Some Fun Pedagogical Techniques to Teach Optics to Students of All Ages

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ABSTRACT

During the COVID-19 pandemic, educational institutions have adopted digital technologies as a medium to share the knowledge and to connect with the students. The idea of learning and teaching has taken a huge turn and needs to be customized and made innovative since the technological era has stepped in. Although the educational information and knowledge are easily available over the internet, the fruitful gains of meaningful knowledge assimilation can only be achieved under the supervision of teachers/mentors. Taking this ideology forward, this paper presents pedagogical techniques to virtually connect with students leading to successful inculcation of the theoretical knowledge with practical wisdom unto the student's mind. The pedagogical idea was exercised with school students studying from 6^{th} to 12^{th} grade. Initially, a teacher-student connect was established. Then, the students were pro-actively made to understand topics through self-apprehended practicals at home, keeping up with the age-old conventional environment so as to gradually ease them in the virtual technology. Practical and tasks that were carried out throughout the pedagogy played a major part in the development of mind with curiosity, questioning and constructivism, emphasizing on the weak points and strengthening their concepts in optics.

Keywords: Pedagogy, K-12, Virtual Learning, Optics Learning, COVID-19

1. INTRODUCTION

Blending and bending the ways of functioning in accordance with the circumstances, is the only route to evolution. With so many things to learn, numerous theories, and a shedload of concepts to go through every day, relying just on brain memory is a tedious and lackluster way of learning. Engaging students' minds, learning through your eyes and ears, firsthand experiencing the bookish concepts is a progressive approach towards studying. Where swatting enhances knowledge, insight enriches wisdom, then the practical knowledge is permanently impressioned giving you a deep understanding of the notion. With the basics covered, the mind can relate and connect with the phenomena of the world with ease. Interestingly, it brings out the eager and keen nature in you to learn about an engrossing and compelling scientific occurrence in the surroundings. Acquiring knowledge through reading, from the teacher's monolog to visual perception, experiences in life or discussion in the classroom seamlessly pass the knowledge. We have tried to blend the lines of theoretical and practical knowledge, limiting the students to lab experiences and experimentation because students need to know how things work in real life in order to increase their creativity, improve their understanding, comprehension, and finally grasp the concept. This is exactly what learning through tasks ensures. Students actively participated in new intriguing activities before they were taught new topics. After gaining theoretical knowledge, topic wise tasks let them put

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their newly acquired knowledge in use and to understand the natural phenomenon. The best outcome of this firsthand student-centric approach was that their budding minds fully understand the basics and are able to relate them with the worldly phenomena. A critically responsive pedagogy invites involvement, and, can be realized by utilizing a conceptual framework into which is incorporated experience, critical thinking, and reflective action. Towards a sustainable education as a means for attaining sustainable living was realized ever since the progress of the human mind. It has been realized that mere attainment of concepts can only lead to theoretical advancements. For development of our modern world and to step in the pioneered era, human's wits are important and so, they're finely inculcated by such pedagogical mind-grasping methods. We acquire life time skills by gaining knowledge through applications and working of things. But owing to the virtual classroom scenario, there is lesser interaction between student and teacher than that would've been there in a classroom. Even so, using innovative methods to attract young minds, we were not only able to cross this barrier but also garner their interests.

2. METHODOLOGY

Unlike traditional method of teaching, we used reversed methodology. Where a traditional method (Figure 1) follows a 'First theory, then practical' approach, our strategy first introduces the learners with the practical aspect followed by the theory and reasoning. Firstly, a test was taken by the students containing questions based on their school standards. Based on their performance in this test, they were divided into two groups namely Group A & Group B. Each group had four teams with an assigned mentor. Each team had members with different levels of performance. Students were to choose two activities of their choice from the list provided. Both teams had different sets of activities. After selection, they were given a period of four days to submit a video of them performing the activities and a brief report containing their experiences and learning. In the meantime, self-made video lectures of several topics were shared by the mentors. Students were free to contact their mentors in case of any doubts, queries and clarification via WhatsApp groups or phone call. After submission, all students took the post test. Post-test contained questions based on the activities chosen and was unique for every student (Figure 2). The comparison between Pre-test and post-test is as given in Table 1.

2.1 Why This Pedagogy?

Traditional methodology though has certain advantages but has several drawbacks such as it fails to make a topic interesting, individual student focus and develop a scientific thought process among students. Unlike traditional classes where a teacher teaches 30-40 students in each lecture, the associated mentors looked after 3-6 students at the most which makes teaching as well as monitoring easier. The mentors also helped the students to select the activities based on their performance. It ensures the growth of every child. In this process, mentors play an important role. This method of teaching is beneficial in the long run; it develops a scientific temperament in the students. This technique makes the students think in the same way as a scientist and researcher does and tries to make the students curious to know the reasons on their own by making them ask questions to themselves before introducing them to the theory part. This strategy makes them self-dependent and more attentive towards the topic concerned.

To start with, they are free to select some concepts of their interest and study underlying principles on their own by consulting the internet or books, and then perform the activity by themselves. This hands-on experience makes the concept crystal clear to them. In this process, if they get stuck somewhere and need to take help in person, their associated mentors are there to help them and clear their doubts and queries. But rather than asking their doubts, they are encouraged to seek answers on their own and if the doubt persists, mentors assist them.

Figure 1 Traditional Pedagogy for Optics

Figure 2 Approach Outline

Table 1 Difference between Pre - Test and Post – Test

PRE – TEST	POST - TEST
This aimed to check the current level of knowledge in Optics and Photonics	For evaluating the learning and concept understanding of the students.
No Marking	Marking was given on the basis of performance.
There was flexibility of choosing the topics that they already knew. Some basic general questions on the optics concept.	Questions were based on their performed activities.
Pre-Test was same for all the students.	Post - test was designed uniquely for each students.

