught them about basic circuits and loads and how to use each component to create their circuit. I started with the most basic concept and the most important one too--Electricity.

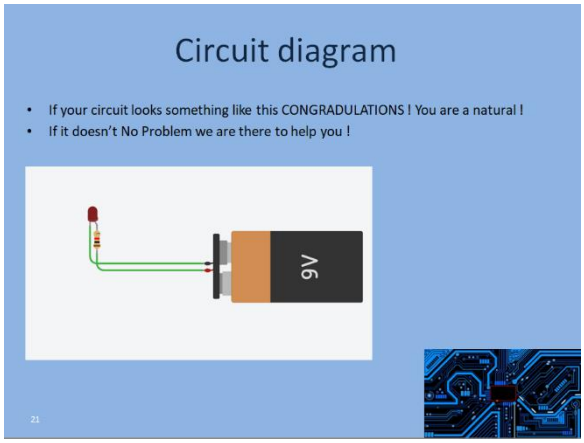


I explained to them the importance of electricity, how it is used, and what it is. To do the following, I made use of an analogy (Like water, electricity flows. It flows in wires and metals. All appliances need a positive and negative voltage to work. Think about it this way, to cross a river, you need both the ends of a bridge, right?)

to allow them to visualize and understand the concept in a deeper manner so that they could not only understand but make sense of the concept as well. Along with the explanation of electricity, I explained the importance of positive and negative voltage and why both are required to make an appliance work. To make things clear, I helped them visualize the concept.

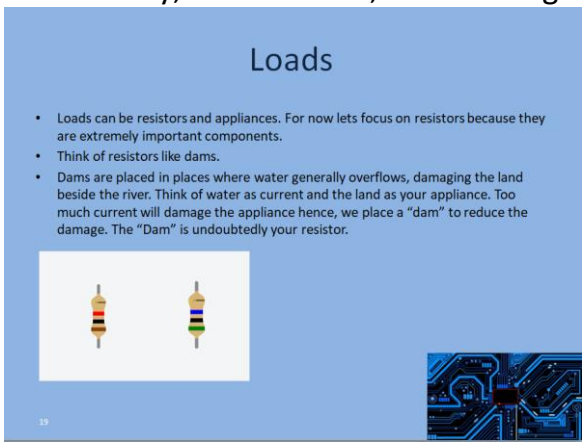
I then moved on to loads. I explained to them the importance of a resistor and how it functions, describing each using an analogy

(Think of water as current and the land as your appliance. Too much current will damage the appliance hence, we place a “dam” to reduce the damage. The “Dam” is undoubtedly your resistor)



related to the one used in electricity in order to create a mental map in their heads and create a visual picture of this vague concept. I tried to make it as simple as possible so that every person could easily grasp and understand the concept. My objective here was to make the next segment easier to understand so that each student could understand the concept behind the circuit instead of mechanically building it.

After completing the theoretical bit, we went on to make the circuit. I drew the circuit diagram for them, a basic one including one battery, one resistor, and one light-emitting diode or LED on the whiteboard. I explained every symbol in the circuit diagram to create a clear picture. I did this to help them visualize the circuit in real life. I then asked each one of them to log on to tinkercad; the website used for making the circuits and asked them to make the circuit. I made this into a competition to make things more exciting stating that whoever finishes first would receive praise.



The students found this extensively difficult with only a few of them cracking it. This may be because the concept is very new for them and they may have never ever done it before. I tried to help every one of them individually but unfortunately, we ran out of time. I could help everyone individually because each one of them was in a

classroom on tinkercad which allowed me to look at their circuits while they were working on them. As we ran out of time a whole segment of the session was missed and I couldn't teach them how to code. All in all, my colleagues and I believed that the session was fruitful for the students as they still managed to learn an essential skill required to tackle almost every problem in robotics.

FEEDBACK ANALYSIS:

The teacher was satisfied with the session, and all the team members present were satisfied with the session too. However, according to them, I could have carried on the session with those who had completed the first segment of circuitry and then reverted to the ones struggling with the circuit to keep the class moving. Students who submitted the feedback form stated that they enjoyed the session.

According to the data received, the session scored exceptionally well in terms of interactiveness and enrichment but received poor scores in terms of presentation. I agree with the review as my presentation was too wordy. I should have played closer attention to the audience as the language used for the description may have been too technical and long. In addition to that, I could have included more pictures,

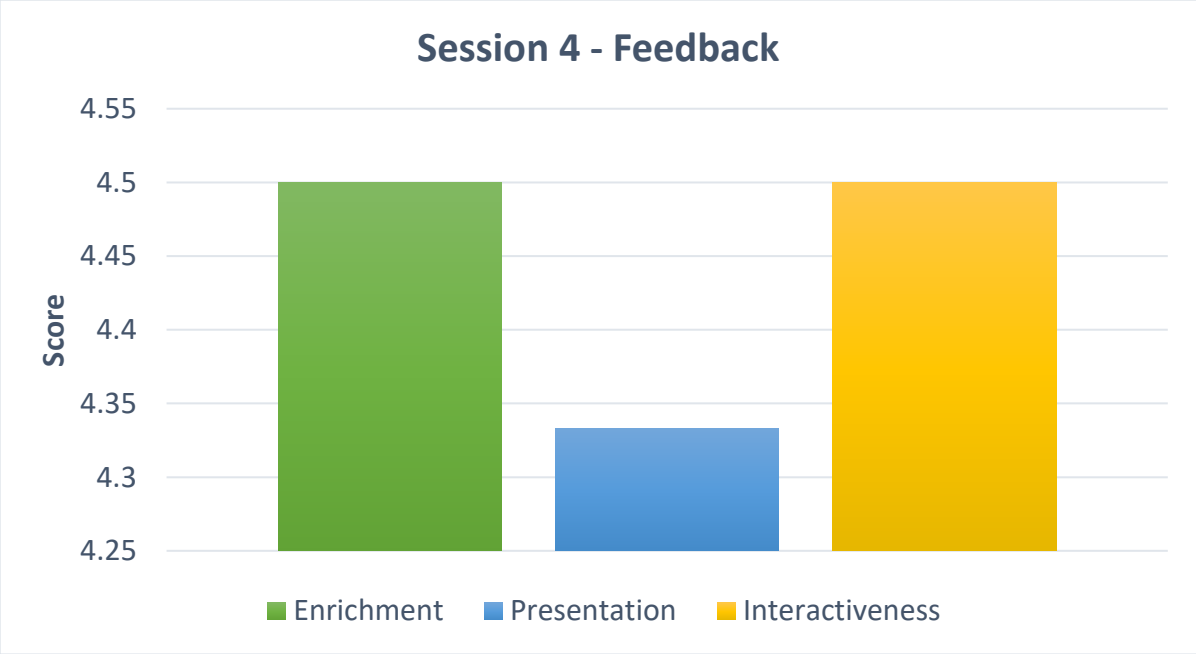


Figure 31: Average scores from student responses

animations, and videos to retain the attention of the students. According to the attendance analysis, session four also received the lowest levels of attendance across all the sessions. The students, however, seemed to not only enjoy their learning but show genuine interest, as the session collectively, has received exceptional results in terms of presentation, teaching, activities, consistency, innovation, and, interest with only a few of them finding the session difficult. Due to the difficulty of this topic and my lack of teaching experience, this session rated poorly in terms of being the student's favourite session. Finally, for a comprehensive review, the session performed at a mediocre level as it was able to get the point and objective across but wasn't able to capture the student's interest and attention. In terms of collective performance, as a team results received are exceptional and beyond expectations.

REFLECTION:

I believe that I could have done a better job. Especially with the time management of the session. I could have also finished my introduction quickly and reduced the time I spent on talking about my experience to create more time for the practical bit of the session. I should have also analysed the difficulty of my session beforehand to create a better structure for the session. In addition to that, I should have put in more research to create a better session. I also learned some things

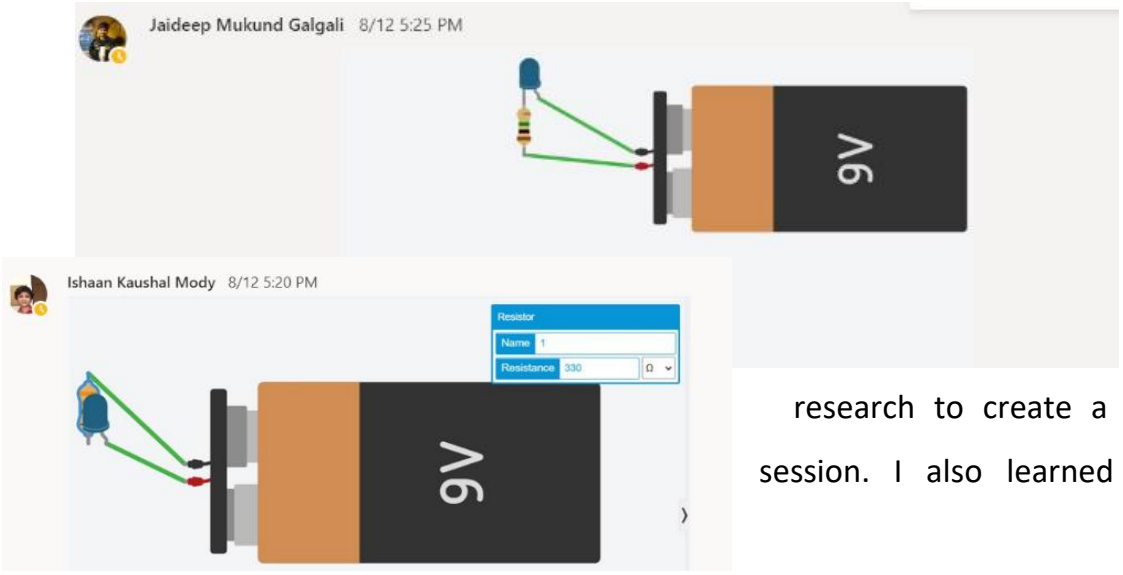


Figure 32: Samples of Student Work

though. I realized that in order to create a great session, a proper plan is required, and time management is extremely important. I believe that the strengths of my presentation were hidden in the explanation of the concepts and the sharing of my experiences. Overall, I believe that the presentation was great but could do with more pictures and reduced text. All in all, I took home several things from the session which, if implemented will most certainly make my future sessions much better.

EVALUATION AND DEVELOPMENT OF MATERIAL:

To begin with, robotics is a practical hobby which meant that performing the same virtually would be very difficult. Luckily, Tinkercad was available. This doesn't mean that everything was plain sailing either. While making the presentation I struggled with making the session interactive and fun for the students whilst simultaneously relaying my experience across. This raised the problem of time shortage which meant that I had to make my presentation both concise and informative. This did not take me much time to do. I got really lucky with the animations and pictures as they illustrated what I wanted to say perfectly. All in all, it took me three days to complete it.

Moving on, the real difficulties I faced were right before my class. I faced difficulties making a classroom on tinkercad; in fact, I had no idea that function even existed before my team members pointed that out. Luckily it was all ready by the next day. I had one more misconception, I believed that in order to use the software, each student had to make an account, which wasn't the case. This led to both my and the student's confusion but luckily my team members had my back again and we managed to quickly resolve the issue. Something that I did not think about was the fact that the students would have difficulty in operating the software. This wasted a lot of time which comes to my biggest problem; time! I could not complete the session, missing out on one entire segment of it which included coding. This was especially disappointing because I had prepared for it and the students were looking forward to that part of the session. Other than all these mishaps, the session went on well.

18TH AUGUST 2020

Topic: Thought Experiements and Paradoxes

A PARADOXICAL REALITY (I)

SESSION 5

Session Co-ordinator:
AKSHAY KAMATH &
ARJUN MAHESHWARI

SESSION 5: A PARADOXICAL REALITY (I)

TEACHING PLAN

SESSION COORDINATORS: Akshay A. Kamath, Arjun Maheshwari

SUBJECT: Thought Experiments and Paradoxes

TOPICS COVERED:

1. Mathematical perspective
    a) The Secret Sauce riddle
    b) The Troll Paradox
2. The concept of infinity
    a) Zeno's dichotomy paradox
3. The logical school of thought
    a) The unexpected hanging paradox.
    b) Card Paradox
    c) Brain in a Vat
    d) The Trolley Problem

METHODOLOGY:

1. An introduction into the paradoxical nature of life.
2. Mathematical perspective; concept of infinity; logical school of thought.
    a. Introduction of the Problem
    b. Allow learners to solve the Problem
    c. Explanation of the solution to the learners/Discussion of solution

Medium of presentation:

1. PowerPoint presentations
2. Videos from TedEd, YouTube

Time required: 45 - 60 minutes.

Sample Puzzles and Material:

The Troll Paradox

You and your brother are in a different world. You meet some cool magical creatures and start to play with them. You later meet a Troll who captures all the magical creatures in a giant net. The creature also captures your brother. Your objective is to free your brother and the creatures.

The rules of the game are as follows: -

- The Troll will let only the creatures go if you say a True statement
- The Troll will let only your brother go if you say a False statement.
- Your statement can only be one sentence.
- If you try to cheat by saying something paradoxical (example- "THIS STATEMENT IS FALSE") then the troll will eat your brother and the creatures.
- You cannot ask questions, fight or get out of this predicament.

What True/False statement can you say to force the troll to let your brother and the creatures go?

Answer: The trick to this answer is to say a statement whose truth or falseness depends on what you want the troll to do.

Example- If you say, "YOU ARE GOING TO FREE THE CREATURES AND MY BROTHER", the troll can respond by saying, "THAT'S FALSE, I AM ONLY GOING TO FREE YOUR BROTHER." Similarly, if you say "YOU WILL FREE THE CREATURES", the troll can say "THAT'S TRUE, I AM ONLY GOING TO FREE THE CREATURES".

But now watch what happens when you say, "YOU WILL FREE MY BROTHER". The statement can't be false because if it were, then the troll by its own rules will have to free your brother. This would make the statement paradoxically true and false at the same time. But the troll hates paradoxes and would never willingly create one, so his

only option is for the statement to be true. If the statement "YOU WILL FREE MY BROTHER" is true, then by his own rules the troll will let your brother and the creatures go, since you said a true statement.

As mentioned before, in a group of 23 people, there are 253 comparisons, or combinations, that can be made. So, we're not looking at just one comparison, but at 253 comparisons. Every one of the 253 combinations have the same odds, 99.726027 percent, of not being a match. If you multiply 99.726027 percent by 99.726027 253 times, or calculate $(364/365)^{253}$, you'll find there's a 49.952 percent chance that all 253 comparisons contain no matches. Consequently, the odds that there *is* a birthday match in those 253 comparisons is *1 – 49.952 percent = 50.048 percent*, or just over half! The more trials you run, the closer the actual probability should approach 50 percent.

The Trolley Problem

The trolley problem is a thought experiment in ethics modeling an ethical dilemma. It is generally considered to represent a classic clash between two schools of moral thought, utilitarianism and deontological ethics. The general form of the problem is this:

There is a runaway trolley barreling down the railway tracks. Ahead, on the tracks, there are five people tied up and unable to move. The trolley is headed straight for them. You are standing some distance off in the train yard, next to a lever. If you pull this lever, the trolley will switch to a different set of tracks. However, you notice that there is one person on the side track. You have two options:

1. Do nothing and allow the trolley to kill the five people on the main track.

2. Pull the lever, diverting the trolley onto the side track where it will kill one person.

SESSION 5: A PARADOXICAL REALITY (I)

SESSION REPORT

LEARNING OBJETIVES:

- Students should be able to spot the flaw in logic in "Zeno's Paradox" and subsequently be able to explain how to solve it
- Students will be able to apply and create a paradox to solve the "Troll's Paradox"
- Students should be able to solve the "Secret Sauce Riddle"

SESSION SYNOPSIS:

We started off the session by discussing ethical dilemmas and about the "Brain in the vat experiment." We did not focus too much on this as it was more of us giving participants information and would get dull and mundane quickly.

Next, we started off with the secret sauce riddle. Arjun managed to explain the secret sauce riddle to the participants without many issues - Occasionally, the team members would ask everyone to raise their hands if they were following his explanation and the majority of the participants raised their hands. To ensure everyone was following, we got the participants to answer short questions like "Could you please list all the perfect cube numbers?" and "What are all the square numbers?".

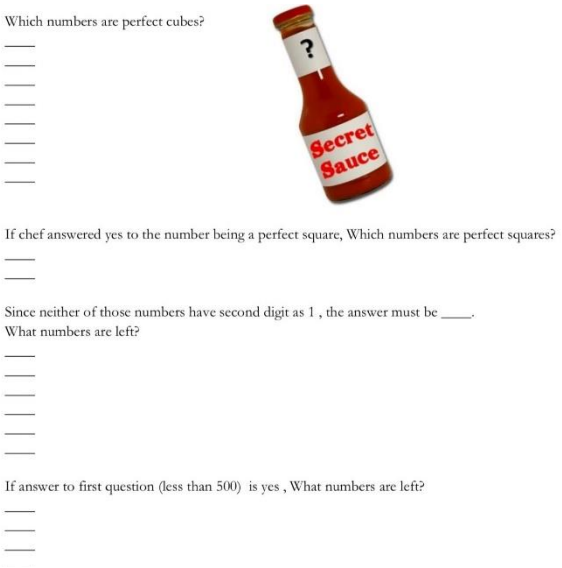


Figure 33: Guiding Sheet for Secret Sauce Riddle

Regarding the Troll Paradox, Arjun explained to the students on how to create a statement, whose truthfulness and falseness depends upon the situation/context of a problem. Students were easily able to grasp this concept with little to no issue.

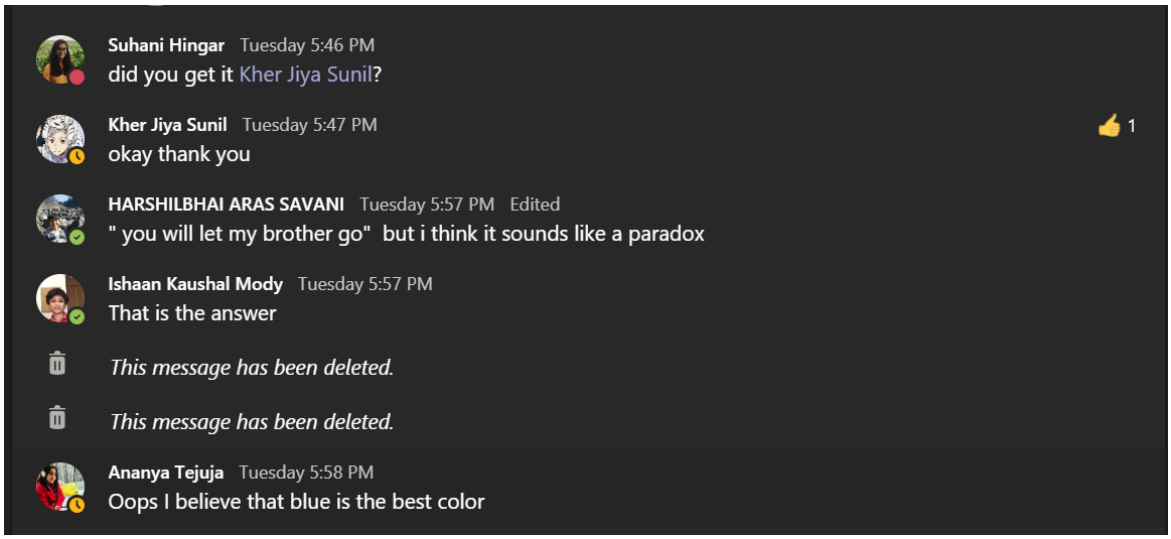


Figure 34: Student Responses and Interaction

The response rate for this problem was quite high and many participants made attempts to solve this question. Notably, some participants were able to guess the correct answer without much difficulties.

Similarly, the response rate for Zeno's Paradox was quite high. Despite our concern that participants may not be able to understand the concept very well, they easily understood the workings and the core concepts extremely well. Akshay was easily able to teach the students the flaw in logic behind this concept. After teaching them about the concept, we got a few participants to explain different key concepts. Firstly, we got one participant to summarise and explain the paradox in their own words. Furthermore, another participant was asked to explain how to solve the paradox by making reference to the square provided in the guiding sheet. Both of these responses were satisfactory to the learning objective indicating that participants understood what was being taught.

The students exceeded our expectations and were easily able to keep up. To our surprise, our lesson was finished approximately 15 minutes before the allotted time. In this amount of time, students debated about their views on Ethical paradoxes such as the Trolley Problem and completed the google forms.

FEEDBACK ANALYSIS:

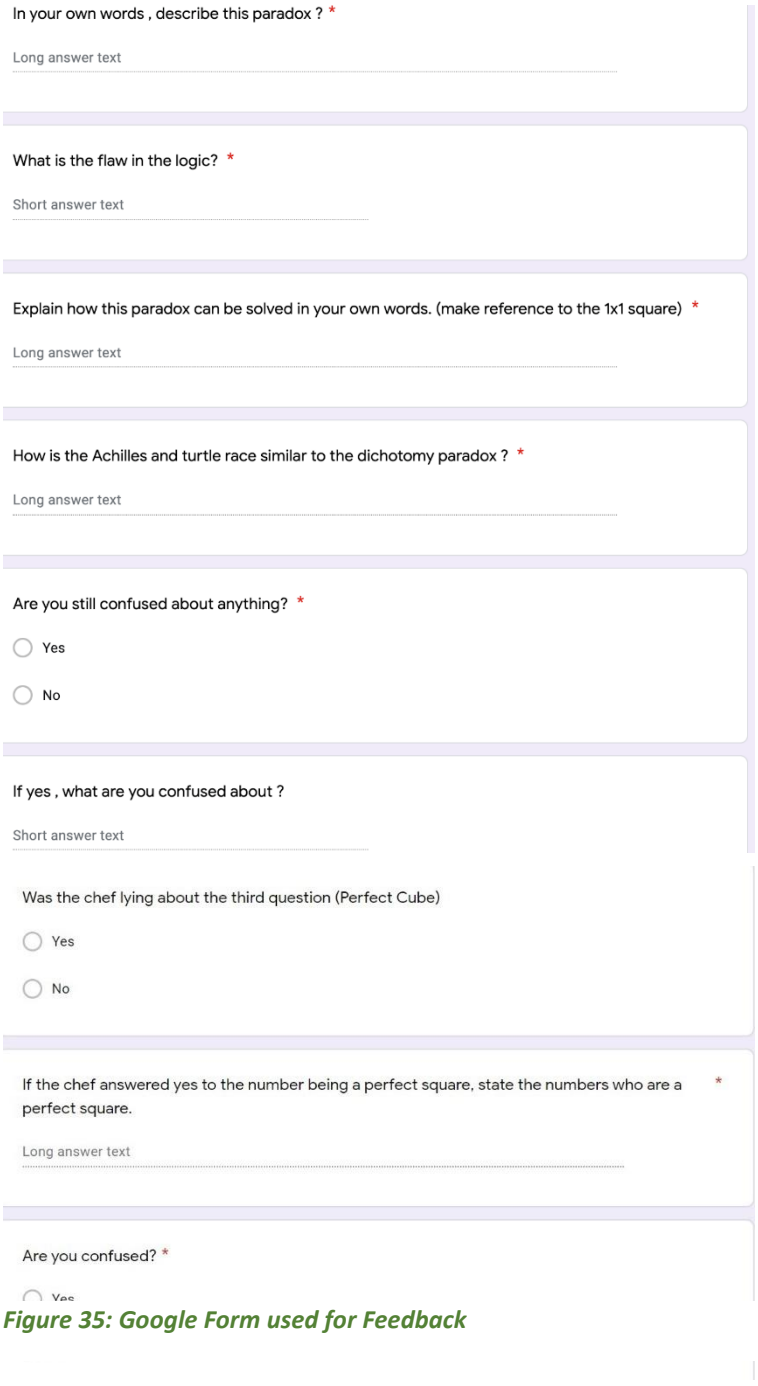


Figure 35: Google Form used for Feedback

Although using google forms was a mundane and dull way of testing the participants comprehension of what has been taught, we felt it was the most effective way. The google forms consisted of Multiple-Choice questions and some open-ended questions to allow participants to explain concepts in their own words.