2.2 Teams

Two teams were formed and contained performers of all levels. Each team had 4 groups having 3-4 students each. Each group had an associated mentor who was responsible for selection of activities and submission. These mentors also had the responsibility of providing lectures to the students and helping them with their doubts.

2.3 Methods of Interaction

2.3.1 Virtual Meeting/Webinar

An introductory webinar was conducted via Google Meet to make the students familiar with the process flow interactively.

2.3.2 Recorded Video Lectures on YouTube**.**

Each mentor made a video explaining one or more phenomena. These videos were self-made by the mentors. Mentors used native languages to have a better connect with the students. Videos were shared over YouTube that ensured that every student could access them as per their schedule. Each video was explanatory and dealt with basic foundations and outlining principles and concepts. Topics covered in the videos lectures were as follows: Photoelectric Effect, Tyndall Effect, Scattering of light, Photoconductivity, Reflection and Refraction, Compton Effect, Photon-Mass interaction, Microwaves, Color theory, Light and its phenomena, Ray optics,
Optical instruments and Image formation, Partial and Total Internal reflection, Mirage Formation, Optical Fibers and Dispersion of Light

1. Prince Sharma delivered a lecture [1] which gave students an idea about how light has changed the human life over the years. He gave them some practical touch through interactive videos and diagrams. The lecture included Electromagnetic Waves and its functioning, Law of Reflection and Refraction, Functioning of Human Eye, Optical instruments and Image formation, working of Solar panels and Application of Light.

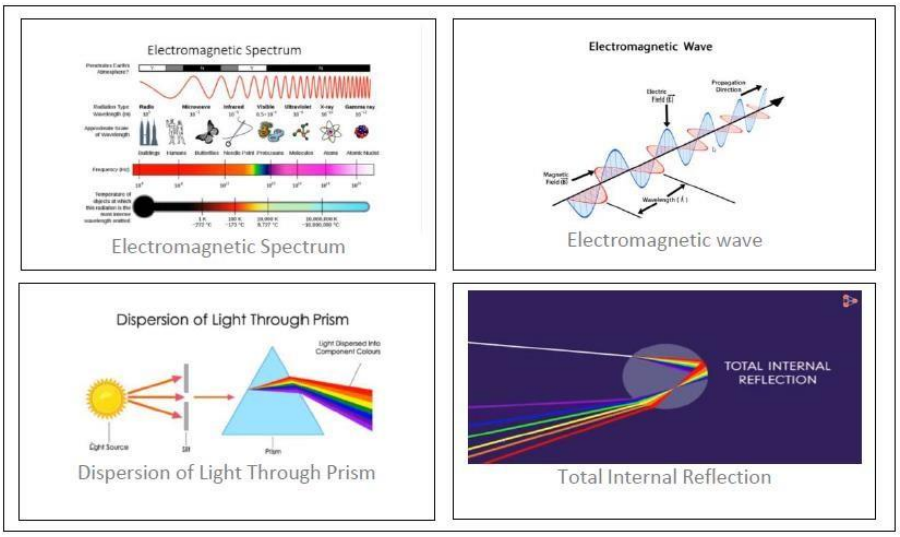


Figure 3 Snapshot of the Video Lecture by Prince Sharma

2. Another lecture was given by Aman Tyagi [2], which covered Electromagnetic Spectrum, Photoelectric Effect theory, Total Internal Reflection, Mathematical expression was explained followed by an animation to clear the concepts to students. The lecture has ensured that all the age group students would get benefitted from it and has a time of learning in a new and refined way. The lecture starts with the very basic terminology used in the concept viz. Threshold wavelength and frequency, wave and particle nature of light, photoelectric emission, etc. Further, it elaborated the evolution of the concept and its importance in the world of modern physics.

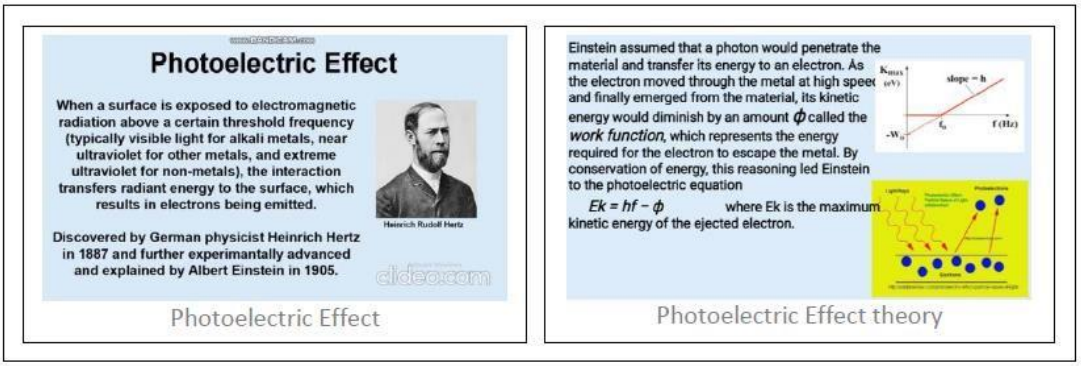


Figure 4 Snapshot of the video lecture by Aman Tyagi

3. Another video lecture was shared by Aditi Sharma [3] which included the basic concepts of color theory. Starting with the basics of color theory, she talked about its applications in everyday life.

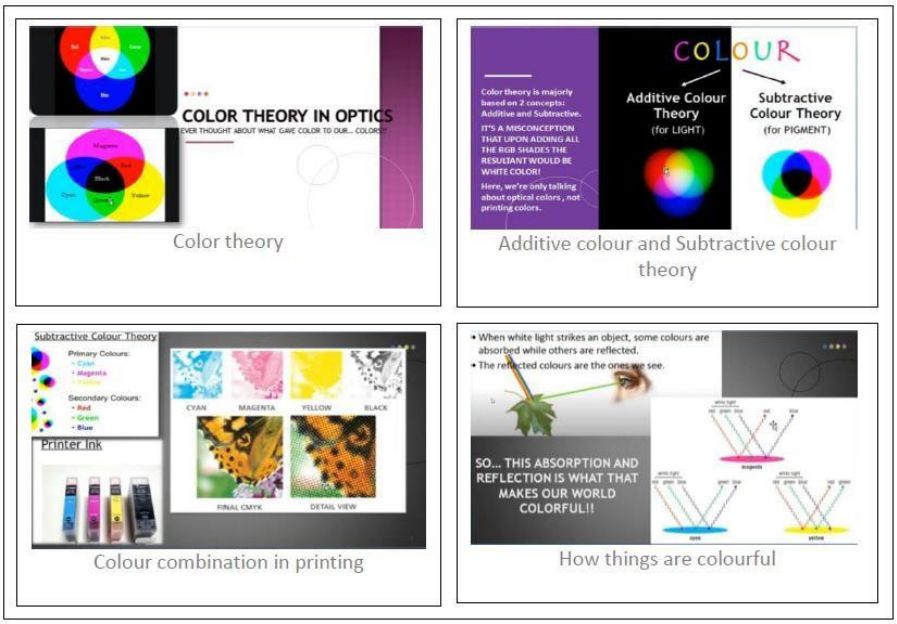


Figure 5 Snapshot of Video Lecture by Aditi Sharma

4. Pushkar Pandey delivered another lecture [4] about the Snell's law, mirage formation and optical fibres, geometrical optics and dispersion of light.

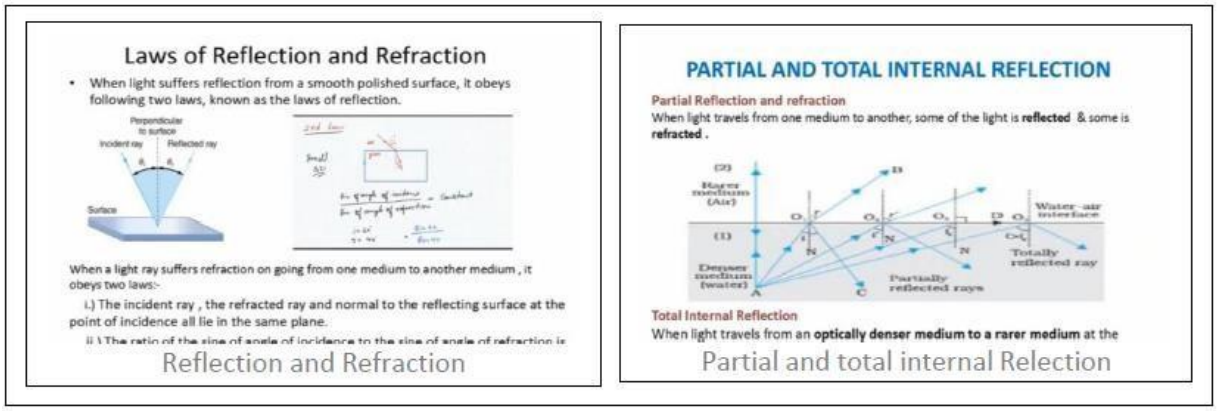


Figure 6 Snapshot of Video Lecture by Pushkar Pandey

5. Prahlad Prajapat provided another informative video [5] about image formation through eyes, wavelength of light and its behaviour and why the sun appears red when at horizon. He explained the outlining principles of these topics and the applications of scattering of light. Dependencies and types of scattering of light were thoroughly explained.

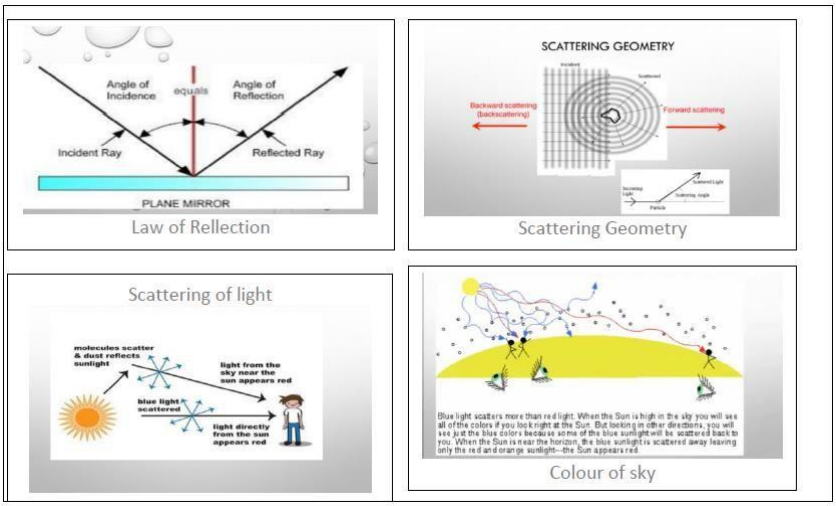


Figure 7 Snapshot of Video Lecture by Prahlad Prajapat

6. Particle theory, quantum theory and wave theory were explained in the video lecture [6] given by Yash Varshney. These topics are believed to be the hardest but he explained the concepts smoothly and made them very easily understandable for school level students.