The participant response rate for the google forms was lower than expected, a trend that we have been observing for quite a while.

REFLECTION:

Individual Reflection

Arjun: I presented The Secret Sauce Riddle, The Troll Paradox and The Trolley Problem and Ethical Paradoxes. Personally, I felt that my pacing was a bit too swift at times and my explanation was a tad bit difficult to understand at times. This could have been because I may have used certain words that may have proved to be difficult for the audience to understand, I will improve on this by using a more friendly and easy choice of words. The students however, did understand my explanation. I will improve these points of weakness in my next session by practicing better beforehand to increase my chemistry with my teammates for an all-around better presentation. I think I managed to help students develop their logical reasoning and thinking skills while presenting a fun and euphoric lesson. I learnt that a few students who were having trouble with understanding a few key concepts (such as Coercive Logic) required a second explanation and will be doing this explanation at the end of the next session. By spending time polish off these problems students will be able to apply these learnings to their daily life as well.

Akshay: During the presentation, I was able to identify one of my weaknesses which is public speaking. I think the presentation did provide me with a great opportunity to get over this fear. At the start of the session, I got terrible anxiety, due to my fear of public speaking, but I was able to pull through and managed to build a rapport with the participants towards the end of the session. I saw Arjun explain with ease and saw the participants responding well which helped me build confidence and after the first 10 minutes, I realised that it wasn't as frightening as I had portrayed it to be.

Both me and Arjun were concerned that we would just blabber on and the session would get boring quickly so we did our best to engage the participants by asking them for their opinions and thoughts. I was quite happy to see the response rate increase towards the end of the session.

I would also like to express my gratitude to the team for their quick-thinking. Our presentation finished earlier than expected and we were quite lost on how to occupy them for the remaining of the time… A few of our teammates took over and engaged in a debate with the participants while Arjun and I checked the responses on the google forms. Lastly, I feel that the session was productive and successful because most of the participants noted that they enjoyed the session and indicated that they learnt something new.

Combined reflection

We both feel that we have learnt many skills throughout this extracurricular activity. Firstly, persistence and tenacity because we spent countless hours reading through many paradoxes, looking through various websites and watching videos. Then, discussing whether they would fit into our presentation. The process was long and tedious but we managed to pull through.

Secondly, public speaking and presentation skills. We were both given this amazing opportunity to refine our skills by teaching students new concepts.

Thirdly, teamwork and cooperation. We both were from different schools before joining Podar and collaborating together to work on this project has definitely put our teamwork and cooperation skills to the test. We were able to work with each other very well and prepare the presentation with efficiency and efficacy. Most of our disagreements arose when we were debating about whether we should include a particular item into the presentation or not but they were constructive criticisms.

EVALUATION AND DEVELOPMENT OF MATERIAL:

During a conversation with our Principal and the teachers who were in charge of this event, it was highlighted that our target audience may not be able to comprehend

complex topics like “Zeno’s Dichotomy Paradox”, “Infinite Hotel Paradox” and other topics.

It was also highlighted that being able to capture and retain the participants attention might be challenging. Similarly, we were concerned that the participants might experience boredom during the presentation as it involved a lot of one-way communication Thus, the coordinators felt the need to focus on making the presentation exciting, interesting and interactive.

As our session was the 5th one, we were able to gauge the participants ability to comprehend complex topics according to their performance and we were able to make adjustments to our presentation accordingly. We made the use of a guiding sheet and short debate at the end to make the session more engaging.

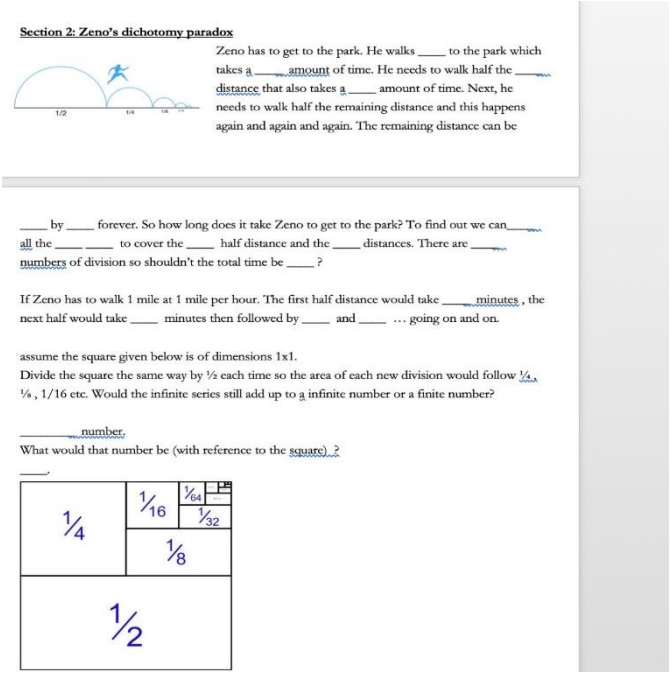


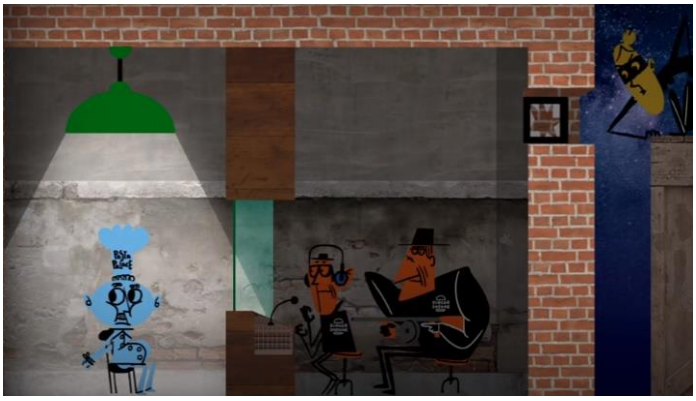
Figure 36: Guiding Sheet

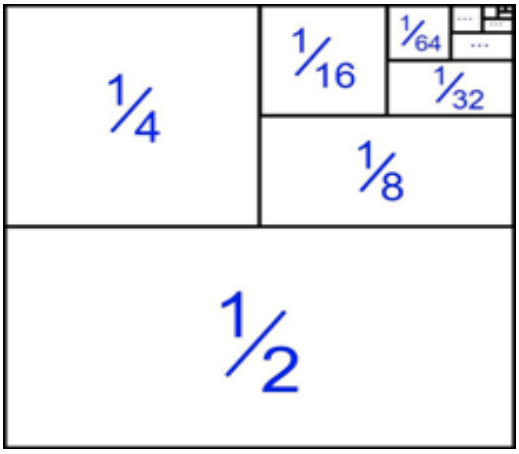
As mentioned above, we provided a guiding sheet to the participants so it would be easier for them to understand and follow along with the coordinators.

The guiding sheet focused only on certain topics - Secret Sauce Riddle, Zeno’s Dichotomy Paradox - because these were the harder topics which we thought the participants might have difficulties to comprehend. The guiding sheet proved incredibly effective as students kept up at an extraordinary pace.

Additionally, to make the presentation more interesting we added various pictures to create narrative elements. These helped us to illustrate the setting pictorially which otherwise would have been boring if done through long paragraphs of text.

Lastly, taking into consideration that some participants may not have been able to understand the text or what the coordinators were explaining, these pictures were added to the presentation so that it could help explain the issue pictorially.





19TH AUGUST 2020

Topic: Ciphers and Encryption

CRACKING THE CODE

SESSION 6

Session Co-ordinator:
ASMI KAWATKAR

SESSION 6: CRACKING THE CODE

TEACHING PLAN

SESSION COORDINATOR: Asmi Kawatkar

SUBJECT: Ciphers & Codes (II)

TOPICS COVERED:

2. Modern Cryptography
3. Zero Knowledge Proof
4. Alan Turing and the Enigma

METHODOLOGY:

8. Revise the ciphers done in the previous class
9. Identify the weaknesses of using substitution ciphers over the internet/in modern cryptography
10. Link the applications of ciphers to modern cryptography
11. Explain Zero Knowledge proof as a method to overcome weaknesses of substitution ciphers
12. Briefly discuss how the Enigma machine works
13. Allow learners to reflect on the difficulties faced by Alan Turing while cracking the code
14. Collect reflections from all learners using a Padlet/Google form

Medium of Presentation:

- Power Point Presentation with puzzles
- Decryption resources online (https://cryptii.com/pipes/caesar-cipher)
- Kahoot/Other quiz to submit their puzzle answers
- Infographic regarding Enigma machine

Time requirement: 45 ~ 60 mins

Sample Puzzles & Material:

SAMPLE #1: Modern Cryptography and Zero Knowledge Proof:

So modern Cryptography/encryption is the key to advanced computer and communication security. This stream of cryptography is completely based on ideas of math such as number theory and probability.

Zero knowledge proof is now used to verify systems. These are techniques which are used to verify things without sharing or revealing underlying data.

Think of a payment app checking whether you have enough money in your bank account to complete a transaction without finding out anything else about your balance. Or an app confirming a password's validity without needing to directly process it.

Note: We will also guide the class through real life examples (sudoku solutions, Where's Waldo book) to understand how Zero Knowledge Proof works.

For example: Alice and Bob are racing to find Waldo in the popular children's book series, where the point is to spot Waldo in a sea of shapes that look like him.

The conundrum:

Alice: I know where Waldo is!

Bob: Alice, do you know what a liar is?

Alice: I can prove it to you without revealing its location.

Alice cuts out Waldo from her scene and shows Bob the snippet. To ensure that Alice didn't just print out a new picture of Waldo, Bob can watermark the bottom of Alice's scene page. This way, Alice proves to Bob that she has found Waldo without revealing the solution to him.

SAMPLE #2: The Enigma Machine:

Straddling the border between mechanical and electrical, Enigma looked from the outside like an oversize typewriter. Enter the first letter of your message on the keyboard and a letter lights up showing what it has replaced within the encrypted message. At the other end, the process is the same: type in the "ciphertext" and the letters which light are the decoded missive.

Imperfections:

- No letter could be encoded as itself
- Each report started with the same subject matter – the weather

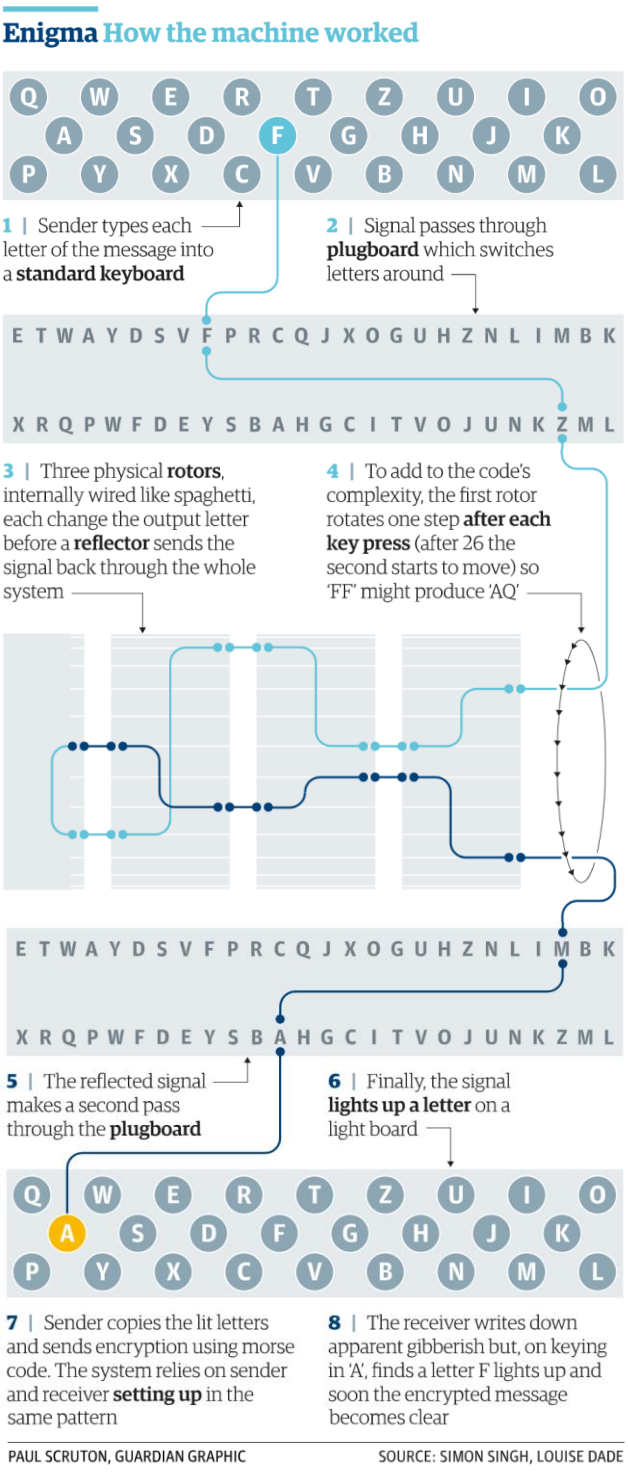


Figure 37: The Working of the Enigma

SESSION 6: CRACKING THE CODE

SESSION REPORT

LEARNING OBJECTIVES:

Students will be able to:

- Recall their previous knowledge of ciphers
- Identify the weaknesses of the ciphers they know
- Discuss the practical applications of cryptography
- Discuss the practical applications of Zero Knowledge Proof
- Apply zero knowledge proof to puzzles
- Understand the functioning of the Enigma Machine
- Successfully solve a Kahoot based on the session

SESSION SYNOPSIS:

This session was a continuation of the very first one, and so to begin with I had a revision puzzle set out for the learners, just to refresh their memories. Admittedly, a few of them were a bit rusty at first, but they got back into the zone soon enough and were able to crack the double encrypted pigpen + caesar cipher puzzle I had set for them.

After that, we moved onto a short discussion into the weaknesses of ciphers. A student had brought this up in the previous

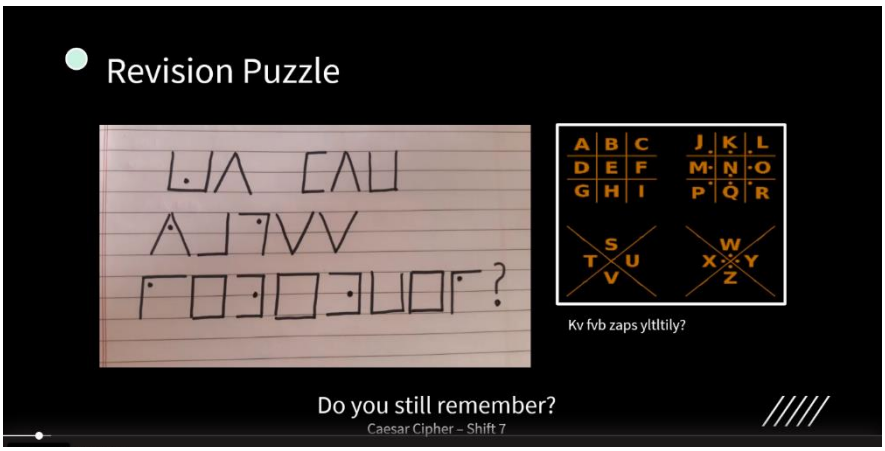
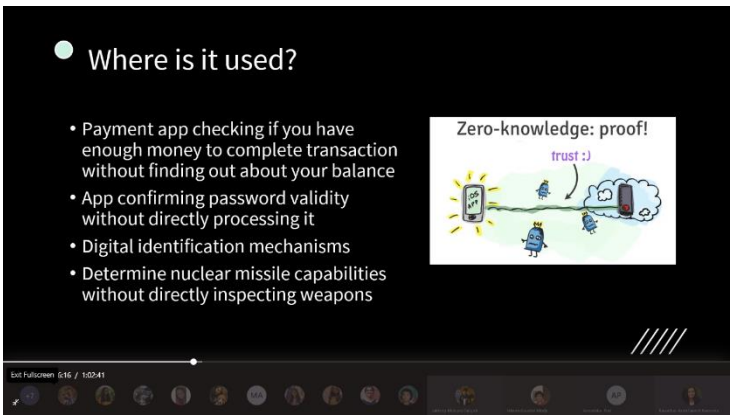


Figure 38: The Double-encrypted puzzle

session, independent of my prompts (which was very surprising and impressive for me), and so I asked the same child to reiterate his idea. Building on what he said, the rest of the students used the images on the slide as hints and successfully came up with the weaknesses of the basic ciphers that we had learnt so far.

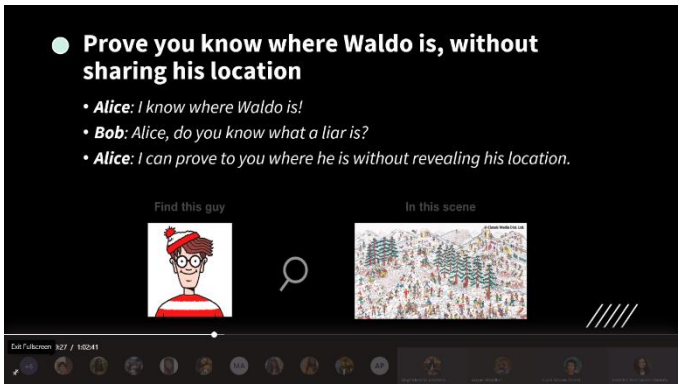
Then we launched into a debate on how to overcome these weaknesses. This was a slightly bigger jump to a more advanced topic, so it was not surprising that a few of them found it difficult to contribute to the discussion. However, seeing their peers come up with the answers, everyone soon started speaking up. It was really admirable to see that a few students tried to answer, despite not being sure of the answer. We made sure to send praise to these learners after the session to encourage their budding confidence.

The discussion on Zero Knowledge Proof (ZKP) required some hints from me, but apart from that the learners were able to infer from each other's answers and contribute fruitfully to the session. We successfully established the applications of Zero Knowledge Proof, before moving onto the first big puzzle of the session.



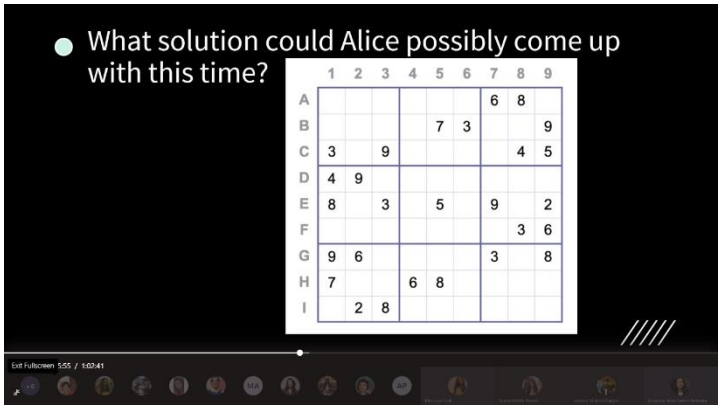
Now the puzzles on ZKP were slightly lengthier so I had chosen to include just two of them, knowing that the understanding of the thought process might take slightly

longer than usual. I made sure to base the problems around popular themes to allow the learners to be engaged in the entirety of the session.



The first puzzle was based on the popular children's book series, 'Where's Waldo?'. Although based on the responses I could tell that they understood the situation, the learners needed my help to be guided to the answer. This had already been anticipated by me, because this concept is quite unconventional so for me, as a teacher, the process and the approach to the solution was more important than the actual solution. I was happy to see that all the learners were able to successfully understand the problem once I had explained the solution to them.

Building on the same understanding, we went into a second puzzle, this one based on the popular game Sudoku. Despite the problem having the same line of reasoning, some students found it more challenging to comprehend this puzzle. Even though I had not prepared for this, I spontaneously turned it into a mini-debate. I had each side voice their opinions on why they thought my solution was inapplicable, and then I went on to show them the holes in their



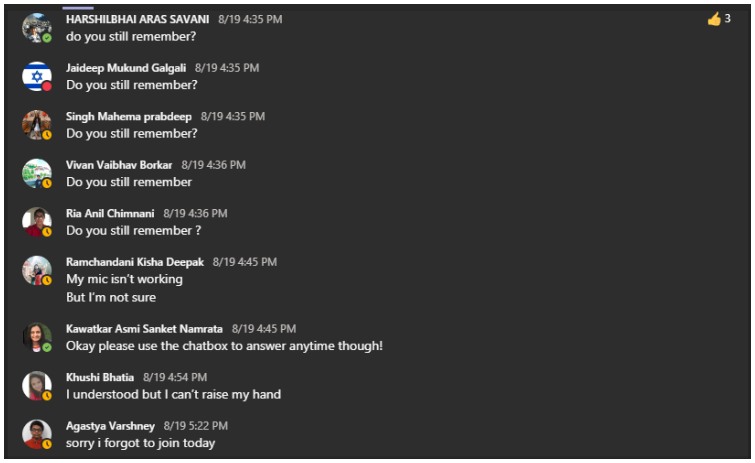


Figure 39: Student interaction in chatbox

argument, and the places where their logic was not valid. In the end, they understood and I was really pleased to see their willingness and confidence to contradict me and make their opinions heard.