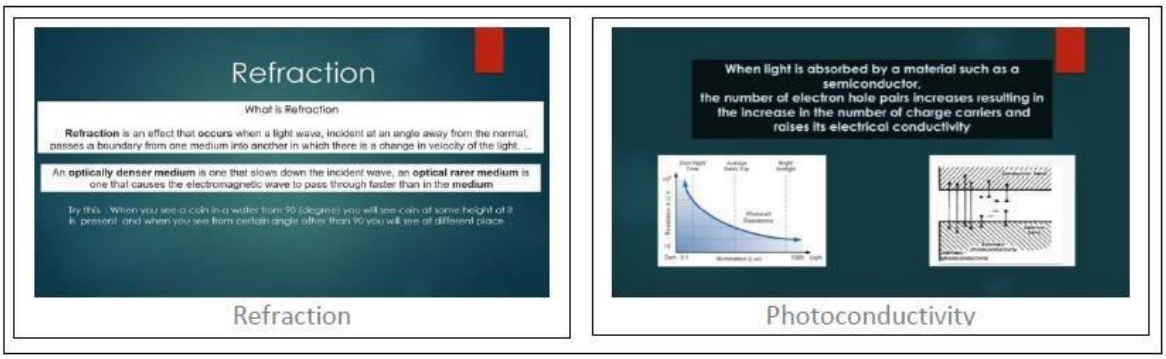


Figure 8 Snapshot of Video Lecture by Yash Varshney

7. Anurag Saxena enlightened the students about Tyndall effect, Compton effect and photon-mass interaction through a video lecture. [7]

Figure 9 Snapshot of Video Lecture by Anurag Saxena

2.3.3 Availability of Mentors on WhatsApp.

Each groups had its respective WhatsApp channels over which mentors addressed the doubts of students. Useful pieces of information and related references were also shared by mentors over these groups.

2.4 Activities

Various tasks to students are provided based on their school standards and complexity. Tasks were based on the topics that students selected and can be performed at home ensuring that the materials required to perform them are easily available at home during COVID. Also there were given a plenty of choices to choose from in case any requirement to perform the task was not available at their homes. Activities assigned to the students were as follows:

1. Hollow Prism

Materials required to perform this activity were a thin hard plastic sheet, some adhesive tape, and students had to make a triangular hollow prism using thin hard plastic sheet and transparent adhesive tape and they had to observe its optical properties and differences from the optical properties of a regular triangular prism (Figure 10) by using a flashlight. Hollow prism does not disperse the light but refracts it, for dispersion of light it is required that prism must be filled with the same medium uniformly which must have a high refractive index. It gave students a clear distinction between dispersion and refraction. Many conceptual questions were aroused by the students.

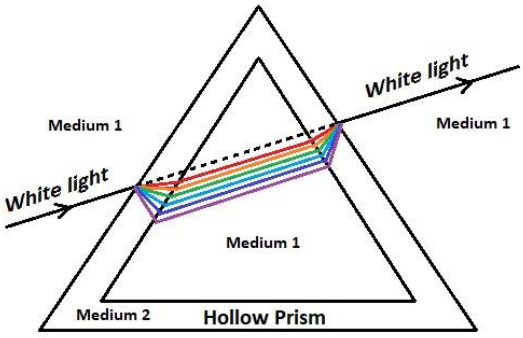


Figure 10 Ray Diagram for Hollow Prism

2. The Broken Pencil

It was a simple and easy task for small class children to observe the refraction of light. The materials required to perform this task was a pencil, water, and a transparent container. Students had to half submerge the pencil in the water (Figure 11) and observe the refraction phenomena by placing pencil at different places and angles in the

container. Due to refraction of light pencil seems to be bent at the surface of the water as like it has broken at that point.

Figure 11 Practical Result of the broken performed by Students

3. Pinhole Camera

In this activity, students had to make a Pinhole camera by using a cardboard box, black paint, and butter-paper. In making process they had to cut 1 face of the cardboard box and glue the butter-paper on that face to make the screen of the camera, also they had to make a small pin hole in the centre on the opposite face to the screen, and black paint the camera from the inside except on the screen. They had to observe the image formation and focusing of image by changing the distance of camera from the light source (lightning candle) on the butter-paper screen in two cases (Figure 12), (i) one pin-hole in camera. (ii) More than one pin-holes in camera. Final observation of this task is the number of images formed on the screen is equal to the number of holes in the camera. By adjusting the distance between source and camera image can be focused on the screen.

Figure 12 Practical result of Pin-hole camera task

4. Black light Highlighter

Highlighter glows more in UV light because of Photoluminescence. Based on this phenomenon blacklight highlighter activity was given to students. Students had to mimic a UV light source by using Blue, Violet, and Red colour filters on a white flashlight these filters can be made by using transparent adhesive tape and sketch pens. These filters filter out the long-wavelength light and only allow shorter wavelength light to pass, in a result intensity of the shorter wavelength light increases. Students had to draw something on a white sheet of paper using a highlighter (Figure 13) and observe the effect of filtered light on that, in a darkroom. Final observation if this task is highlighter glows more in black light then the white light.

Figure 13 Black light Highlighter performed by Students

5. Make the shadows

Mobile flashlight, butter paper, and a opaque paper sheet were required to perform this task. Students had to make paper cutting so that light can pass at various places and shadows can be formed by the rest part of the sheet they had to observe the shadow formation and sharpness of the shadow on changing the distance between cutting paper sheet, light source and screen where shadows formed in two cases.

a. Using only flashlight.
b. After applying butter-paper in front of flashlight.

Butter paper works as a diffuser it spreads light evenly in all directions. There is no effect on the sharpness of shadow in the first case when the distance between papercutting and screen is changed but in the second case with butter-paper as diffuser is used in front of the flashlight sharpness of shadow increases as the distance between screen and paper cutting decreases.

6. Capture the invisible light

This task shows the invisible electromagnetic spectrum around us which we cannot see by our naked eyes. Infrared light is used in Television remotes, Air-conditioner remotes, set-top box remote, etc. to control devices, which is emitted by IR blaster in the remote. This led can be captured glowing by a camera not having an IR filter. Students

had to record the video of IR led flickering when remote button is pressed (Figure 14). This task was very easy and aimed to give a very short and brief info about IR data transmission.

Figure 14 Capturing the invisible light

7. Black & white

Colour of an object concludes the absorbed electromagnetic spectrum and emitted electromagnetic spectrum by that object, absorbed light is converted into heat, and vibrations in that object and emitted electromagnetic spectrum defines its colour that we actually see.

This task requires only two papers one black and one white. Students had to place it in direct bright sunlight for about 25-30 seconds and had to observe that which paper becomes hotter (Figure 15). As black coloured paper absorbs most of the light falling on it so it becomes hotter than the white paper which does not absorb much light which follows absorbed electromagnetic spectrum is converted into heat and vibrations.

Figure 15 Absorption of light

8. Tyndall Effect

When light passes through a colloid or suspension or a medium containing particles of size 40-900 nm, its path becomes visible because of the scattering of light by the particles, this phenomenon known as the Tyndall Effect. This was also a very easy task which requires a transparent container, water, flashlight, soda-bicarbonate (Figure 16). Students had to mixed water and soda-by carbonate (also corn-starch, fine sand can be used) to make a colloid or suspension and they had to observe Tyndall effect by using a flashlight. As the result of this task path of light becomes visible in the mixture.

Figure 16 Tyndall Effect

9. Optical Illusion

There are many optical illusions around us some of them happen due to the sensitivity and working conditions of our body parts and some of them happen because of optical effects. In this task when the observer sees through a paper tube, placing palm of another hand on side of the tube, looking with both eyes open it appears that there is a hole in the palm (Figure 17). Students had to observe this and had to find out why it appears like that. As the result it appears like that because we see two slightly different frames at the same time because of distance between our eyes and mind process it as a one frame. Because this task could not be captured in video or photo so students were allowed to perform similar tasks for submission.

Figure 17 Optical Illusion

10. Microwave on fluorescent lamp

This task was for higher standard students and for those who were not able to perform other tasks. In this task, a YouTube video link was given. The video shows a fluorescent lamp glows in the presence of microwaves. Students had to understand why that happens. [8] It happens because microwaves excites the mercury vapours in the fluorescent lamp and emit UV light later white coating inside of the lamp converts it to white light which is visible.

11. Sky is blue

Sky colour is blue because of the scattering of the light, this task shows the same. Water, milk, flashlight, and transparent container were required for this task. Students had to mix water and milk in different proportions and they had to observe the light passing through it and at the end of the container. As the concentration of milk (scattering particles) increases light at the other side of the container shifts to red, this shows blue light scatters (Figure 19) more the same which happens due to atmosphere of earth.

Practical result of Sky is blue

Figure 18 Sky is blue

12. Make a Rainbow

We generally see a colourful rainbow after the rain. In nature, a rainbow is formed when sunlight is refracted on entering a droplet of water, reflected inside the back of the droplet, and finally refracted again when it leaves the droplet and disperse into seven colours (Figure 19).

A task was given to students to make a rainbow at their home and observe the science behind it. One of the ways recommended was the formation of a rainbow using a Compact Disk (CD). Like water drops in the falling rain, the CD separates white light into all the colors that make it up. The colors we see reflecting from a CD are interference colors, like the shifting colors you see on a soap bubble or an oil slick. You can think of light as being made up of waves-like the waves in the ocean. When light waves reflect off the ridges on your CD, they overlap and interfere with each other. Sometimes the waves add together, making certain colors brighter, and sometimes they cancel each other, taking certain colors away. Students had to do the same they had to place a CD in direct sunlight and focus the light reflected by it on a paper to obtain a rainbow. [9] [10]

Figure 19 Making a Rainbow

13. Dispersion of light

Dispersion of Light can be defined as the splitting of white light when it passes through a glass prism into its constituent spectrum of colors. Students were asked to perform a couple of tasks based on the concept and sense the science behind it. Some of the tasks were like

Making a prism: in which they have to make a triangular prism using transparent plastic sheet and transparent adhesive tape. They have to fill water in the prism to disperse the light

Formation of a rainbow: students have to place a mirror in the water in a transparent container at an angle which also acts as a prism. Mirror placed in the water reflects the white light and due to change in refractive index white light disperses. (See References [11])

14. Image formation through lenses and mirrors

Real and Virtual Images can be formed using lenses and mirrors. High diopter spectacles and spoon can be used to form Images. In this task, students had to observe the formation (size, position, clarity) of the image using things at home. In this task students had to form the image on the screen using things at home. Concave and

convex lenses/mirrors form different images when distance between object and lens/mirror is changed. Students had to form images by doing so either for lenses or mirrors (Figure 20).

Figure 20 Image formation through lenses and mirrors

15. Find the Color values

This task is based on the RGB color model (Additive color model). By mixing Red, Green, Blue colors in different proportions a broad array of colors can be produced. Different color samples were given to the students (Figure 21). They had to make the same colors as given by using RGB color app where they can set different values of RGB to make colors and observe the effect of increasing values of colors on each other.