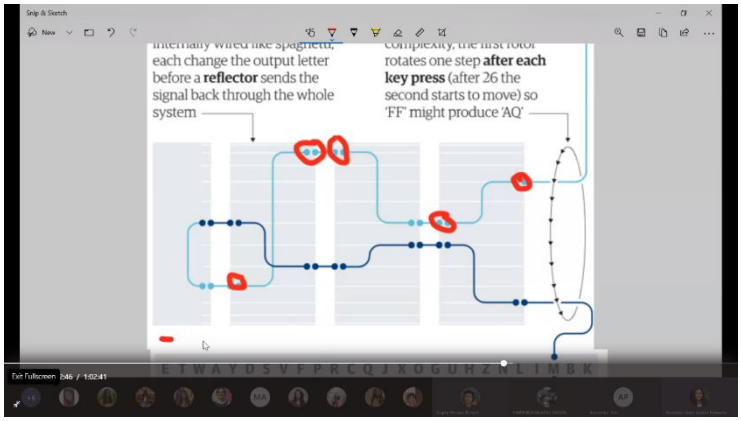


Figure 40: Understanding the Enigma with annotations

After this, we moved to the second half of the session - the Enigma Machine. We collectively walked through an infographic which detailed the workings of the enigma machine. The learners were not required to understand the exact nuances of the machine, but only to gain a general idea about the complexity of its functioning. Having established this idea, we moved to a short discussion on previous knowledge of the Enigma machine before watching a clip from the famous movie 'The Imitation Game', which was about Alan Turing and how he cracked the Enigma code. After they watched the video, I asked the learners to identify the weaknesses of the Enigma Machine which had been mentioned in the video clip. They were successful in coming up with both weaknesses and we went on to a short Kahoot based on the entire session.

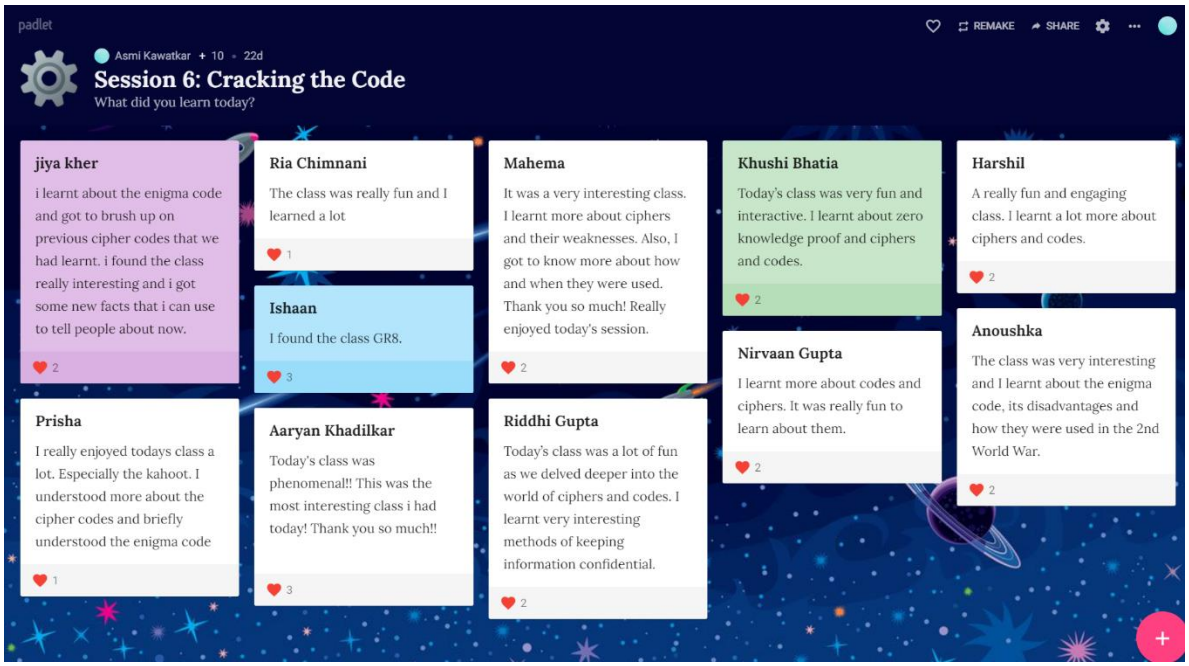
Figure 41: Kahoot, a crowd pleaser

All learners were able to complete the Kahoot, and unfortunately, because of the setback with the Sudoku puzzle, I was unable to do a class reflection. Instead, I asked all learners to type their individual reflections into a padlet and the session came to an end.

FEEDBACK ANALYSIS:

My teammates said that the session had been an extremely interesting and engaging one, and that some of them had also learnt something new along the way!

The students all wrote in saying that they were able to learn about a concept they had never known of, and that they thoroughly enjoyed the session. As seen from the contented responses in the Padlet, the learners felt that they were able to achieve their learning objectives. I was so happy that they were all able to successfully reflect on their learnings and cite exactly what they had gained from my session.



REFLECTION:

Admittedly, I spent a lot of time pondering about the exact details of what I should include in the second session, because the learners had shown such immense interest in the first one. I decided to include the video and the kahoot as I knew from observing the other sessions, that the students really enjoyed those.

I was jubilant that my session had been a success, but I have to give credit to my teammates for supporting me with backend work, feedback and endless criticism which pushed me to be even better.

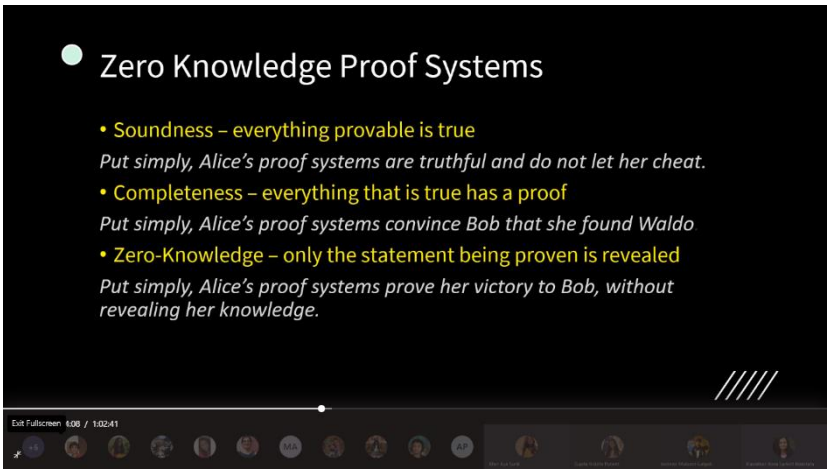
This constant positive feedback mechanism is what made me improve my ppt, Kahoot and the entire structure of the session by giving me the confidence I needed in knowing that my work was bulletproof, because it had stood up to the criticism of my team members.

Our team meetings allowed me to practice my presentation skills, so I was able to remain calm and in control while handling the students. Sometimes I have a tendency to be slightly overbearing, and this is something that I was trying to work on during the session. I made sure to keep an open mind, to listen to all opinions and all frames of thought before giving my input on the same.

The time management setback was a little unnerving and I was dejected to have to miss out on the class reflection, as I really wanted all the learners to hear from each other as well. However, I was able to quickly adapt and move to the padlet, thinking that the learners would be able to see each other's work there as well.

All in all, it was a wonderful learning experience, and I was able to become a better thinker, leader and communicator.

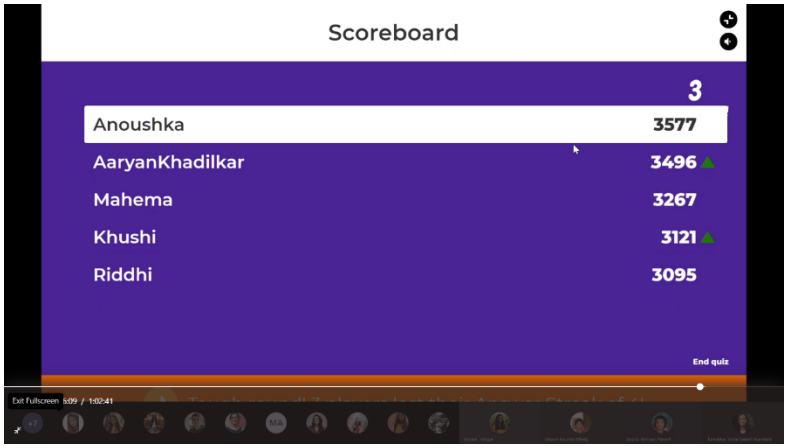
EVALUATION AND DEVELOPMENT OF MATERIAL

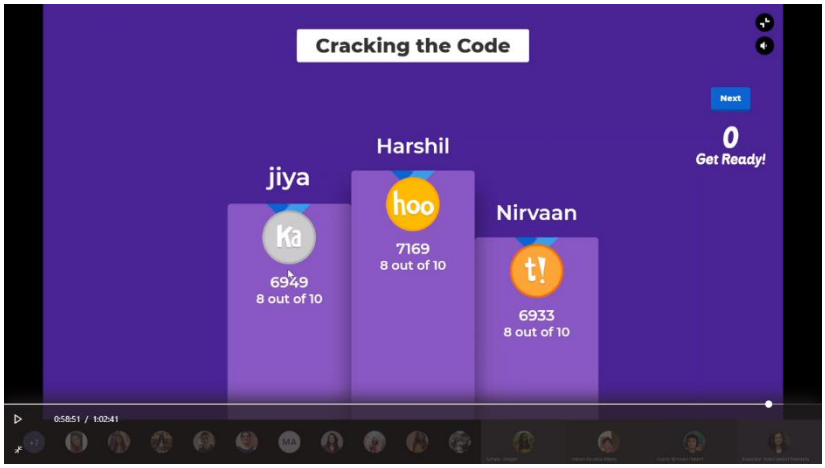


In the initial lesson plan, I had not planned to venture into such depth with the topic of zero knowledge proof. I had actually planned to stick to the basics. However, over the course of the previous sessions, the interest that the students displayed really inspired me to go deeper and be more elaborate about the applications and working of zero

knowledge proof. I decided to include the second sudoku problem as well because I thought that they would be able to grasp it fairly quickly.

Secondly, this time I decided to include a Kahoot as well. This was not the initial plan, but the enthusiasm with which the Kahoots of previous sessions had been welcomed taught me that this could be a very potent and useful method of conveying information and testing the understanding of the students.





25TH AUGUST 2020

Topic: Origami and Cubing

EXPLORING DIMENSIONS

SESSION 7

Session Co-ordinators:
ABHIJIT KAMATH,
ASMI KAWATKAR &
SIDDH MEHRA

SESSION 7: EXPLORING DIMENSIONS

TEACHING PLAN

SESSION COORDINATORS: Abhijit Kamath, Siddh Mehra, Asmi Kawatkar

SUBJECTS: Origami & Cubing

TOPICS COVERED:

1. Origami models:
    1. Flapping bird - made of a square sheet (10 min)
    2. Origami boomerang - made of half A4 (8 min)
2. Crease pattern talk with images of finished product (5 min)
    1. Elias stretches
    2. Level shifters
    3. Origami turtle homework (include crease pattern and finished collapse)
3. Introduction to cubing
    1. The origin of cubing
    2. Demonstration (video/real life)
    3. Discussing the different ways to approach a puzzle like the Rubik's cube
    4. Introduction to the world of cubing

METHODOLOGY:

1. Introduce learners to origami
2. Explain the importance of crease patterns
3. Guide learners to create a model of their own
4. Introduce learners to cubing
5. Explain the approach to solving the complicated problem
6. Guide learners to connect problem solving to real life

Medium of Presentation:

1. PPT
2. Video
3. Live demonstrations

Time Requirement: 45 minutes

Sample Material:

The 2 folds to master origami: Mountain and valley fold. They are basically the same fold however for ease mountains are creases that come out towards your and valleys are folds that go away from you.

Crease patterns are a quick and easy way to record how to fold an origami model. A crease pattern is basically just an origami model that has been unfolded and shows all the creases on the original flat piece of paper. It's much harder to fold an origami model from a crease pattern than it is from a diagram
→ they consist of coloured lines which can either be red or blue. Where red is a mountain while blue is a valley.

Today we will be teaching 2 diagrams: Elias stretches names after Neal Elias and level shifters. This will give you the basic understanding of how to read a crease pattern and fold with it.

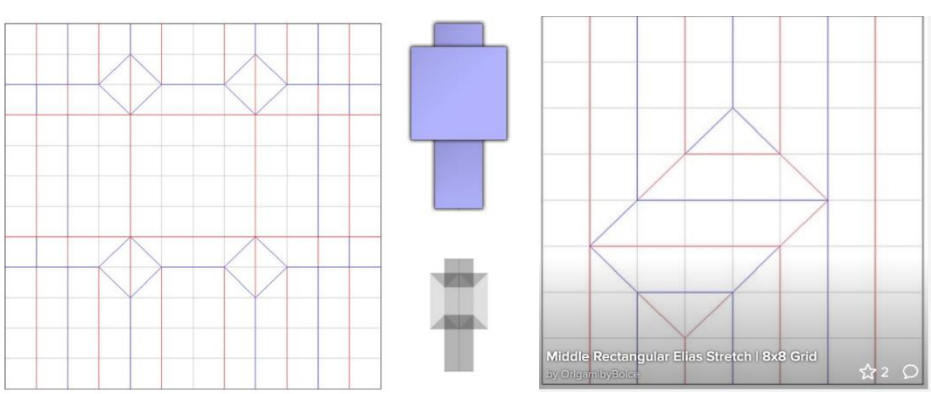


Figure 42: Collapsed Elias Stretch

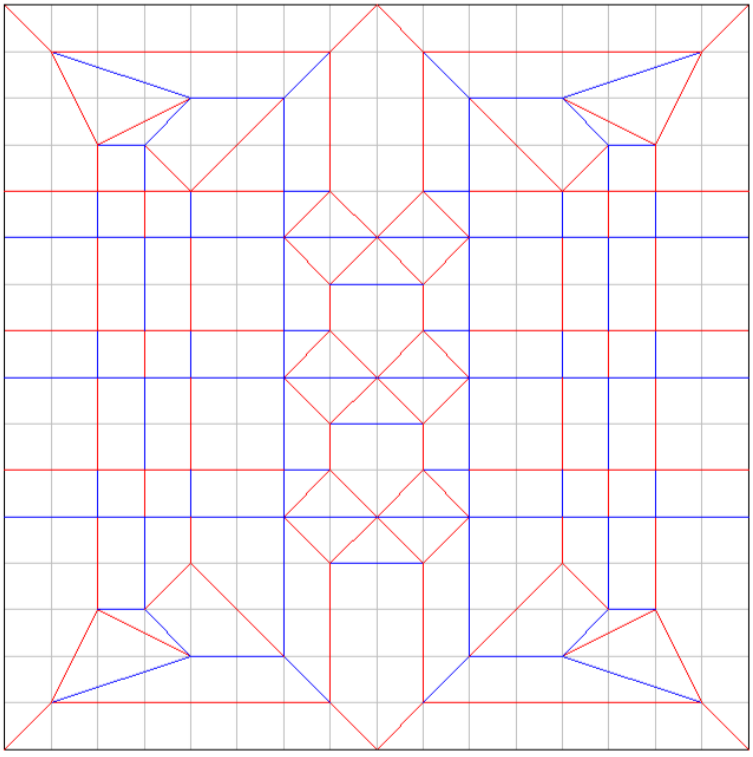


Figure 43: Homework - Turtle

SESSION 7: EXPLORING DIMENSIONS

SESSION REPORT

LEARNING OBJECTIVES:

- Students will be able to:
- Successfully fold 1 model
- Read crease patterns with a square grid and understanding
- Understand the importance of spatial reasoning
- Solve puzzles related to spatial reasoning and dimensional analysis

SESSION SYNOPSIS:

The session was rather smooth. we had decided not to include too much difficult jargon and we tried to add images to refer to everything Abhijit was referring to so that the students could visualise and relate to what he was saying. At the beginning, Abhijit decided to give a short overview of the art form origami. The introduction consisted of: definition of origami, definition of kusudamas , definition of kirigami , images that showcased all three types of art forms in origami.

Abhijit was in-charge of teaching the attendees how to read and fold a crease pattern. He used a comic to quickly summarise what Abhijit was going to teach them. It was a humorous way to introduce the next topic: crease patterns. Abhijit introduced what were the 2 most common folds called; Mountain and valley folds. Next, He showed them 2 simple crease patterns - level shifters and Elias stretches - and explained why they were called level shifters and Elias stretches.

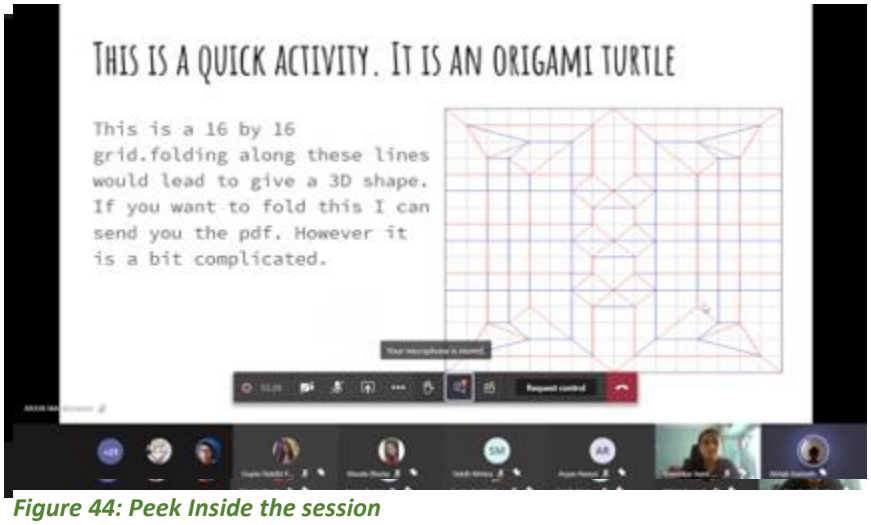


Figure 44: Peek Inside the session

After the basic steps were taught like mountain and valley folds, we moved onto teaching a bird, or rather a flapping bird. We chose this model due to it being particularly easy to fold and also it being an action model, where when the tail on being pulled would flap its wings like a bird flying. It was a 3D model, there were a few complex steps but after carefully folding it step after step all of us eventually made it. Folding the later part of the model seemed pretty tough for a few students, hence we decided to emphasize and repeat those steps quite a few times until all of them eventually got it. Furthermore, we shared a video so that they could watch the steps they missed, and we made a ppt which had a detail description of how to fold the bird.

Next, we showed them a completed fold to showcase how their work should look like and told them the basic instructions they have to follow. Abhijit used Origamibyboice's YouTube video to showcase the folding sequence since it would be a good summary of everything that he had taught them. They came with their work ready so all they had to do was follow the video. We ended my session with a short homework assignment. It was Brandon Wong's turtle crease pattern for beginners so that they could reinforce their learning at home.

We used multiple mediums to engage the audience. Since the audience varied from grade 7 to 9, We made sure to limit the amount of information per slide so that We did not lose the students' attention. We also gave them a choice to pick so that they could feel more included. We summarised what we have taught through an instructional video and we also used kahoots to gauge how many students followed the lesson.

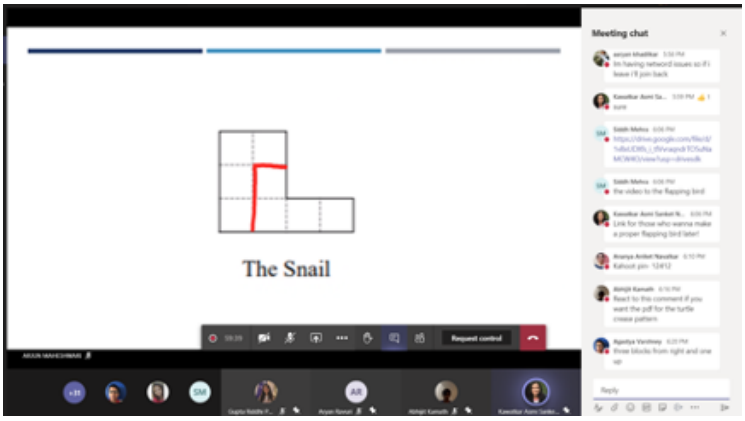


Figure 45: A problem in 'Split Decisions'

After the Origami part, we talked about spatial reasoning. We introduced the idea of spatial reasoning through a short discussion on cubing and its relation to spatial reasoning, as well as why spatial visualisation is important. We then proceeded to play a short game titled 'Split Decisions' where students were given puzzles and they had to figure out ways to divide the shape into two equal parts (not symmetry). For a lot of them, it was initially difficult. However, once a couple of their peers had explained the basic reasoning and ideas behind the approach to the puzzle, it became much easier for everyone. The class participated very well, and we were able to finish the puzzles (both 2D and 3D) as we had planned.

We had the learners fill in google forms for feedback, so that we could improve our lessons next time based on their inputs as well, and then the session came to an end.

FEEDBACK ANALYSIS:

We realised that our first draft was fun, but it did not really meet a learning objective. After some thought, we decided to dwell deeper into the initial idea of origami to teach

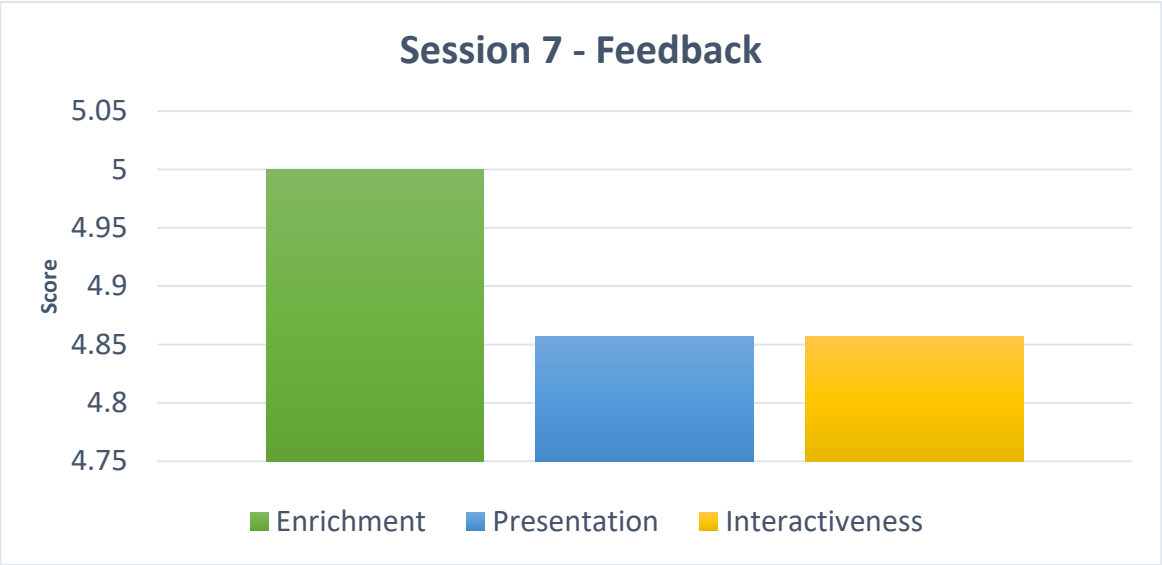
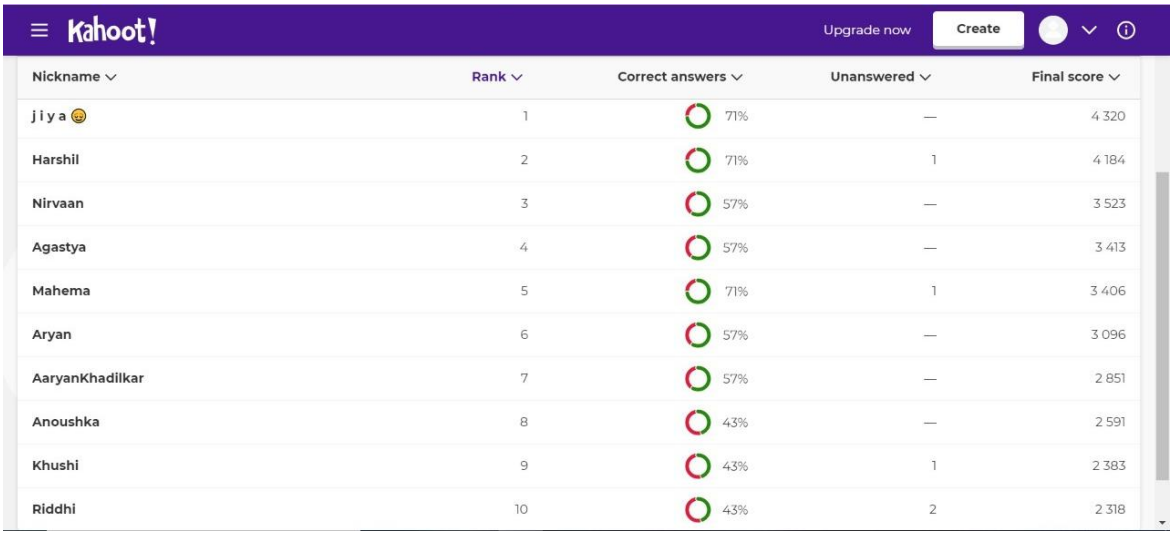


Figure 46: Average scores from student responses

them how to read crease patterns so that they could develop some 3D awareness. Our main team told us that it would be too boring and many students may not be able to relate to such a niche art form. We decided to include Kahoots after looking at the feedback by our participants through google forms. We also lengthened our slides by dividing the information across more slides after our teammates found it that the participants were more focused when our teammates tested it out. They said that we



Nickname	Rank	Correct answers	Unanswered	Final score
jiya	1	71%	—	4 320
Harshil	2	71%	1	4 184
Nirvaan	3	57%	—	3 523
Agastya	4	57%	—	3 413
Mahema	5	71%	1	3 406
Aryan	6	57%	—	3 096
AaryanKhadilkar	7	57%	—	2 851
Anoushka	8	43%	—	2 591
Khushi	9	43%	1	2 383
Riddhi	10	43%	2	2 318

Figure 47: Kahoot analysis of learner performance

could try to get everyone to fold with their cameras on and other members could provide help through the comments section. Siddh gave a thoughtful suggestion stating that the final video could be shared so that the students could retry it.

REFLECTION:

Abhijit: I felt that the lesson was not properly suited to meet the learning objective of spatial thinking. While I did touch up on how a crease pattern (a 2 d image) can be turned into a 3d image. we could have come up with a better technique to teach and test the students. I found that They learnt how to read it but I might have not given them enough practice. The sessions were rather short thus I could not fully cover my entire agenda to the best of my abilities. If we had a bit more time, I would divide the first half into folding for fun and leisure so that they get used to handling paper and taking instructions related to folding. The other half I would go through 2 crease patterns. 1 which I would teach and the other for them to try out. However, due to time constraint and lack of audience participation in the past sessions I felt like this was a decent way of conducting the session.

I could have demonstrated folding more crease patterns to highlight on the spatial thinking aspect. I could have sent them some videos in advance to prepare them for the sessions so that we could hop into more complex crease patterns.

I was able to learn how to plan a lesson and ensure audience participation. I had to put myself in the audience's shoes to figure out how to make someone interested in origami. Most of the students had never heard or seen anything as origami and I had to come up with ways to pique their interest.

Asmi: This session was definitely the largest learning experience for me because I had to do a lot of research into the background of my material. I spent a lot of time finding the spatial reasoning puzzles. Spatial reasoning has always been one of my personal weak points, and so this session gave me the opportunity to really work on my own skills as well as develop enriching content for the learners.

When I found the puzzles, I was actually unable to find their corresponding solutions. So, I had to solve every single one of them, and manually write the solutions and put them up. This was a fun brain exercise for me and I really enjoyed it.

In our original teaching plans, you might notice that spatial reasoning as a separate concept is not included. That's because it wasn't. We had not planned on doing a separate section on spatial puzzles, but instead discuss cubing as a sport. However, based on the students' responses and level of engagement during the previous

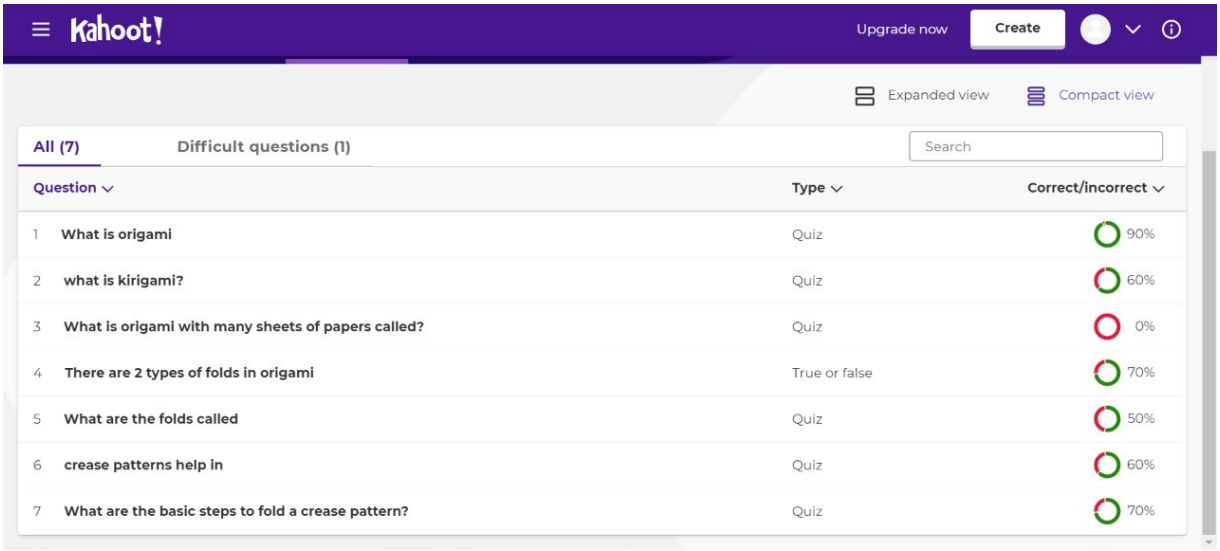


Figure 48: Question wise analysis of Kahoot performance

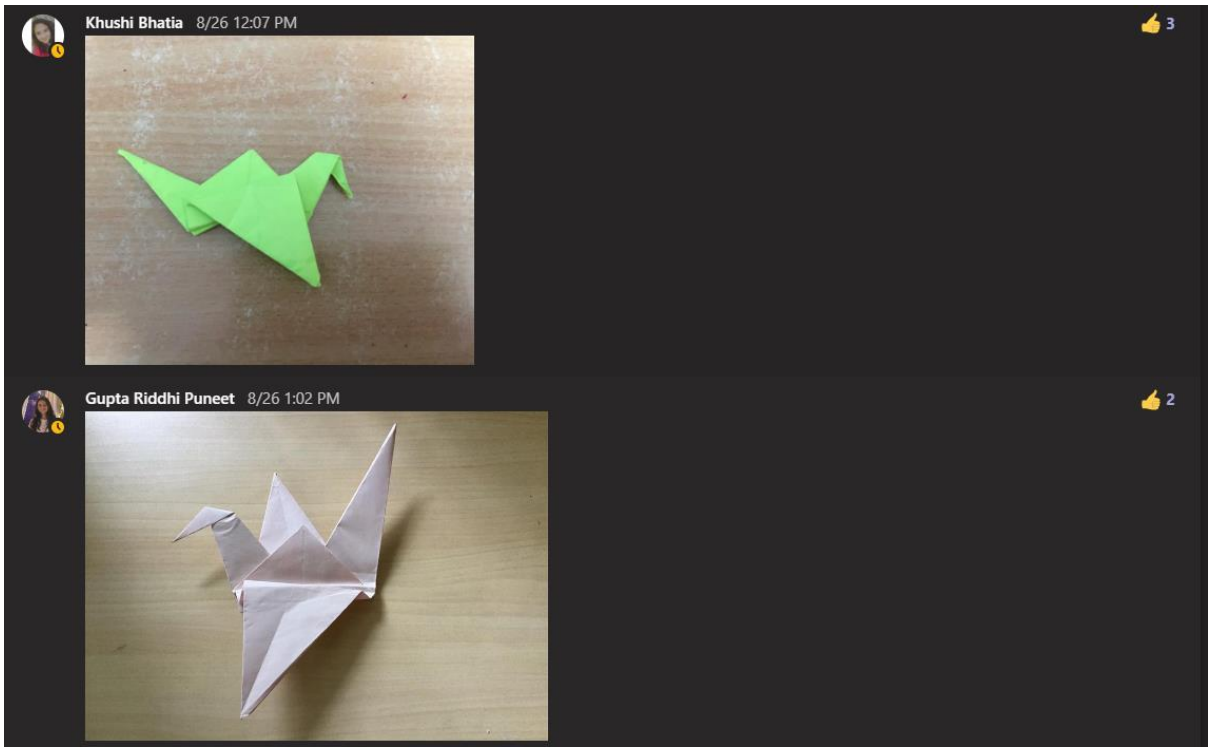
sessions, I realised that cubing might be too narrow of a topic, which might not capture all their interests. Furthermore, it was already extremely difficult for me to find the appropriate level of engagement and learning because cubing is an extensive field, and it is not too easy to teach even a small portion of the matter in the time that we had.

In the end, we decided to change things up a bit, and I had to make a few last-minute changes to the ppt and slides. This was done based on the feedback we got from the team during a host of team meetings that we conducted, during which our team members gave us feedback on our class material.

Over the course of this process, I was able to collaborate better with my fellow co-ordinators, to bring a seemingly un-synchronised pair of topics into one cohesive session. We were forced to think out of the box, broaden our horizons and come up with more creative methods of expressing ourselves and presenting the content to the learners. I became a more critical-minded person, as I was able to critique my own work, spot the imperfections and improve it as well.

Siddh: Time was certainly a constraint, I felt we should have had a few more classes of basic origami step teaching before teaching the actual model to the students. It was a great experience to teach these students, they showed keen sense of interest in actually making the model and then playing with it. I felt not all of them were interactive and some did face technically issues too. Overall, I thoroughly enjoyed the session, I hope the students liked it and I'll be eagerly awaiting to grab anymore opportunities like this

STUDENT WORK:



26TH AUGUST 2020

Topic: Thought Experiments and Paraodoxes

A PARADOXICAL REALITY (II)

SESSION 8

Session Co-ordinators:
ABHIJIT KAMATH, AKSHAY KAMATH & ARJUN MAHESHWARI

SESSION 8: A PARADOXICAL REALITY (II)

TEACHING PLAN

SESSION COORDINATOR: Akshay A. Kamath; Arjun Maheshwari; Abhijit A. Kamath

SUBJECT: Thought Experiments and Paradoxes

TOPICS COVERED:

1. Mathematical perspective
    a. The Birthday paradox.
2. The concept of infinity
    a. David Hilbert's infinite hotel paradox.
3. The logical school of thought
    a. Schrödinger's Cat
    b. The Grandfather Paradox
    c. Mary's Room
    d. The Barber's Paradox
    e. Mont Hall
    f. Ragnarök Riddle
    g. Braess' paradox

METHODOLOGY:

3. An introduction into the paradoxical nature of life;
4. Mathematical perspective; concept of infinity; logical school of thought.
    a. Introduction of the Problem
    b. Allow learners to solve the Problem
    c. Explanation of the solution to the learners/Discussion of solution

Medium of presentation:

3. PowerPoint presentations
4. Videos from TedEd, YouTube

Time required: 45 - 60 minutes.

Sample Puzzles and Material:

Schrödinger's Cat Paradox

Schrodinger imagined taking a cat and placing it in a sealed box, with a device that had a 50% chance to kill the cat within the next hour. At the end of that hour he asked, what is the state of the cat? Common sense suggests that the cat is either alive or dead. But Schrodinger pointed out that according to quantum physics, at the instant before the box is opened, the cat is equal parts alive and dead at the same time. It's only when the box is opened that we observe a single conclusion.

Monty Hall Problem

The problem became famous on an American game show called let's make a deal and it was named after the host: Monty Hall. However, the problem was first proposed by Steve Selvin to the *American Statistician* in 1975

The game show consisted of 3 doors. Behind 2 doors are goats while behind 1 door was a car. The contestant has to pick 1 door, but you don't know what is behind it. Then the host will reveal 1 other door which has the goat behind it. This leaves you with 2 doors. Would you change which door you picked?
Try to think about it and let's see if anyone can come close to the answer!!!

Answer

Common misconception:
First pick: ⅓ chance of picking
Upon revealing: the door you have picked, and the other unpicked door has 50 / 50 chance.

There are 2 goats thus you have ⅔ chance to pick the wrong door. If you pick the wrong door and switch you will win. However, picking the correct door would cause you to lose if you switch.
6/9 = 2/3 times switching would be beneficial.

Braess' Paradox

Braess' paradox is the observation that adding one or more roads to a road network can slow down overall traffic flow through it. The paradox was postulated in 1968 by German mathematician Dietrich Bress' who noticed that adding a road to a particular congested road traffic network would increase overall journey time. Basically, removal of roads can improve traffic. Seems rather counterintuitive right? Let's discuss

Answer 1

1 road is dependent on number of cars.

1 road has a fixed travel time.

All 100 cars will be travelling on road 1 at first. Eventually drivers will realise that road 2 is faster and soon one by one each car will switch roads as 1/100 + 45 min is faster than 3999/5 + 45.

Eventually there will be a natural equilibrium where 2000 cars will be on road 1 and 2000 cars would be on road 2 as no road has a shorter time.

Now let's construct a road connecting the 2 X points. Let's call this braess road and it takes no time to cross it. Eventually cars travelling on road 1 would start to switch across as
2000/100 + 4000/100 < 2000/100 + 45
Eventually everyone would start using this road and the total time would be 80 minutes.

Ragnarok Riddle

Ragnarok Riddle: A battle between the Norse gods and monsters. The Norse gods were winning until the serpent jormungandr emerged. It swallowed Valhalla (majestic, enormous hall in Asgard) and elongated Itself to form one continuous body with no head and no tail. As jormungandr is digesting Valhalla, Odin says he has enough energy to strike the serpent with one final bolt of lightning. Odin runs with superspeed across the serpent's body, with an overcharged Mjolnir, to cut it in half. Odin cannot run over the same section twice or he will fall into the snake's body. Odin can move across points where the creature intersects itself. If you leave a single spot un-zapped, the serpent would regenerate. What path can Odin take to destroy the serpent?

SESSION 8: A PARADOXICAL REALITY (II)

SESSION REPORT

LEARNING OBJECTIVES:

- Understand the Mary's Room Paradox
- Explain the logic and reasoning behind The Birthday Paradox
- Understand the Monty Hall Problem and explain its reasoning
- Solve the Braess' Paradox
- Solve Ragnarok Riddle
- Solve the Konigsberg Bridge Problem

SESSION SYNOPSIS:

This was our second session on the topic of "Thought Experiments and Paradoxes". We started off with Mary's room. Akshay managed to explain the concept to the students effectively. The students were able to understand this concept well. We tried to get participants to participate by asking "If she will learn anything new" and asked them to type their answers in the chatbox. The response rate was limited and only about 2-3 people replied. After explaining them, we asked them to raise their hands to indicate that they understood - Majority of participants raised their hands.

The students enjoyed this problem as it involved math and logical reasoning. Arjun gave them a brief explanation on this particular paradox. The Students were able to keep up easily because it involved the simple understanding of math. When we did a mock presentation, we felt that that would have had difficulties understanding. However, the students answered and cleared this problem effortlessly

Next, we introduced the Monty hall problem. Abhijit gave a brief description of the problem and then asked the participants a series of questions. First, he asked them

whether they would switch doors or stay on the same door and then asked them to explain their choice. Many of the participants replied but were not exactly able to explain their choice (2 of the participants knew the problem beforehand but were also not able to explain their choice properly). During the explanation, Abhijit used a table to portray the information pictorially to better explain the issue.

1	2	3
Stay (correct)	switch	switch
switch	Stay (correct)	switch
switch	switch	Stay (correct)

Figure 49: Table to explain the Monty Hall problem

By using the information in the table, Abhijit explained how to derive the probability of winning. Before explaining the probability, he highlighted the common misconception and explained why it was wrong.

Next, we had the Ragnarok problem. We were inspired to use this from TedEd. When asked if the students had ever heard of such a problem, 1 boy knew this due to graph theory. The rest were quite new to this. They found this rather interesting and many were eager to answer. The students might have found it interesting as the problem looked very simple, (connecting the dots) but it was actually quite hard.

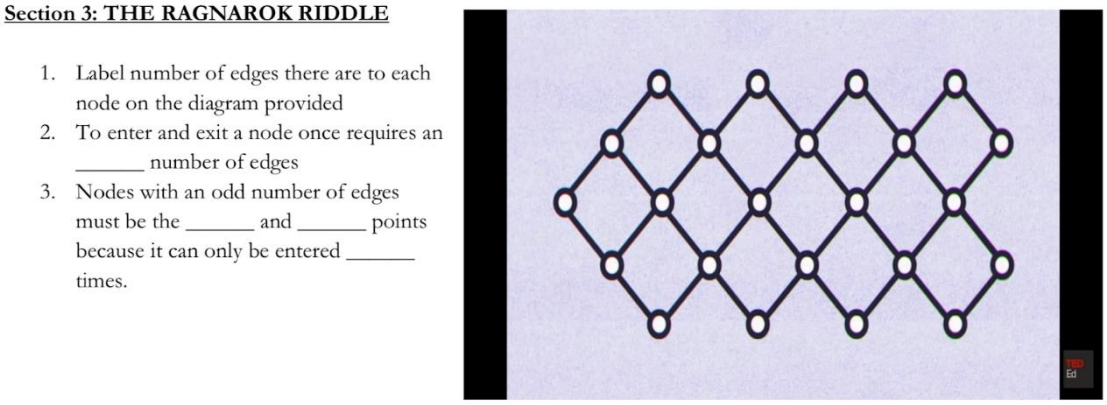
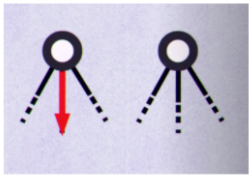


Figure 50: Snippet from the guiding sheet

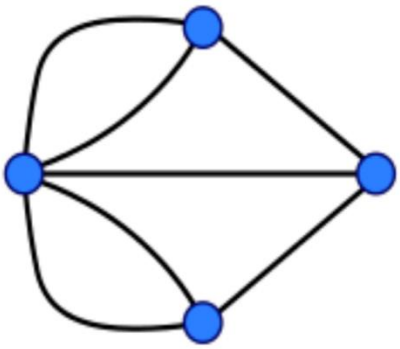
SOLUTION

1. Entering node and exiting the node will take care of 2 edges.
2. Edges come in pairs so number of edges is even
3. The only exception is for the start and ending points (exit without entering , enter without leaving)
4. Look at each node and label how many edges they have
5. The nodes which have an odd number of edges will be the starting and ending points



After we asked them for solutions none of them had found the answer. Upon giving the solution (the start and end point) the students found that there were many ways to solve it.

The path did not actually matter. It was the start and the end points that mattered the most. The start and end points could be derived from the number of edges (entrances/exits) on a node. The nodes with the odd edges are the start and the end point. We further strengthened this by showcasing the Konigsberg bridge problem and how it is unsolvable. The students were given guidance sheets to fill out as we taught so it was made comprehensible to follow.



Section 4: 7 BRIDGES

1. Label number of edges there to each node on the diagram provided
2. All nodes have _____ number of edges.
3. Can you cross all 7 bridges without crossing any bridge more than once? (Yes/No)

Lastly, the infinite hotel paradox was taught by Akshay. During our mock presentation, the teacher who was guiding us and our group members had pointed out that this

topic could be hard to grasp. It was difficult for even us to understand on the first try and we had to watch the videos more than once. Thus, we decided to include it just to interest the participants and it was not included in the learning objectives. Surprisingly, most of the students understood it and a few of them noted that this paradox was their favourite.

Like the first session, we provided a guiding sheet to aid understanding of the topic.

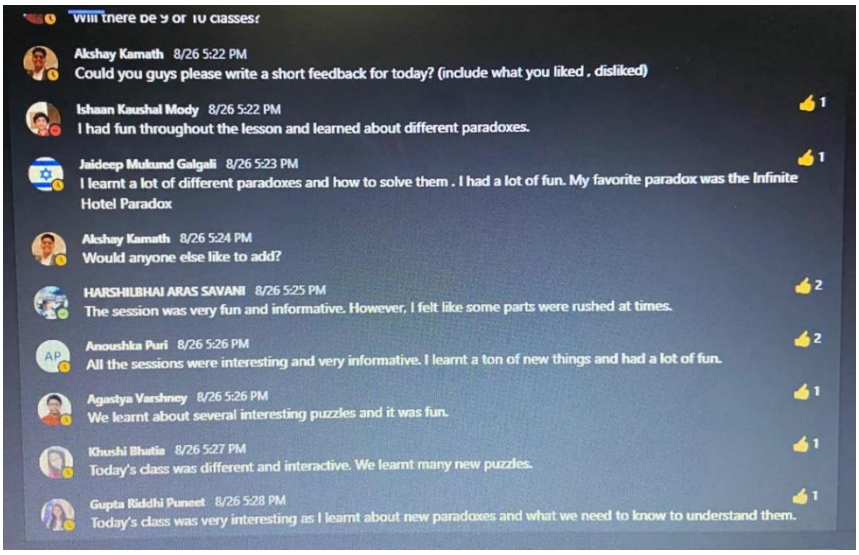
Section 2: THE MONTY HALL PROBLEM

Door 1	Door 2	Door3	Result of staying on door #1	Result of switching to other door
		Car		
	Car			Wins goat
Car			Wins car	

Probability of winning if you switch = _____
Probability of winning if you stay = _____

Figure 51: Guiding sheet, Monty Hall Problem

FEEDBACK ANALYSIS:



The session was loved by all and they all thoroughly the session throughout. All of them found it interesting to be a part of and one of them found 'The Infinite Hotel' paradox the best from the lot. Though an overall positive response, one of the learners did feel

that some parts were rushed and we totally agreed. We will definitely take this into account and help improve their learning experience. We chose to have the feedbacks come in the chat box for a change as they had been filling the form for the past seven sessions and this being a continuation, we thought it would be best to stick to the chat box during the session itself.