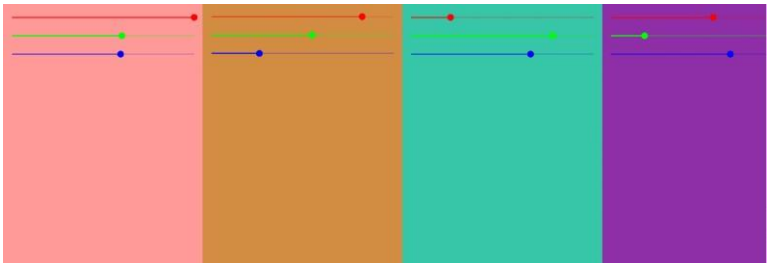


Figure 21 Understanding the Color Values

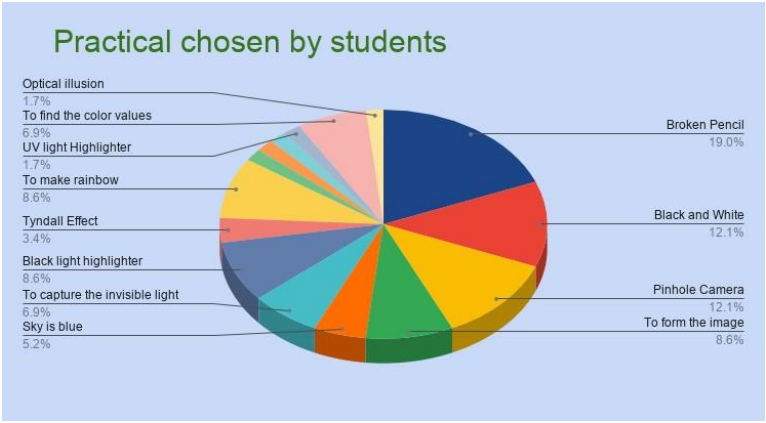


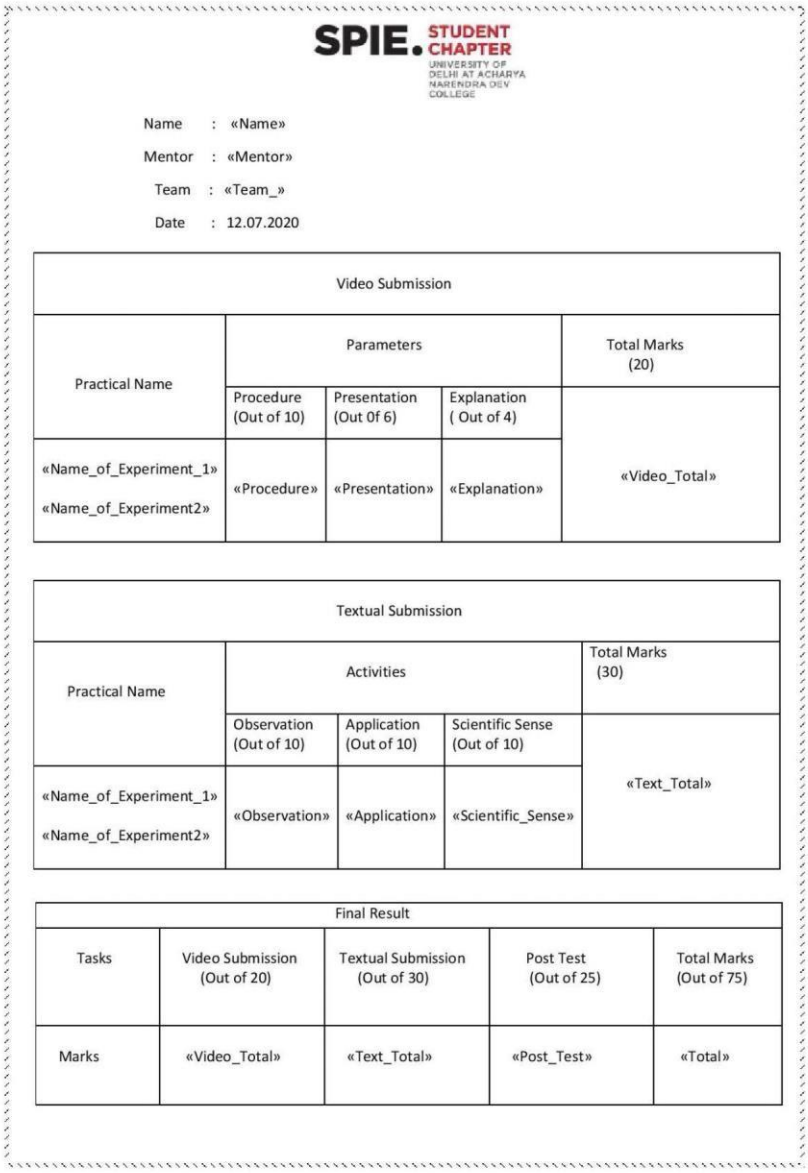
Figure 22 Following pie graph shows the interest of the students on various practical.

3. RESULTS AND DISCUSSION

Understanding of the students was measured based on their performance at each stage of the event. Students were evaluated on the basis of their following submissions.

1. Video submission made by the students where they had to record their videos of the chosen tasks.
2. Textual submission where students had to submit all the inquisitive questions that came while doing the experiment.
3. Lastly students had to go through a Post-test.

Following form gives the details of the evaluation process.