REFLECTION:

Abhijit: I felt like the biggest problem for this was that my topics were a bit too mathematical and hence it was difficult for me to explain through dialogue. I could have added more slides to break the mathematical equations a bit more. I used a tabular form to showcase the Monty hall problem, but I think I could have made it a bit more interactive. Overall, I think time constraint was the biggest problem. I felt that we were hopping from topic to topic and there wasn't enough time to check if they fully understood.

In the future, I would probably limit the number of problems that we are doing so that I can go more in depth about them and try to explain them completely. I felt that the lesson was rather 1 sided and the students did not get to participate that often. I wanted to have more attendee responses but looking at previous sessions the students were rather unresponsive and shy which made it very difficult to see if they were following or whether they truly understood. There were a few eager ones collectively it was still quite a hassle to get responses. I feel that time constraint really made it difficult to carry out a more interactive session.

Akshay: In my opinion, the session was productive and successful. The students were able to follow along with the presentation and met all the learning objectives. I was quite happy with the participants response rate compared to previous sessions. The participants were able to follow along with some complex explanation and they were

able to explain the key features of the issue. Although, I felt that the explanation on certain issues was a bit rushed -we had a lot to cover, many lengthy topics and a video!

I think my presentation skills also improved from the previous session and I was more comfortable with engaging with the students and talking to them. However, I was quite scared that they would not be able to understand some complex topics - Infinity Hotel paradox - due to my explanation but in the feedback many of them noted that they were able to understand it and said it was their favourite part of the presentation. It was still a challenge to get responses from the students - many of them did not want to speak up or use the chat box - so it was quite difficult to engage with them and make the presentation interesting.

Arjun: According to me, the session went off extremely well. I covered all the necessary points, and the students were easily able to keep up. The students participated throughout the class, while asking reasonable questions and finding the correct answers. I was slightly afraid that the students wouldn't be able to keep up with the pace of the class when it came up to the Infinite Hotel Paradox. However, I was severely mistaken as the students exceeded my expectations. I taught the students about the Birthday Paradox, which they enjoyed and could easily understand. All in all, I believe that the session went really well.

Combined reflection:

Our creativity was put to the test as we struggled to find a way to get maximum response rate from the participants. We tried google forms, Padlet , verbal interaction and much more in previous sessions. Half way through our session we realised that the best way to interact with participants was to get participants to raise and lower their hands using the Teams application feature. Another challenge that we learnt to mitigate was getting and maintaining participants' attention. Our first presentation was met with a lot of constructive criticism by us and also our other team members.

After all the changes, we were able to make the presentation more interesting. Additionally, It was quite difficult to find problems and paradoxes that would not be too difficult to explain nor would it be too abstract that the students may find it boring. After going through a huge selection process and even editing out slides a few days before based on other session responses we were successful in teaching it by being spontaneous.

EVALUATION AND DEVELOPMENT OF MATERIAL:

After gathering feedback from the participants and our team members, we decided to make some major changes into our presentation. We removed many abstract paradoxes (which do not really have an application in real life and also would not really teach the student anything). We decided to add the Konigsberg 7 bridges problem to compensate for all the presentation slides we cut down.

1ST SEPTEMBER 2020

Topic: Treasure Hunt

THE BIG PICTURE

SESSION 9

Session Co-ordinators:
ASMI KAWATKAR &
ANANYA NAVALKAR

SESSION 9: THE BIG PICTURE

TEACHING PLAN

SESSION COORDINATOR: Asmi Kawatkar, Ananya Navalkar

SUBJECT: Miscellaneous

TOPICS COVERED:

1. Ciphers & Codes
2. Paradoxes & Problems
3. Riddles
4. Revision of concepts taught in previous sessions

METHODOLOGY:

1. Provide learners with a mission file, with their first clue
2. Guide learners through the first clue
3. Provide a .zip file containing the rest of the clues
4. Allow learners to solve the clues at their own pace, with guidance and discussion from session coordinators
5. Conduct an interactive paradox session with team members playing characters
6. Correctly guide learners to identify the culprit
7. Collect reflections from learners on google form

Medium of Presentation:

- Power Point Presentation with puzzles
- Decryption resources online (https://cryptii.com/pipes/caesar-cipher)

Time requirement: 60 mins

SESSION 9: THE BIG PICTURE

SESSION REPORT

LEARNING OBJECTIVES:

- Students will be able to recall and apply the skills developed over the course of the club to solve the treasure hunt

SESSION SYNOPSIS:

Prior to this session, we received the news that the first 15 minutes of the session would be taken over by the Mental Health team for a short talk about Peer Pressure

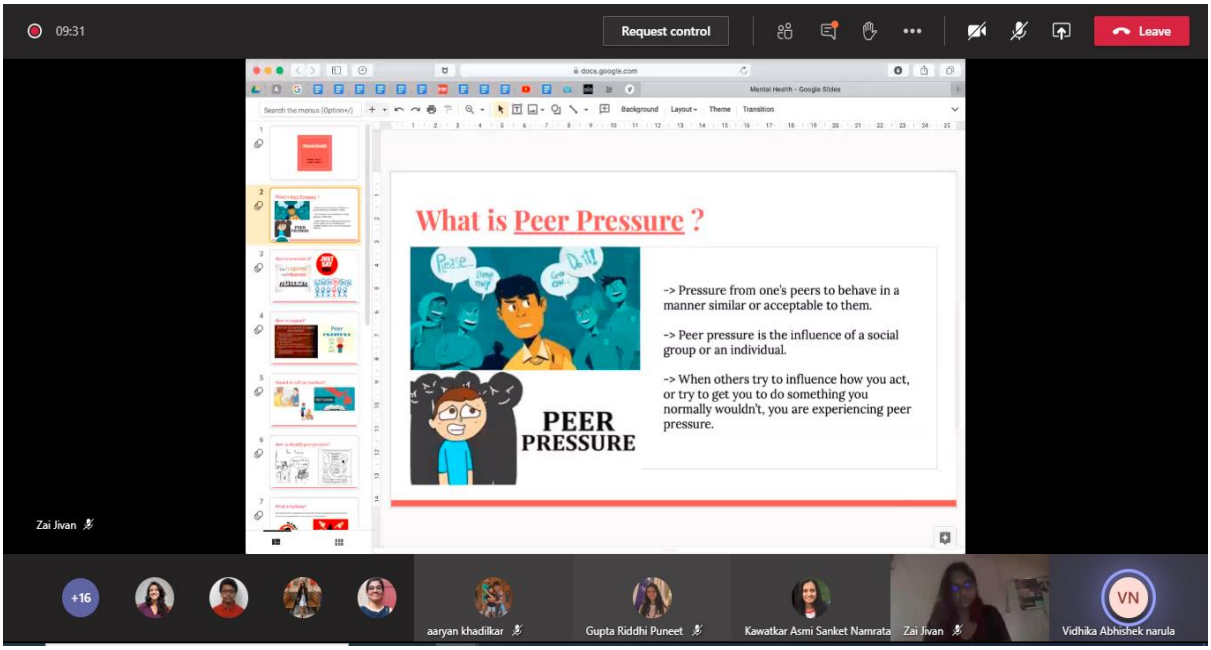


Figure 52: The Mental Health Presentation

and Bullying. We made sure that the session began on time because we wanted to ensure all the learners had enough time to solve and culminate all their learning from this process.

Once the Mental Health talk was over, we had Arjun on standby, ready to present his screen with the PPT, to ensure that we wasted no time at all. We uploaded the .zip file of all the clues to the files section during the mental health presentation so that the

learners would have access to the clues immediately when the treasure hunt began. Before the session we had already informed the learners to login on a laptop if possible so that they would be able to independently progress with the session if they so wished to do.

We had decided to give each of the team members a character to play in our murder mystery, and they were all suspects so the learners had to crack each and every clue, which would in turn lead them to the next one and eliminate suspects along the way; at the end it would lead them to the answer as to who the actual murderer was.

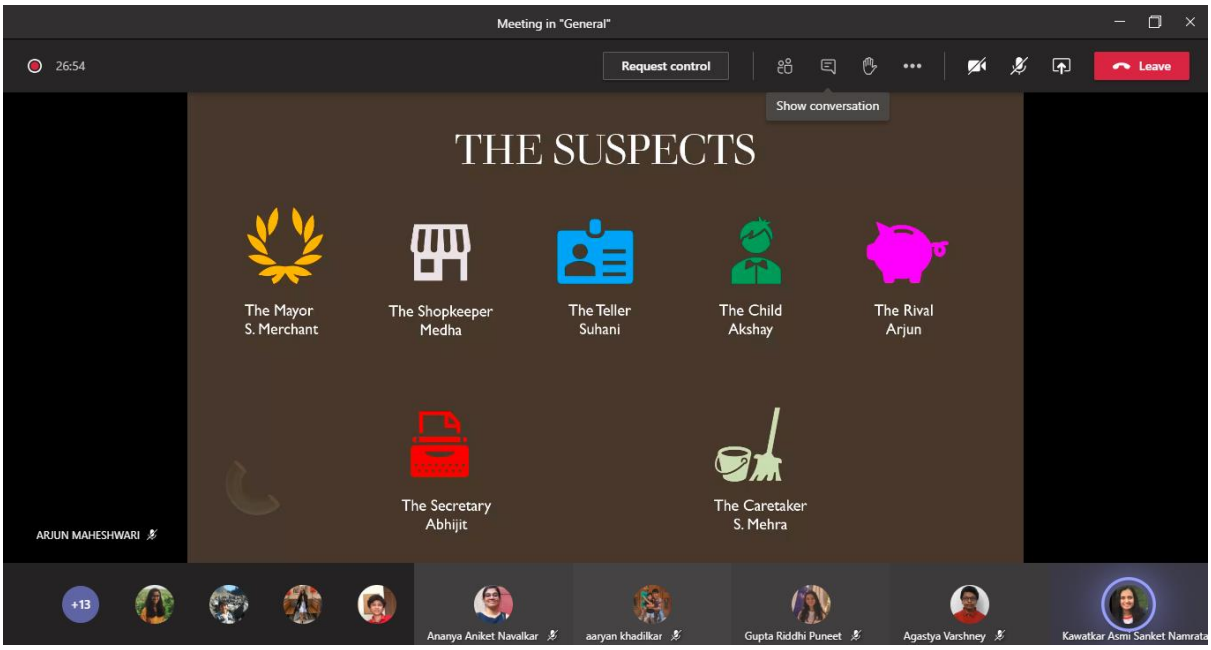


Figure 53: The Introduction of the Suspects

I began by introducing the suspects and giving the learners their first mission file, which listed their first clue – a pigpen cipher. The ciphertext could be decoded to 'Open Sesame' and so they had to open the file called 'Sesame' from the list of files given to them in the .zip folder.

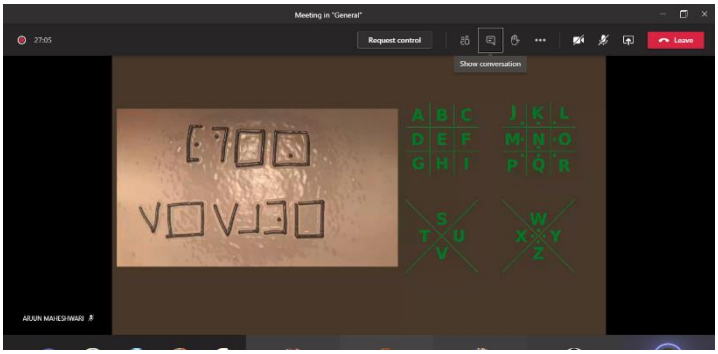


Figure 54: Open Sesame

We, as the session organisers, shared our screen for this, and we solved each clue along with those

learners who were unable to solve them independently or simply wished to be a part of the team effort.

Each clue was different and focused on a unique aspect which we had covered during our previous sessions. We made sure to include everything from 4Pic1Word puzzles and riddles (from session 2) to ciphers and codes (from session 1 & 6) to Thought experiments and Paradoxes.

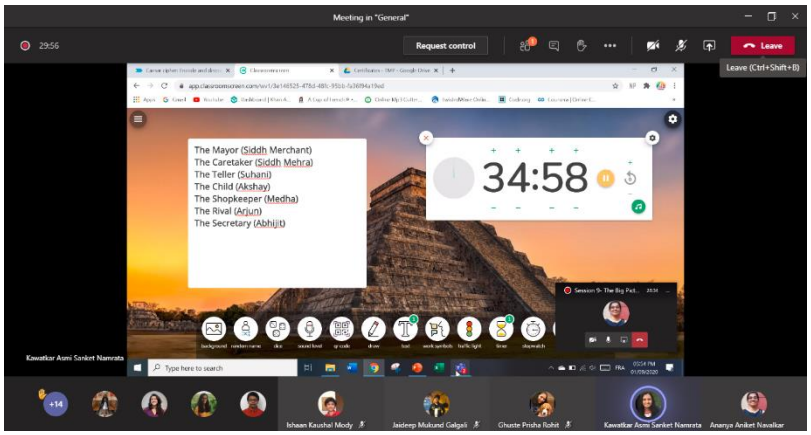


Figure 55: Keeping track

While learners were eager to answer each clue and were able to crack them within an appropriate time limit, we also had to make sure that they were mindful of their overhanging time constraint (35 mins) and so we had shared a classroom screen which had a 35 minute timer running and also a list of the suspects so that we could keep track of which ones had been eliminated along the way.

Some of the clues even led them to external google forms where they had to answer the quiz and the order of the correct answers was a clue to the next document in the .zip file.

In the end, we discussed the final clue with the learners as it was a slightly complex one and we had to give them a couple of hints to guide them to the conclusion. After that, we integrated the certificate distribution process with our feedback form, hoping that this would increase the response rate of the students.

We had set up an elaborate production line prior to the session wherein each team member knew their role to play and each performed their duties diligently to assist us

during the final session. Once the receipt of the forms was confirmed by one of the members, the other would send the certificate of the corresponding student into the chatbox. We verbally took a few reflections since we had a couple of minutes remaining as well.

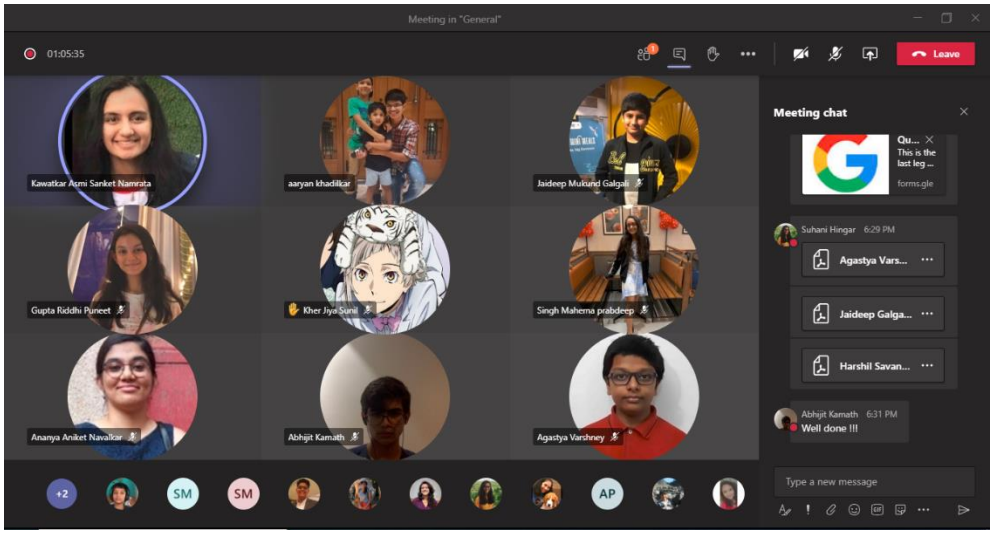


Figure 56: A peek into the session

FEEDBACK ANALYSIS:

Being the last session, we did not take session-specific feedback, however we took overall feedback for the entire project. The analysis of the feedback and the appropriate charts can be found in the Quantitative Analysis section of this report.

However, we all thought that this session and our entire project was a huge success and we were quite delighted with the verbal feedback we received from the students. Not only that, but also the mere fact that they were successfully able to work together, cover for each other's strengths and weaknesses by learning from each other and crack the treasure hunt in a record time of 35 minutes, just went to show that we had actually been able to push them to think out of the box as we had aimed.

REFLECTION:

Asmi: Ananya and I spent a lot of time intricately devising this treasure hunt, making sure all the clues were appropriately linked and there were no loose ends. In fact, even

right before the session, there were still changes being made, despite our best efforts to be prepared. I had to make sure all of the google forms links worked, that all of the clues were in the file and were the latest updated versions (because we made a lot of small changes). It was an organisational nightmare! However, I took it up as a challenge and even though it was very time consuming, it taught me to juggle multiple pieces of information at the same time and become a better organised person overall.

Furthermore, I learned to be a better leader because coordinating with so many different people for so many different elements turned out to be a lot more challenging than I had anticipated. There were so many different things to consider and take care of!

To be honest, the team did really struggle to get the work completed on time because some of us really had to work on our time management skills. I found it really challenging to keep everyone motivated and on task because we had to manage our school work as well as preparing for this, something we had hyped up so much and what we had promised was going to be a really fun and unique session!

Even though the entire session went smoothly, I really wish we had a larger turnout. We had been seeing this trend for a while now though, so it was anticipated. We had the same enthusiastic group of children coming in and others who had signed up didn't show up. So that was a bit disappointing, considering that we had taken the trouble of rendering a certificate for each of them.

However, for those that did attend I was jubilant to read their feedback and see that they had all enjoyed our sessions and our teaching. It really gave me confidence in my abilities and I felt proud to be a part of this team.

Ananya: We managed to maintain the students' enthusiasm which we had been building up from the first session well. All the students, even the ones who didn't participate much, participated which I was delighted to see. This session also had the most team collaboration as the puzzles were set by everyone according to what they

taught to the students. I believe that we worked well together and overall there weren't any major issues between us. I had made a huge mistake in setting the final puzzle but our team got together and we fixed it. This taught me the importance of getting other opinions because had Asmi not called for a meeting to discuss this, we would have had a flawed puzzle. Next time I have to set a puzzle I'll definitely get someone to solve it for me. I think I did better during this session than my previous as I had a smaller role and I had the experience of conducting sessions. So, I was comparatively less nervous and more attentive. Overall, I believe that I did a decent job but I think that our session went extremely well.

EVALUATION AND DEVELOPMENT OF MATERIAL:

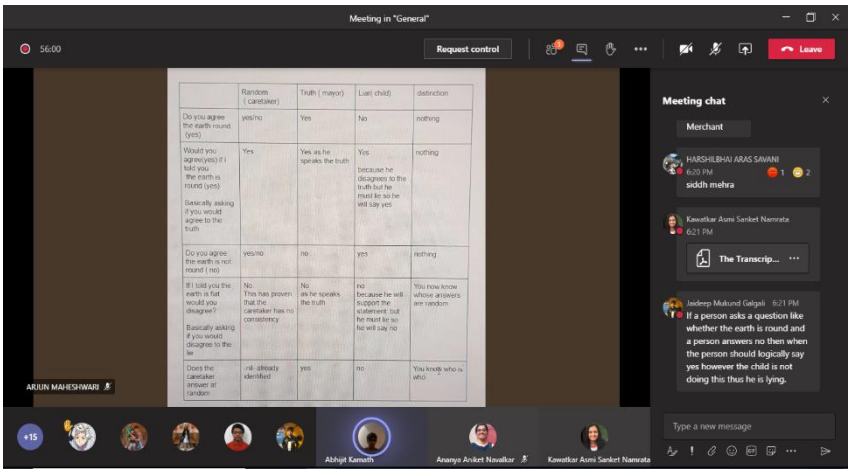


Figure 57: The special table

Throughout our project, we had really focused on taking the students feedback into account for each and every little detail because we wanted to make this experience customised to THEM.

The night before the treasure hunt, we had a team meeting where we were mulling over the last clue, and we realised it didn't quite add up. We actually sat and reworked the entire thing to make it as comprehensive to the learners as possible. We even made a special table just to explain the entire concept to them!

Secondly, we had observed the trend of low feedback responses, and we really needed the feedback for our own development and improvement so we integrated it right into the treasure hunt to make the transition seamless and we gave it a password, which was the name of the murderer to really get everyone to respond…and they did!

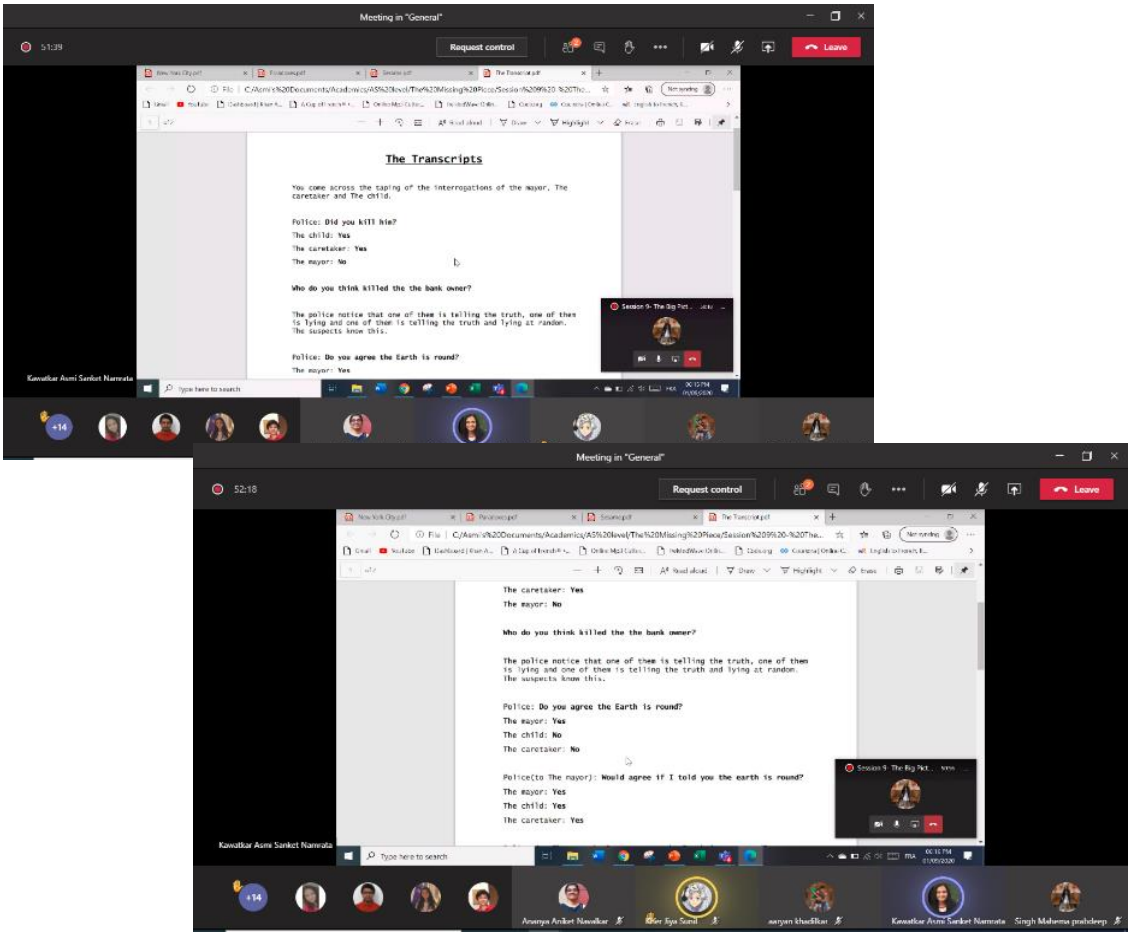


Figure 58: The clue that we changed

QUANTITATIVE ANALYSIS

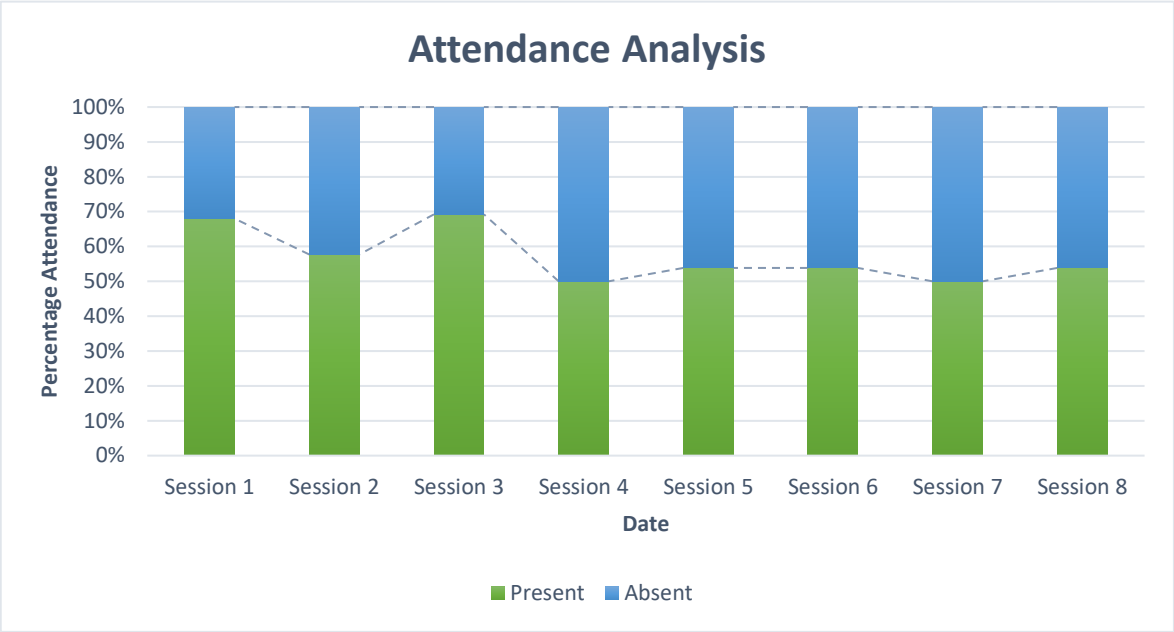


Chart 1: Attendance Analysis

We kept a meticulous attendance record for every session. At the end, we collated it to reflect in Graph 1. As seen here, initially we had a little fluctuation in the percentage of students who showed up for the session. However, after that the proportion of students evened out and stayed constant. We were glad that we were able to retain the interest of that batch of students, because they showed up diligently for every single lesson. Over the course of the project, we were able to build really strong relationships with this batch of learners and we hope that they will retain the puzzles that we have solved together. Although initially we were disappointed by the

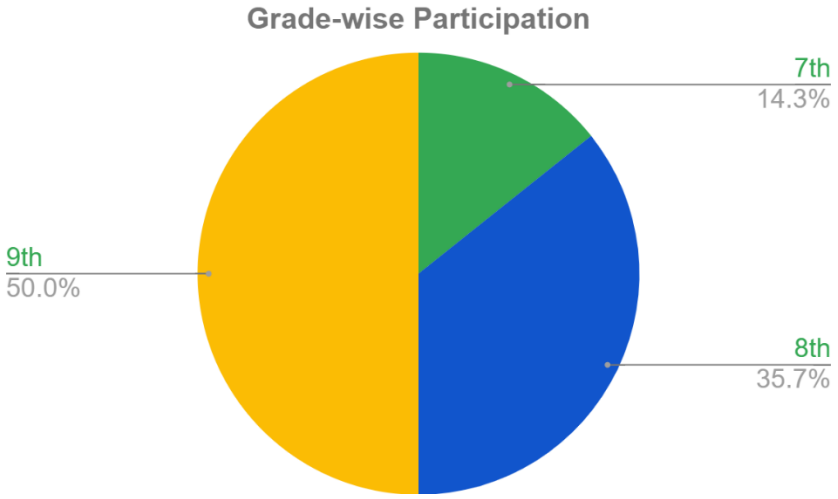


Chart 2: An understanding of our sample distribution by grade

proportion of absentees, we learnt to be optimistic and focus on our learners who actually displayed enthusiasm for learning. Nevertheless, we continued to encourage

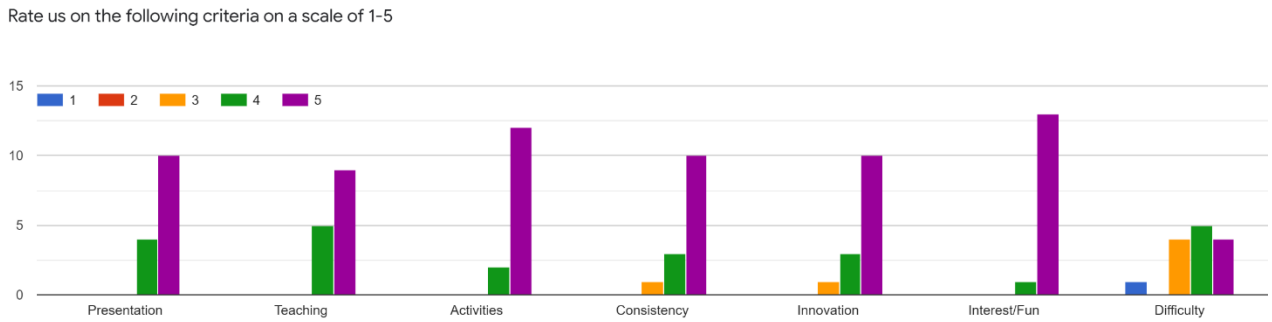


Chart 3: Criteria based scores based on student responses

all the learners to join in each session.

After Session 9, we asked learners to rate us on 7 criteria on a scale of 1 to 5. Chart 3 shows the scores that students gave us. Most of the students rated us 5 on all criteria. However, we got some lower ratings for Difficulty. From this, we can reasonably infer that the students either found our sessions too challenging or not challenging enough. So, we were less successful in catering to the varying levels of problem solving aptitude in our group of learners.

As shown in chart 4, we also asked learners if we met their expectations of us over the course of the sessions.

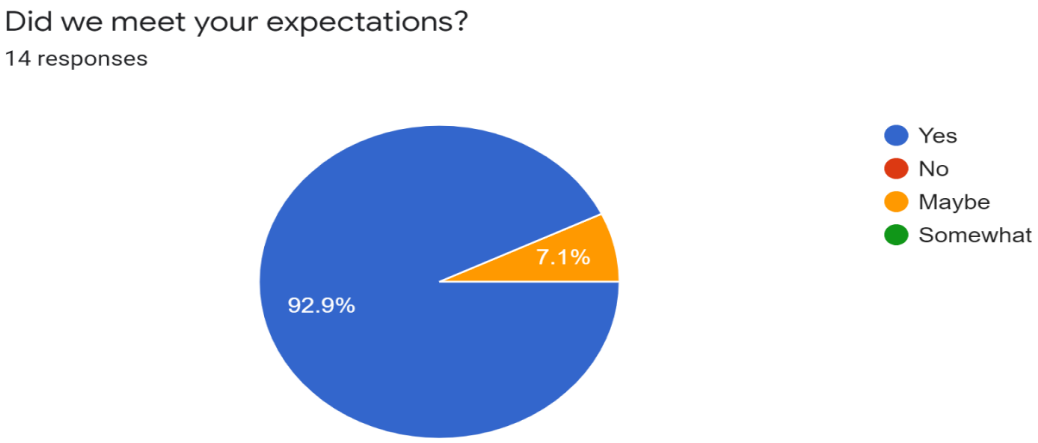


Chart 4: Did we meet your expectations?

We were delighted to see that 93% of them said “Yes”, and even more delighted to see that none of them had said no. Although 7% did say “Maybe”, we hadn’t completely disappointed them, which was a win for us, considering that it was our first time as student-teachers!

We also asked the learners about their favourite session, simply for us to gauge which of our teaching styles they most responded to. By a clear margin, the winner was session 1, followed by sessions 2 and 3 tied for second place as shown by chart 5.

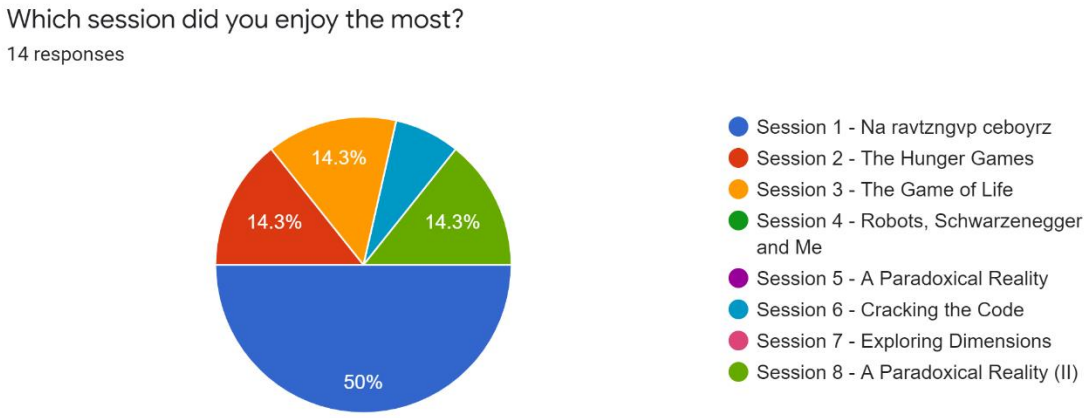


Chart 5: Which was your favourite session?

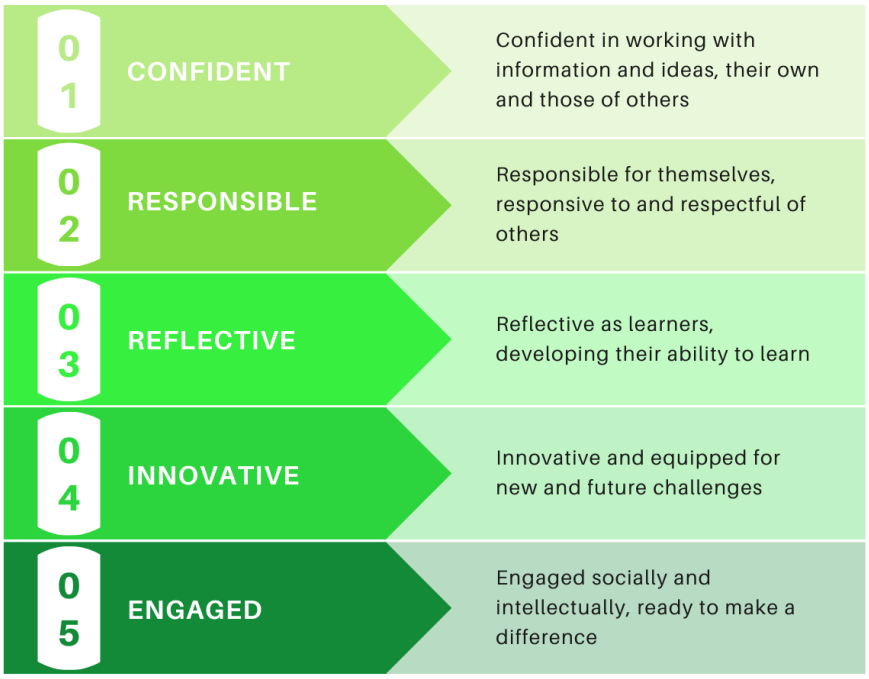
Lastly, we also asked the students whether they would take part in our project again (Chart 6), if there was a module to. Much to our joy and amazement, every single one of them said yes! We have honestly never been happier. Although our project has its drawbacks, each one of us has experienced a learning curve from the very first day to the very last day of this initiative.

Chart 6: Would you take part again?

TEAM REFLECTION

Cambridge Learner Profiles

Skills developed during the Missing Piece Project



As students of the AS level, we made sure that our Cambridge Learner Profiles were well covered over our entire project. As shown in this infographic, we made sure to stay confident while delivering our sessions and while interacting with the students. As we have stated in our session reflections, some of us faced problems with public speaking. However, over the course of the project we were able to successfully overcome these fears by putting ourselves outside of our comfort zones. We became more comfortable with working with unfamiliar information, based on our previous knowledge.

We definitely became more responsible because, as teachers, we were responsible for the learning of all our students. We kept ourselves accountable by doing peer assessments, with team members critiquing each other's work and making sure everyone met the deadlines and produced work which was of good quality. We also learned to be respectful of others opinions because sometimes, the criticism was a little harder to accept. Nevertheless, we worked on it and definitely grew as people.

By writing a reflection after each session, we were forced to express our learning in words, which really made us take a step back and consider the learning that we had

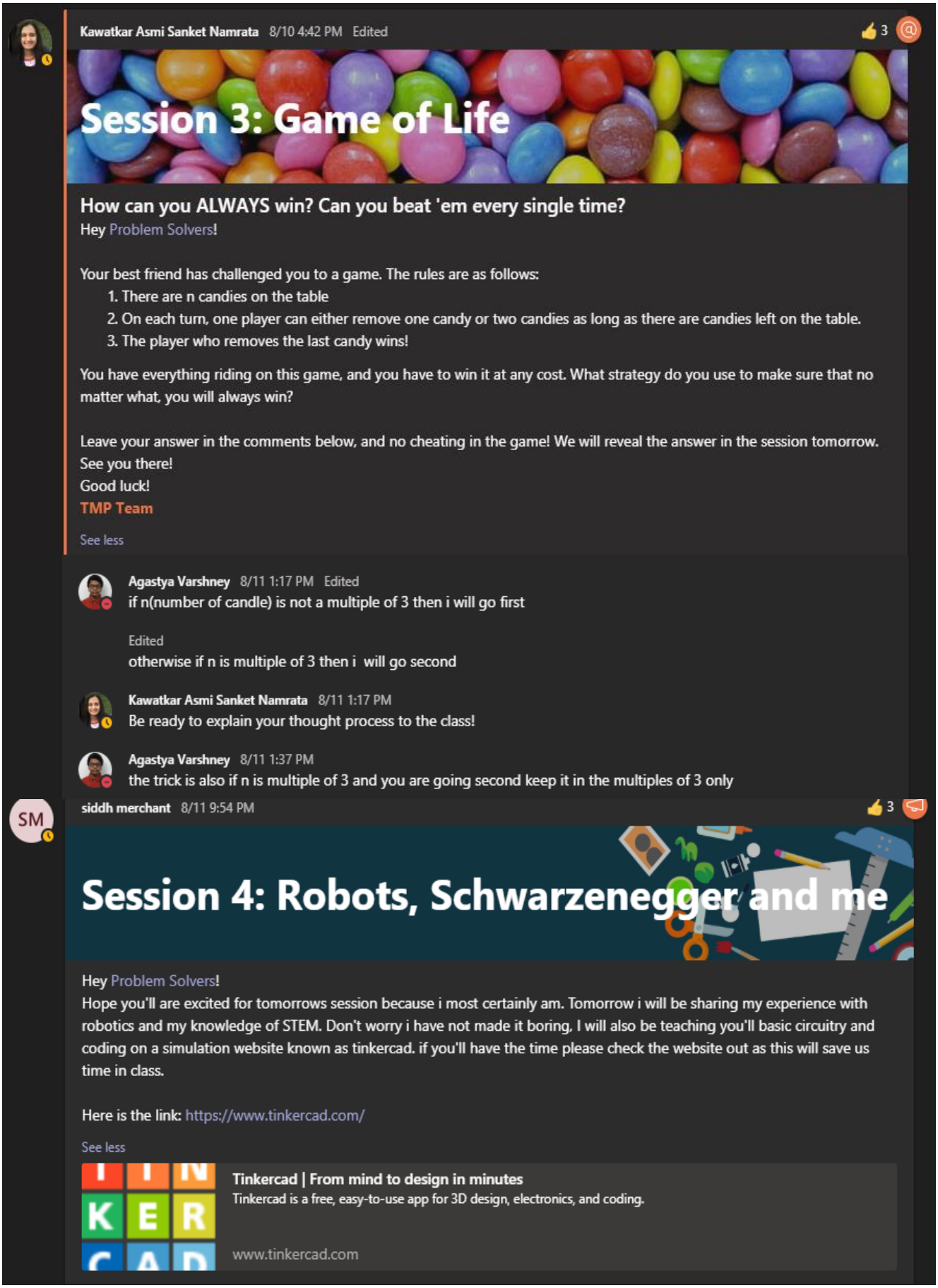
taken away from the experience. By putting it down on paper, we were able to quantify our experience and effectively reflect on our strengths.

Being in charge of one or two sessions each also allowed each of us to be responsible for that one session, and enhance our leadership qualities as well.

The fact that we had to conduct the entire project on an online platform encouraged us to get creative and find new and innovative ways to retain our learners' interest. Making each session unique and interesting was certainly a rigorous and highly creative process for us. We had to find solutions to about a million problems before the project even took off.

Lastly, throughout the sessions, we were able to effectively communicate and engage with each other as well as with our students. Our communication skills definitely developed, but the restriction of online communication allowed us to use our technical expertise to our advantage to make sure that this entire process was a positive learning experience for all of us!

BEFORE THE SESSION - ANNOUNCEMENTS


Kawatkar Asmi Sanket Namrata 8/10 4:42 PM Edited
3
Session 3: Game of Life
How can you ALWAYS win? Can you beat 'em every single time?
Hey Problem Solvers!
Your best friend has challenged you to a game. The rules are as follows:
1. There are n candies on the table
2. On each turn, one player can either remove one candy or two candies as long as there are candies left on the table.
3. The player who removes the last candy wins!
You have everything riding on this game, and you have to win it at any cost. What strategy do you use to make sure that no matter what, you will always win?
Leave your answer in the comments below, and no cheating in the game! We will reveal the answer in the session tomorrow.
See you there!
Good luck!
TMP Team
See less
Agastya Varshney 8/11 1:17 PM Edited
if n(number of candle) is not a multiple of 3 then i will go first
Edited
otherwise if n is multiple of 3 then i will go second
Kawatkar Asmi Sanket Namrata 8/11 1:17 PM
Be ready to explain your thought process to the class!
Agastya Varshney 8/11 1:37 PM
the trick is also if n is multiple of 3 and you are going second keep it in the multiples of 3 only
SM
siddh merchant 8/11 9:54 PM
3
Session 4: Robots, Schwarzenegger and me
Hey Problem Solvers!
Hope you'll are excited for tomorrows session because i most certainly am. Tomorrow i will be sharing my experience with robotics and my knowledge of STEM. Don't worry i have not made it boring, I will also be teaching you'll basic circuitry and coding on a simulation website known as tinkercad. if you'll have the time please check the website out as this will save us time in class.
Here is the link: https://www.tinkercad.com/
See less
Tinkercad | From mind to design in minutes
Tinkercad is a free, easy-to-use app for 3D design, electronics, and coding.
www.tinkercad.com


Kawatkar Asmi Sanket Namrata 8/18 1:58 PM Edited
4
Session 5: A Paradoxical Reality
Get ready for a mind boggling session!
Heyyo Problem Solvers!
Today we will be working with all sorts of famous problems and paradoxes, trying to figure out their flaws and solve them as we go! Be sure to have the guiding sheet either printed (if possible) or open beside you, so that you can follow along!
See y'all at 5:30pm today!
TMP Team
See less
Session 5- A Paradoxical Reality - Guiding Sheet.pdf
The Missing Piece (Grades 7, 8 and 9) > General
Reply
Kawatkar Asmi Sanket Namrata 8/19 12:51 PM
2
Session 6: Cracking the Code
The ciphers are back!!
Problem Solvers, can't wait to see you guys in session today (it's a part II of our very first session).
We will be continuing with a lot of discussion, debate and some astounding puzzles! There will also be a kahoot at the end so please keep your devices ready accordingly!
See you at 4:30pm!
TMP Team
Kawatkar Asmi Sanket Namrata 8/25 8:28 AM
3
Session 7: Exploring Dimensions
Lets look at puzzles from a whole new dimension!
Hey Problem Solvers!!
For today's session, please keep 3 square sheets of paper, larger than 10cmx10cm ready. Also, fold one of the sheets into an 8x8 grid by folding it in half multiple times.
See you at 5:30!!
TMP Team
See less
Kawatkar Asmi Sanket Namrata 8/25 1:54 PM
2
Problem Solvers, We will also need you to turn on your cameras today so please do so, for the first half of the session. Thanks!
Reply

Kawatkar Asmi Sanket Namrata 8/26 10:29 AM Edited 2

Session 8: A Paradoxical Reality II

Let's level up!!

Hi there Problem Solvers!!

Today is the second-to-last session of the Missing Piece, and we can't wait to see you guys in the evening! Let's delve deeper into the mind-boggling world of paradoxes and thought problems with another session of Paradoxical Reality with Akshay, ARJUN and Abhijit!!