SPIE. STUDENT CHAPTER
UNIVERSITY OF DELHI AT ACHARYA NARENDRA DEV COLLEGE

Name : «Name»
Mentor : «Mentor»
Team : «Team_»
Date : 12.07.2020

Video Submission				
Practical Name	Parameters			Total Marks (20)
	Procedure (Out of 10)	Presentation (Out 0f 6)	Explanation (Out of 4)	
«Name_of_Experiment_1» «Name_of_Experiment2»	«Procedure»	«Presentation»	«Explanation»	«Video_Total»

Textual Submission				
Practical Name	Activities			Total Marks (30)
	Observation (Out of 10)	Application (Out of 10)	Scientific Sense (Out of 10)	
«Name_of_Experiment_1» «Name_of_Experiment2»	«Observation»	«Application»	«Scientific_Sense»	«Text_Total»

Final Result				
Tasks	Video Submission (Out of 20)	Textual Submission (Out of 30)	Post Test (Out of 25)	Total Marks (Out of 75)
Marks	«Video_Total»	«Text_Total»	«Post_Test»	«Total»

Figure 23 Marking Format

3.1 Evaluation Scheme

3.1. Scientific Sense Grading

This is a part of textual submission in which student write their observation of optical activity. Marks are given out of 5 for each activity and thus 10 for both. For A+ grade, student has to score between 8 and 10. Similarly, students have to score marks for a specific grade as shown in Figure 24. Textual submission was the first part. This Scientific Grade divides the students into categories on the basis of their self-understanding of concepts. This grade system is very helpful in order to analyse performance of the students and track the record of each student. Below is a bar graph between the number of students and grades achieved by students in this section.

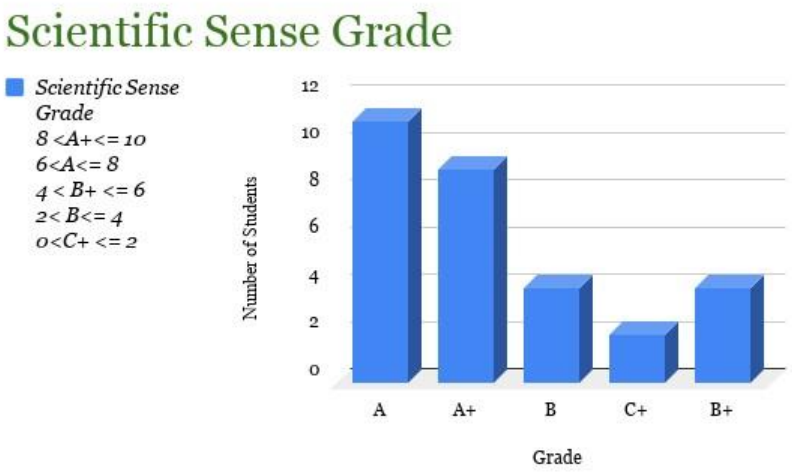


Figure 24 Textual based Evaluation

3.2. Video Activity based evaluation

Student had to record their video while performing an activity and explain the queries that came to their mind. They were judged on the three-parameter i.e. procedure (out of 5), presentation (out of 3) and explanation (out of 3) for each activity. Based on three parameters students were evaluated. Figure 25 shows the bar graph between the number of students and the corresponding grades achieved by students for two activities.