We hope to see maximum participation in preparation for the TREASURE HUNT which will be held on next Tuesday (1st Sept).

The guiding sheet for today's session has been uploaded, please refer to it during the club.

See ya!
TMP Team

See less

Session 8 - A Paradoxical Reality II - Guiding Sheet.pdf ...
The Missing Piece (Grades 7, 8 and 9) > General

Kawatkar Asmi Sanket Namrata Monday 9:58 AM Edited 4

Session 9: The Big Picture

IMPORTANT!

Gear up for the last session of the Missing Piece! (*IMPORTANT INSTRUCTIONS BELOW*)

Hey there Problem Solvers!!

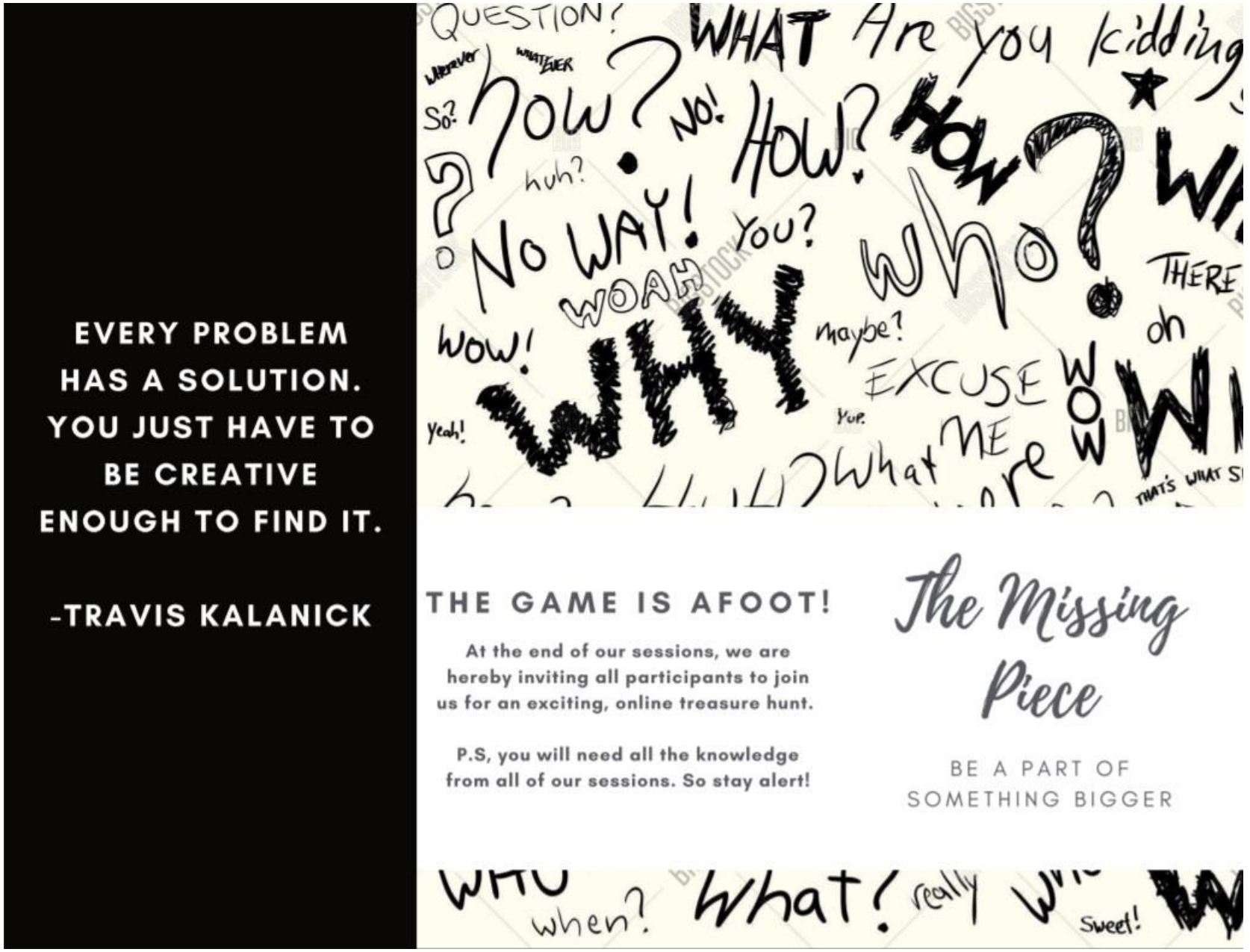
After a whole month of sessions, we have finally come to the end of the Missing Piece club. Here are the instructions for tomorrow's EPIC treasure hunt:

1. **Please try to login on a LAPTOP or have a laptop open beside you or another device on which you can open .zip files**
2. Please make sure your mic/camera is working, and if it is not then do inform us at the start of the session
3. Make sure you have a stable wifi, and a piece of paper and a pen beside you
4. Join on or before 5:25pm, so that we can get everyone settled in by 5:30pm sharp
5. Please be responsive and quickly unmute yourself when asked to do so

See you tomorrow!
TMP Team

GALLERY - BROCHURE

Figure 59: Brochure which was designed by the team and sent out to evoke interest pre-registration


EVERY PROBLEM HAS A SOLUTION. YOU JUST HAVE TO BE CREATIVE ENOUGH TO FIND IT.
-TRAVIS KALANICK
QUESTION?
WHAT
Are you kidding
How?
NO!
HOW?
huh?
No WAY!
You?
WOAH
WHY
WOW!
maybe?
EXCUSE
Who?
THERE
oh
Yeah!
Yup.
WOW
What
ME
THAT'S WHAT
THE GAME IS AFOOT!
At the end of our sessions, we are hereby inviting all participants to join us for an exciting, online treasure hunt.
P.S, you will need all the knowledge from all of our sessions. So stay alert!
The Missing Piece
BE A PART OF SOMETHING BIGGER
when?
What!
really
Sweet!

GALLERY - PRAISE AND ENCOURAGEMENT

Kawatkar Asmi Sanket Namrata 8/4 6:47 PM

Praise

Kawatkar Asmi Sanket Namrata sent praise to

Ishaan Kaushal Mody, HARSHILBHAI ARAS SAVANI, Jaideep Mukund Galgali

You guys did amazing today! You exceeded all of our expectations and proved yourselves to be super solvers! Keep up the good work :)

TMP Team

Kawatkar Asmi Sanket Namrata 8/11 7:12 PM

Praise

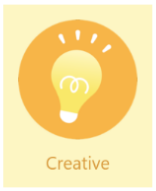
Kawatkar Asmi Sanket Namrata sent praise to

Gupta Riddhi Puneet, Gupta Nirvaan Puneet, Ananya Tejuja

Excellent work in cracking puzzles and trying your innovative strategies at all of the problems! Keep up the good work!

Kawatkar Asmi Sanket Namrata 8/18 8:14 PM

Praise



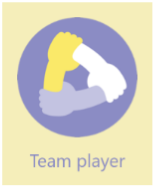
Kawatkar Asmi Sanket Namrata sent praise to

Ananya Tejuja, Khushi Bhatia, Kher Jiya Sunil

Keep up the creative, out-of-the-box thinking!

Kawatkar Asmi Sanket Namrata 8/20 8:38 AM

Praise



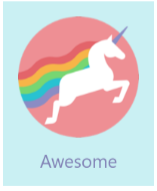
Kawatkar Asmi Sanket Namrata sent praise to

aaryan khadilkar, Singh Mahema prabdeep, Anoushka Puri

You guys did a really good job of participating in discussion yesterday! Keep it up!

Kawatkar Asmi Sanket Namrata 8/25 6:44 PM

Praise



Kawatkar Asmi Sanket Namrata sent praise to

Kher Jiya Sunil, Gupta Riddhi Puneet, Khushi Bhatia

Your enthusiasm for learning really reflected in your eager participation today! Y'all are awesome!

Kawatkar Asmi Sanket Namrata 8/11 7:10 PM

Praise

Kawatkar Asmi Sanket Namrata sent praise to

Agastya Varshney, Ishaan Kaushal Mody

You guys really communicated your opinions well today! We are glad to see you thinking out of the box! Keep it up! :)

Kawatkar Asmi Sanket Namrata 8/25 6:46 PM

Praise

Kawatkar Asmi Sanket Namrata sent praise to

Aryan Ravuri, aaryan khadilkar, Anoushka Puri

We are so happy to see you guys speaking up more and participating! Looking forward to hearing all your ideas!

SM siddh merchant 8/12 5:49 PM

Praise

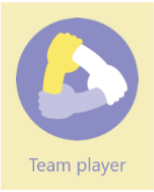
siddh merchant sent praise to

Ishaan Kaushal Mody, HARSHILBHAI ARAS SAVANI, Jaideep Mukund Galgali, Khushi Bhatia, Gupta Nirvaan Puneet

Congrats guys!
you'll did an excellent job !

Kawatkar Asmi Sanket Namrata 8/26 6:06 PM

Praise



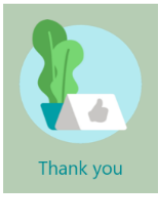
Kawatkar Asmi Sanket Namrata sent praise to

Ishaan Kaushal Mody, Agastya Varshney, Jaideep Mukund Galgali

You guys did a great job contributing to the group discussion and putting forth your solutions today! Keep up the solving!

Kawatkar Asmi Sanket Namrata Yesterday 6:49 PM

Praise



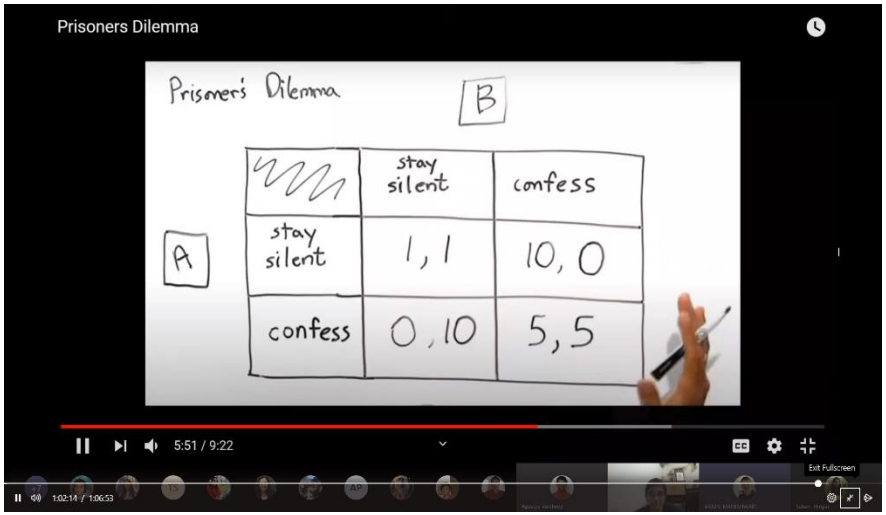
Kawatkar Asmi Sanket Namrata sent praise to

Agastya Varshney, Anoushka Puri, aaryan khadilkar, HARSHILBHAI ARAS SAVANI, Ishaan Kaushal Mody, Jaideep Mukund Galgali, Kher Jiya Sunil, Khushi Bhatia, Ramchandani Kisha Deepak, Singh Mahema prabdeep, Gupta Nirvaan Puneet, Ghuste Prisha Rohit, Gupta Riddhi Puneet, Trusha Kedar Sohoni

You guys did SOO WELL in solving the Treasure Hunt today!!!

Thank you for attending the Missing Piece sessions diligently and for participating with enthusiasm in all our crazy puzzles! We hope you learnt a lot from us and we hope that we have only fuelled your curiosity to solve all of the puzzles around you!!

GALLERY – MODES OF PRESENTATION

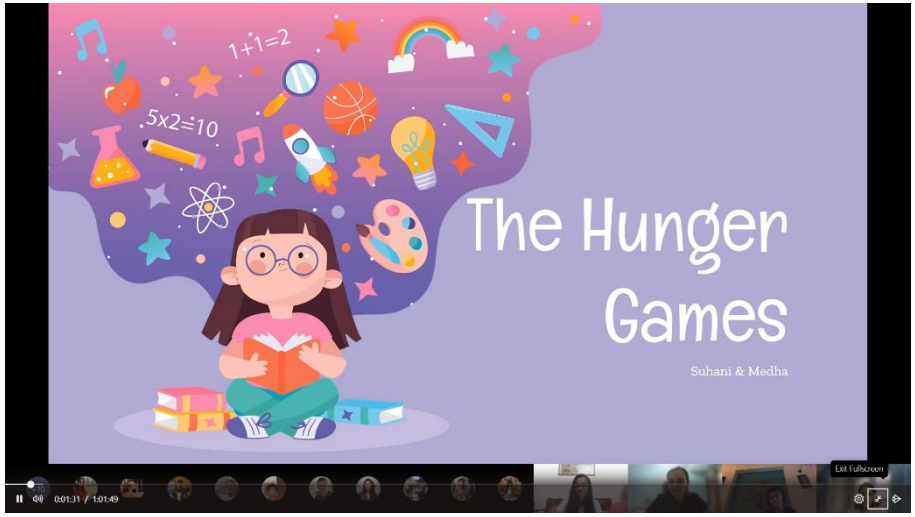


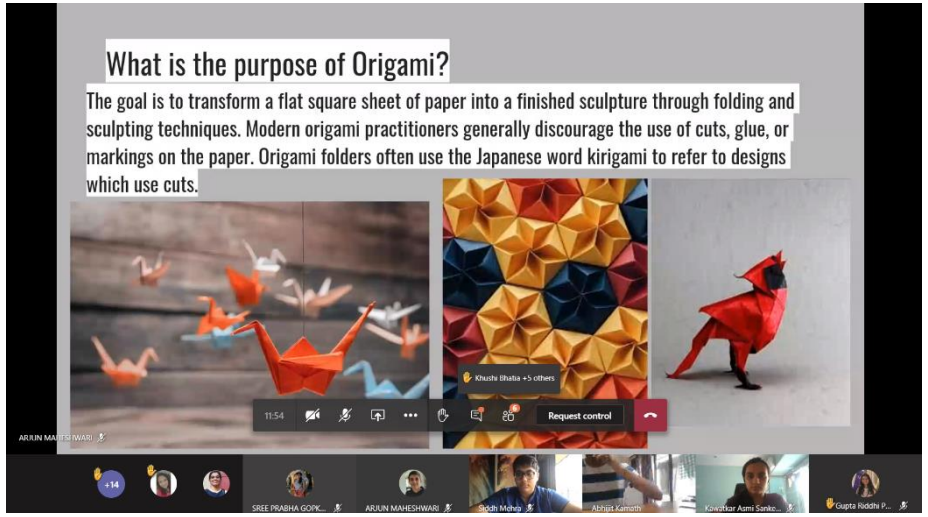
Presentation Medium 1: Videos

We made sure to use a variety of modes of presentation throughout the project, not only because we wanted to explore and push the limits of online learning, but also to keep learners engaged.

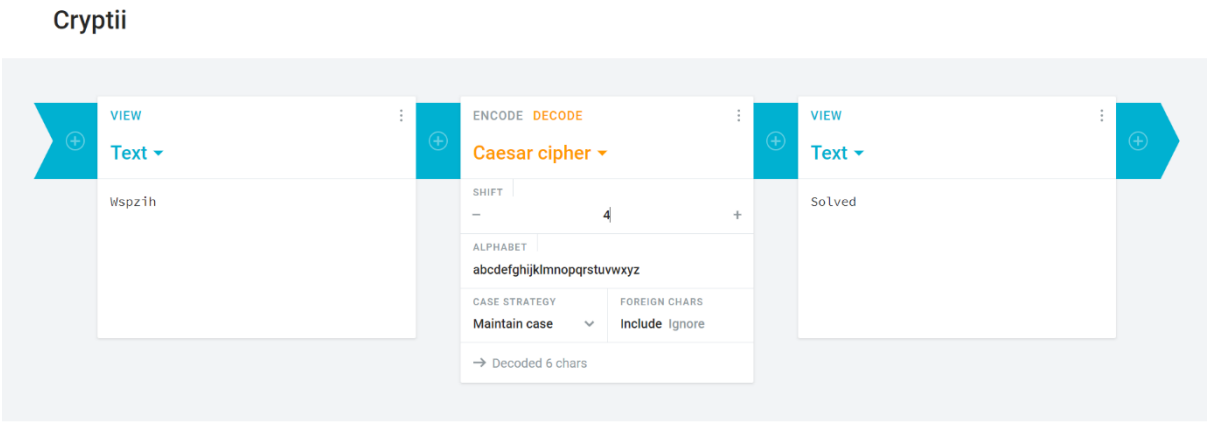
We used videos to explain difficult concepts or the ones which we thought were slightly complicated and might be a bit confusing to the learners.

Our primary method was PowerPoint presentations, which are simple and effective.

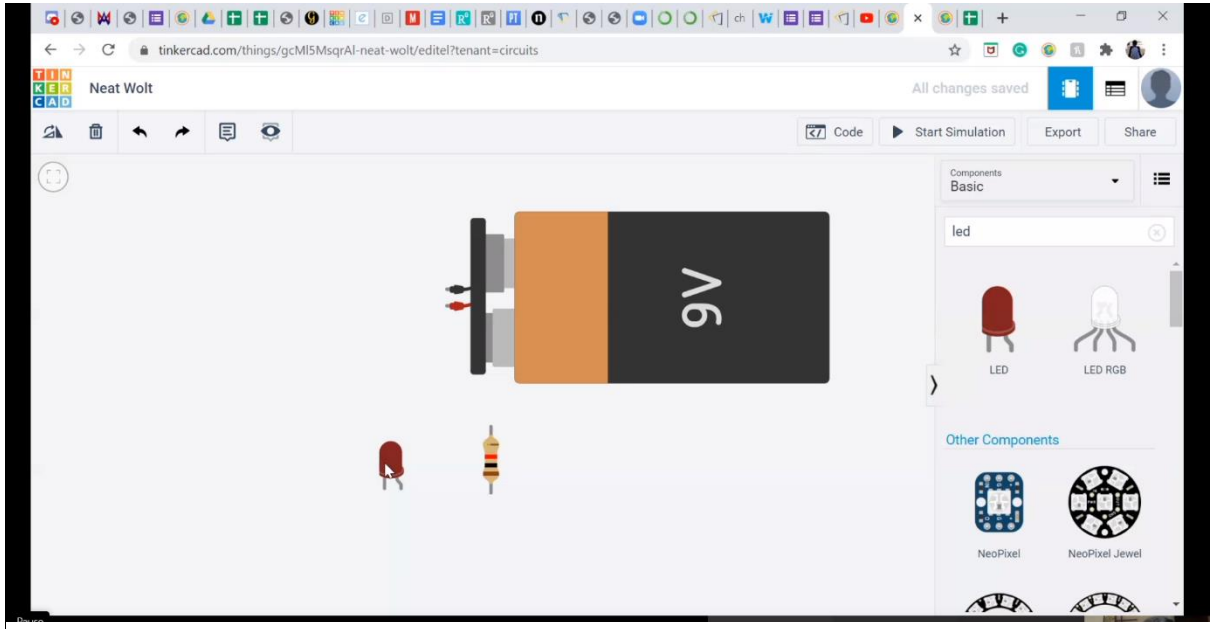




Presentation Medium 2: PowerPoint Presentation



Presentation Medium 3: Open source resources - Cryptii.com

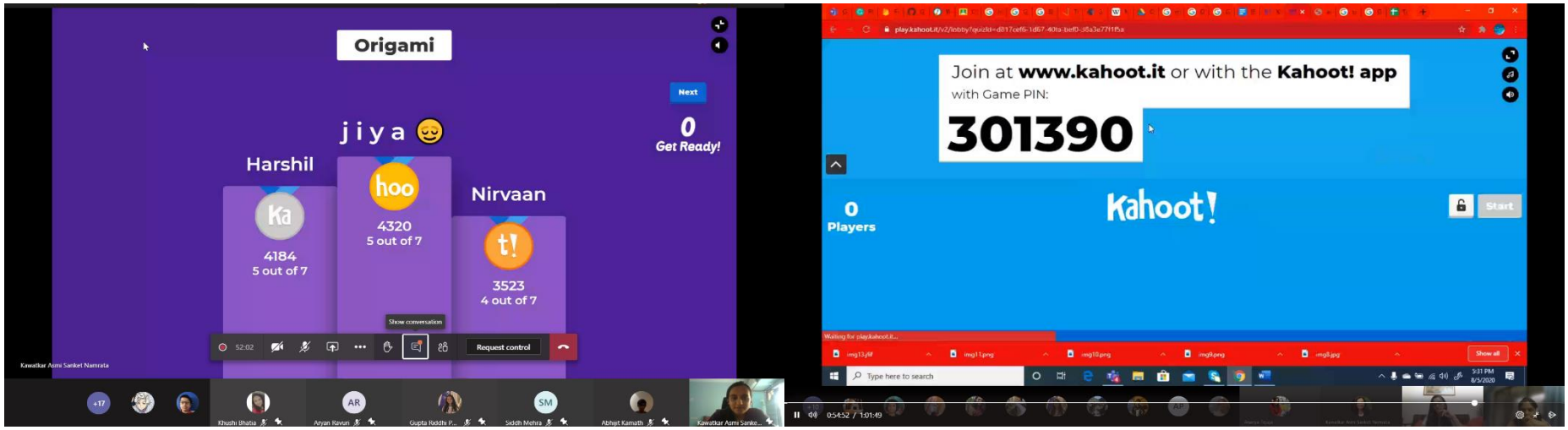


Presentation Medium 4: Open source resources - Tinkercad.com

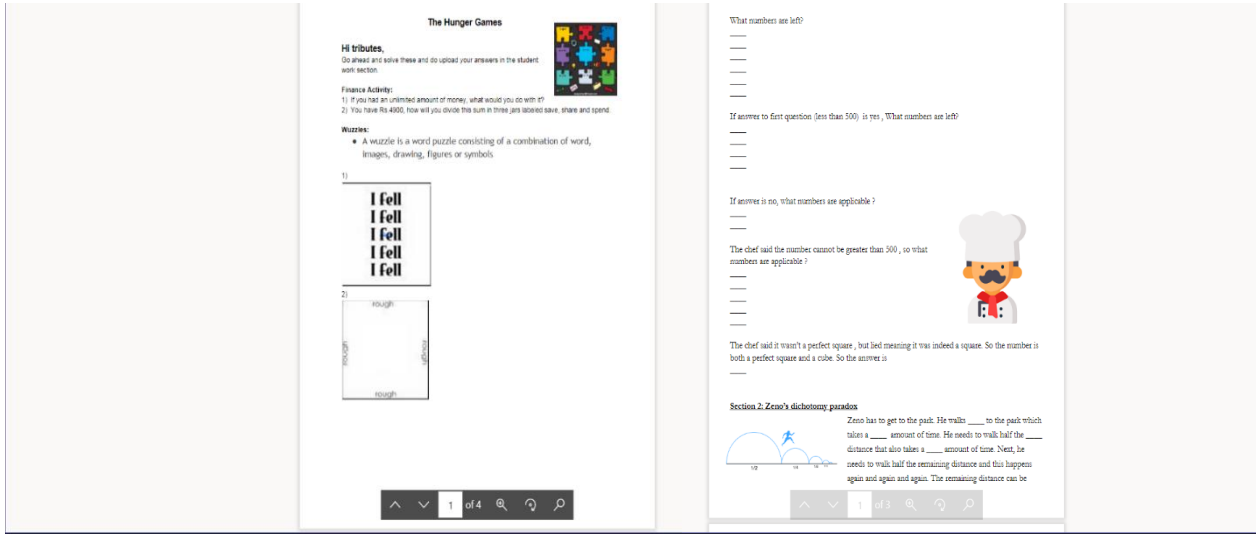
We also tried to use as many open source resources which were freely available to us. For example, we used Cryptii.com for the ciphers and codes sessions, and Tinkercad.com for the Robotics and STEM software.

We wanted to use resources which the learners could easily access even after the sessions, which was the main motive behind the choosing of these particular websites.

Also, being aware of cyber safety, we made sure the websites we chose and endorsed were student friendly, legitimate and did not expose our learners to any unnecessary risk.



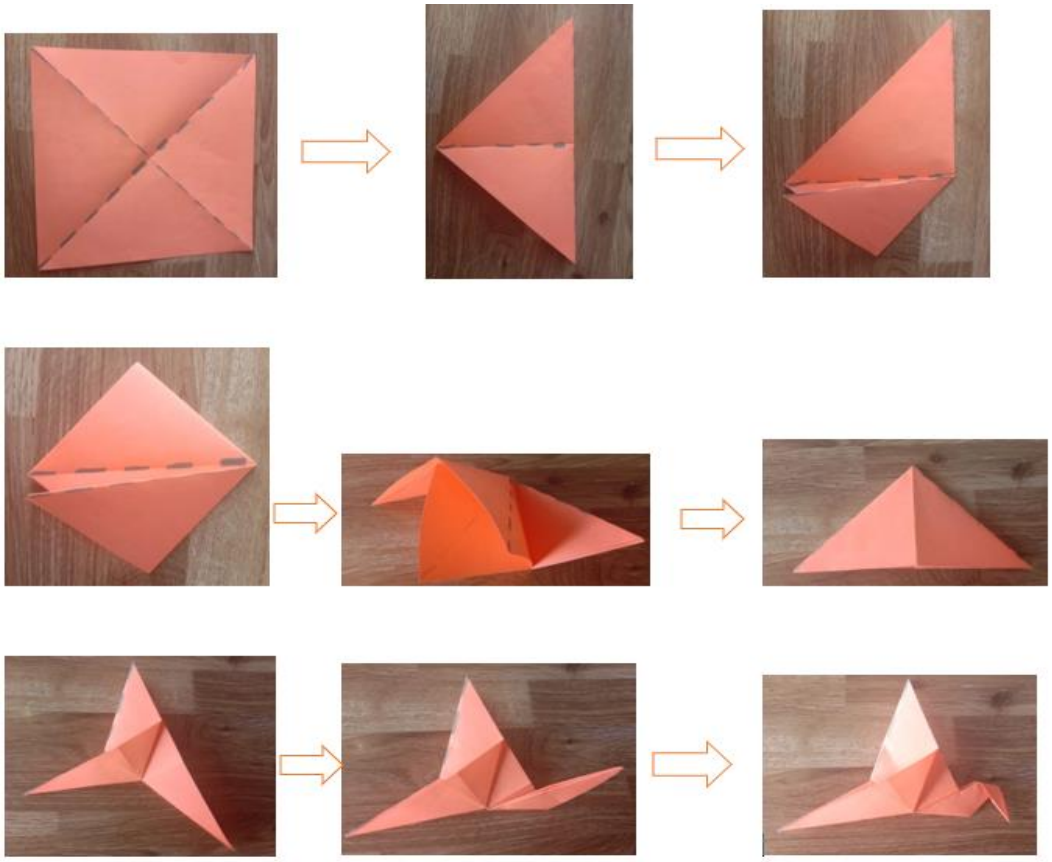
Presentation Medium 6: Kahoots



Presentation Medium 5: Guiding Sheets

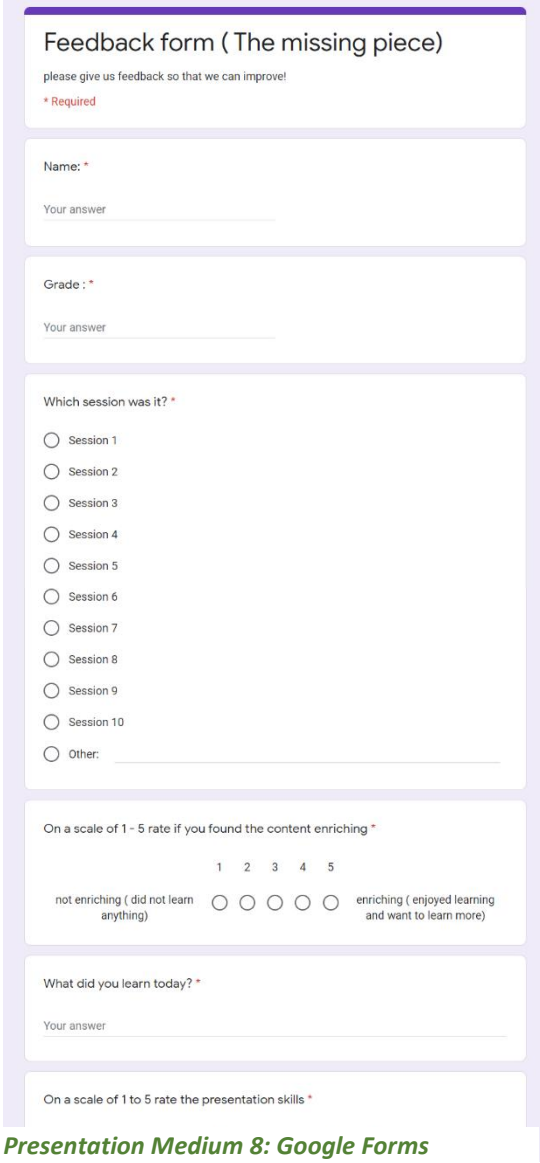
Kahoots were an extremely popular method of presentation, and the learners absolutely loved them.

Guiding sheets just made it really easy for us to make sure the learners were following along, especially considering that this was an online platform and that this was the only way for us to estimate their progress.



Presentation Medium 7: Live Demonstration

We used live demonstrations to display the origami folding because this was easy and effective way to convey the folding. Also, we used google forms to convey the quizzes and collect the responses as well.



Feedback form (The missing piece)

please give us feedback so that we can improve!

* Required

Name: *

Your answer

Grade : *

Your answer

Which session was it? *

- Session 1
- Session 2
- Session 3
- Session 4
- Session 5
- Session 6
- Session 7
- Session 8
- Session 9
- Session 10
- Other:

On a scale of 1 - 5 rate if you found the content enriching *

	1	2	3	4	5	
not enriching (did not learn anything)	○	○	○	○	○	enriching (enjoyed learning and want to learn more)

What did you learn today? *

Your answer

On a scale of 1 to 5 rate the presentation skills *

Presentation Medium 8: Google Forms

SAMPLE CERTIFICATE

PODAR
Nurturing The Future. Since 1927.
PODAR INTERNATIONAL SCHOOL (IB & Cambridge International)
M U M B A I

Skills Developed:

Logical Reasoning • Analytical Thinking • Interpretation of complex information • Spatial Awareness • Critical Thinking • Problem Evaluation • Strategic Decision Making

CERTIFICATE OF PARTICIPATION

This award is presented to:

STUDENT NAME

for his/her commendable participation and performance in

THE MISSING PIECE

under

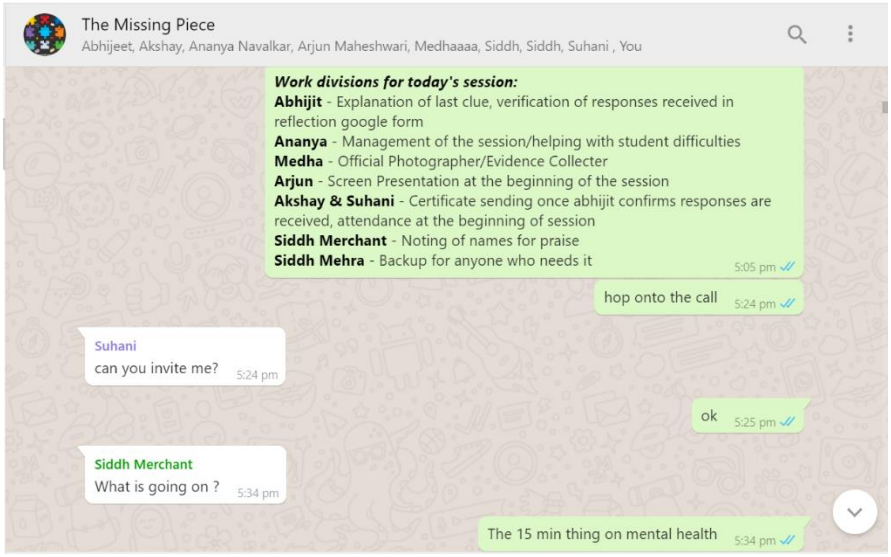
THE EXTRACURRICULAR PROJECT

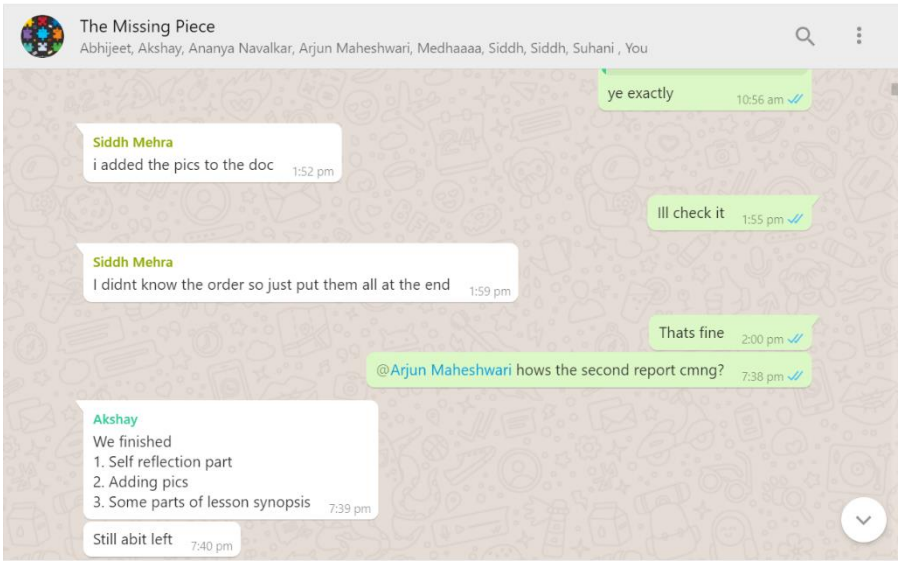
From 4th August to 2nd September, 2020

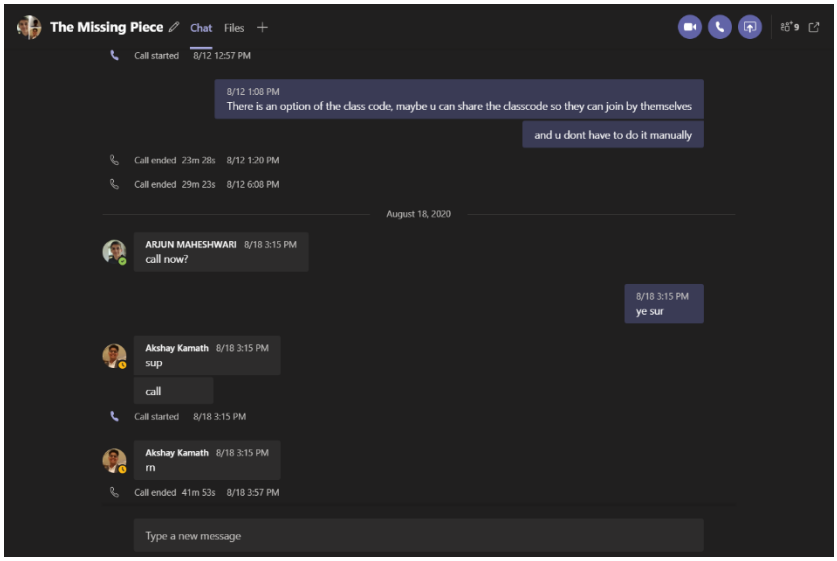
DR. VANDANA LULLA
DIRECTOR/PRINCIPAL

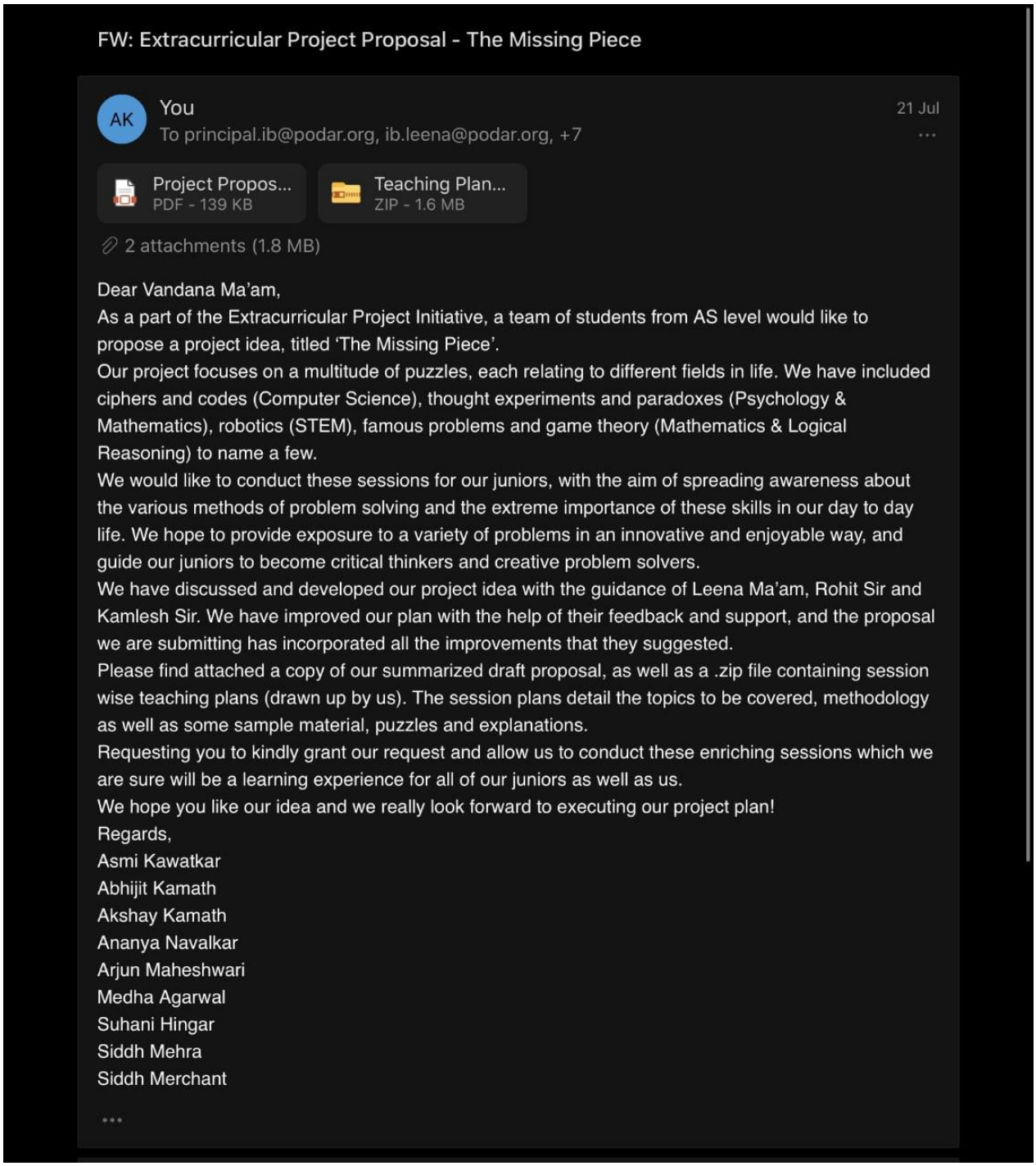
EVIDENCE

COMMUNICATION EVIDENCE:









FW: Extracurricular Project Proposal - The Missing Piece

AK You
To principal.ib@podar.org, ib.leena@podar.org, +7
21 Jul

Project Propos...
PDF - 139 KB

Teaching Plan...
ZIP - 1.6 MB

2 attachments (1.8 MB)

Dear Vandana Ma'am,
As a part of the Extracurricular Project Initiative, a team of students from AS level would like to propose a project idea, titled 'The Missing Piece'.
Our project focuses on a multitude of puzzles, each relating to different fields in life. We have included ciphers and codes (Computer Science), thought experiments and paradoxes (Psychology & Mathematics), robotics (STEM), famous problems and game theory (Mathematics & Logical Reasoning) to name a few.
We would like to conduct these sessions for our juniors, with the aim of spreading awareness about the various methods of problem solving and the extreme importance of these skills in our day to day life. We hope to provide exposure to a variety of problems in an innovative and enjoyable way, and guide our juniors to become critical thinkers and creative problem solvers.
We have discussed and developed our project idea with the guidance of Leena Ma'am, Rohit Sir and Kamlesh Sir. We have improved our plan with the help of their feedback and support, and the proposal we are submitting has incorporated all the improvements that they suggested.
Please find attached a copy of our summarized draft proposal, as well as a .zip file containing session wise teaching plans (drawn up by us). The session plans detail the topics to be covered, methodology as well as some sample material, puzzles and explanations.
Requesting you to kindly grant our request and allow us to conduct these enriching sessions which we are sure will be a learning experience for all of our juniors as well as us.
We hope you like our idea and we really look forward to executing our project plan!
Regards,
Asmi Kawatkar
Abhijit Kamath
Akshay Kamath
Ananya Navalkar
Arjun Maheshwari
Medha Agarwal
Suhani Hingar
Siddh Mehra
Siddh Merchant

We kept a record of all our communication, both intra-team and to external parties involved in guiding and critiquing our work throughout the process.

ORGANISATIONAL EVIDENCE:

Name	Date modified	Type	Size
Certificates - TMP-20200901T071516Z-001	01/09/2020 05:08 PM	File folder	
Documentation	10/09/2020 10:55 PM	File folder	
Session 1 - Na ravtzngvp ceboyrz	09/09/2020 04:43 PM	File folder	
Session 2 - The Hunger Games	31/08/2020 05:52 PM	File folder	
Session 3 - Game of Life	31/08/2020 05:54 PM	File folder	
Session 4 - Robots, Schwarzenegger and Me	31/08/2020 05:54 PM	File folder	
Session 5 - A Paradoxical Reality	31/08/2020 05:56 PM	File folder	
Session 6 - Cracking the Code	10/09/2020 10:19 PM	File folder	
Session 7 - Exploring Dimensions	31/08/2020 05:57 PM	File folder	
Session 8 - A Paradoxical Reality (II)	31/08/2020 05:58 PM	File folder	
Session 9 - The Big Picture	10/09/2020 08:35 PM	File folder	
Teaching Plans - Old	25/07/2020 11:37 AM	File folder	
Teaching Plans - Updated	25/07/2020 04:15 PM	File folder	
The Missing Piece - Evidence	25/07/2020 04:19 PM	File folder	
vid	22/07/2020 09:14 PM	File folder	
blue-puzzle-pieces-paint-splashes-background_23-2147491304	08/08/2020 10:30 AM	JPG File	61 KB
Certificates - TMP-20200901T071516Z-001	01/09/2020 12:44 PM	Compressed (zipped)...	6,723 KB
CERTIFICATES	01/09/2020 05:08 PM	Compressed (zipped)...	6,722 KB
Codes and Ciphers	23/07/2020 02:35 PM	Microsoft Word Doc...	1,721 KB
Draft Proposal - Extracurricular Project	15/07/2020 02:22 PM	Microsoft Word Doc...	35 KB
Mock Teaching Session	24/07/2020 08:35 AM	Microsoft PowerPoint...	5,503 KB

Session 1 - Guiding Sheet.pdf	August 3
Session 1 - Morse Code Activity.pdf	August 3
Session 1 - Na ravtzngvp ceboyrz .pptx	August 4
Session 2 - Problems Sheet.pdf	August 8
Session 2 - The Hunger Games.pptx	August 8
Session 3- The Game of Life.pptx	August 11
Session 4 - Robots, Schwarzenegger and m...	August 18
Session 5- A Paradoxical Reality - Guiding S...	August 18
Session 6 - Cracking the Code.pptx	August 19
Session 6 - Enigma.png	August 19
Session 7 - Exploring Dimensions I.pptx	August 25
Session 7 - Exploring Dimensions II.pptx	August 25
Session 8 - A Paradoxical Reality II - Guidin...	August 25
The Big Picture - Mission File.zip	September 1

Name	Modified
Certificates	September 2
Session Materials	August 2
Student Work	August 2
Orientation - General Rules & Information....	August 3
Screen Shot 2020-08-13 at 9.36.56 AM.png	August 12
Screenshot (63).png	August 12
The Missing Piece - Introduction.pdf	August 2
The Transcript.pdf	September 1
The Weekend Bonanza - 1.pdf	August 7
TMP - Weekend Bonanza 1 - MS.pdf	August 11
Weekend Bonanza 1 - Q4 Answer.jpeg	August 11
WhatsApp Image 2020-08-07 at 4.34.38 PM...	August 7

ACKNOWLEDGEMENTS

To conclude our documentation, we would like to thank all of our teachers, and the faculty advisors who guided us in improving our work, and taught us how to be teachers.

Special thanks to Vandana Ma'am, Leena Ma'am, Rohit Sir and Kamlesh Sir, for supporting us and entrusting us with the responsibility of teaching our juniors and stepping into your shoes for a month!

We would also like to thank our peers and classmates who put up with us and gave us feedback and help when we needed it.

Lastly, we want to thank all the other awesome people involved: the IB Directorial team, the Missing Piece Managers, the Guest Teachers and everyone else without whom this project could not be the success that it has been!

Thank you so much!

The Missing Piece Team

THE END

This project was a huge success and we look forward to many more such opportunities!