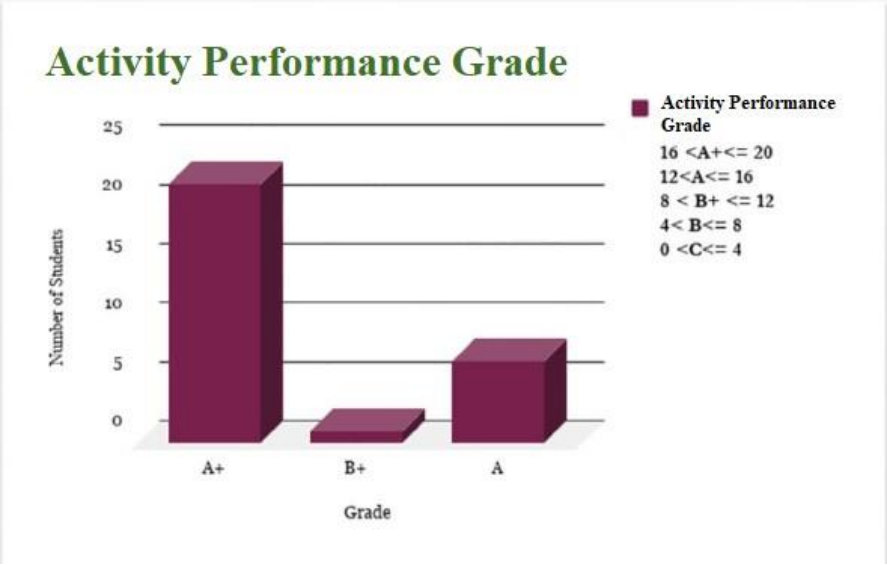


Figure 25 Video Activity based Evaluation

3.3. Post – Test Grade- The post-test grades are as shown in Figure 26.

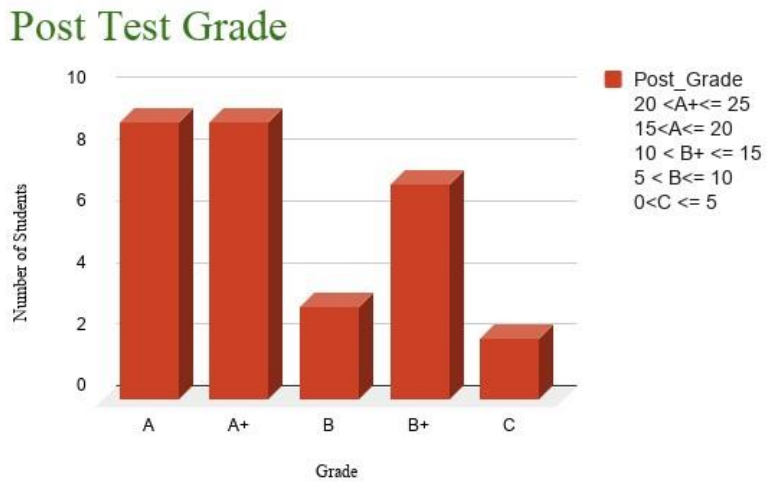


Figure 26 Post Test Grades

3.4. Overall Grade that indicate the overall performance of the student are as shown in Figure 27.

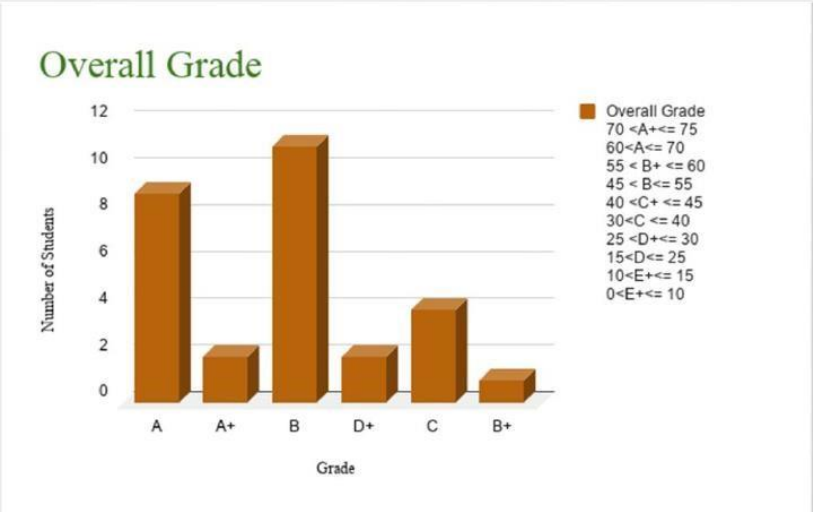


Figure 27 Overall Grades

Out of 29 participating students, 10 students scored A in the scientific sense grade and 8 students scored B. Overall performance of students was good in textual submissions and all students were actively participating. The students' performance in Video submissions was absolutely brilliant with more than 20 students scoring A+ in the Activity Performance grade. No student scored C or below, which implies that students enjoyed performing these activities the most and thus getting hands-on experience. Post-test grade reflects the understanding of students throughout this programme. So, in a way it can be considered as an efficiency parameter of the whole activity. Post-test was unique to every student and was based on the activities selected by the student. As seen from figure 14, around 60% of students, scored an A or A+ in post-test grade and them another 25% got B+, which depicts the increased level of understanding of students. Overall grade is obtained by clubbing all the above grades and is the final assessment result. As seen from Figure 15, more than half of the students acquired an overall grade of A, A+ and B. Maximum possible marks were 75 and to get an A, student had to score at least 60 and 8 students managed to score A. More than 10 students got B which means that they scored between 45 and 55.

4. CONCLUSION

Video submitted by the students showed great enthusiasm and zeal to participate and learn new things. As evaluated by the video submitted by students it can be concluded that most of the students were able to grab the concepts but being kids could not express well in online test. The motive of the pedagogy was to develop a scientific sense among students through self-thinking and exploration. It did not only give birth to curiosity towards science but also brought a pleasant fun experience during their learning path. This activity might be the kick start to their career as a budding scientist as most of the students built an excellent perception. Overall performance and curiosity of the students were very satisfying. Students among them had an outstanding performance and enthusiasm that facilitated smooth conduct of activity in virtual mode. The focus towards practical hands-on experience was successfully achieved even under the COVID-19 pandemic situation although comparatively lesser students were able to take part. Although it has been harder to conduct practical activities at a few locations but the enthusiasm of self-doing innovatively shifted the students to practical world over the rote theoretical learning with no proofs.

5. ACKNOWLEDGEMENT

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FEEDBACKS FROM THE STUDENTS

ANDC HAS ALWAYS BEEN ACTIVE IN EDUCATIONIST PROGRAMS AND EVENTS AND I HAVE BEEN ONE OF THE WITNESS OF THOSE BEWILDERING EXPERIENCES SINCE I WAS IN 9TH CLASS. I WAS SEEMINGLY HAPPY TO KNOW THAT THEY FOUND A WAY FOR ANOTHER SUCH IN TIME OF PANDEMIC. AS FAR AS THE PROGRAM IS CONCERNED, IT WAS AGAIN TREMENDOUS. TRULY GOT TO ENRICH MY KNOWLEDGE ABOUT OPTICS. I WOULD LIKE TO SEE ANDC EXPANDING THEIR HORIZON OF EVENTS DURING NEXT YEARS JUST LIKE THE INTELLECTUAL PROPERTY EVENT THEY CONDUCTED LAST YEAR.

I FIND A VERY GOOD EXPERIENCE DURING THIS PROGRAM. I WAS ABLE TO UNDERSTAND EVERYTHING THAT WAS EXPLAINED BY THE TEACHERS.

IT WAS NICE EXPERIENCE AS I HAVE LEARN THAT THERE ARE MANY LIVE PRACTICALS WHICH WE CAN DO EASILY AT OUR HOME

THE EDUCATION SYSTEM NEEDS A TRANSFORMATION TODAY. WE ARE STILL STUDING VIA AGE-OLD METHOD OF TEACHING. HERE ARE CERTAIN SUGGESTIONS.
1. WE SHOULD EMPHASIZE ON PRACTICAL LEARNING
2. TRANSFORMING THE EDUCATION PATTERN BY INCLUDING VACATIONAL COURSES AND PROFESSIONAL COUSES.
3. MORE EMPHASIS ON SKILL BASED LEARNING AND PROMOTING ENTREPRENEURIAL SKILLS IN THE STUDENTS WITH THERE BASIC CHANGES WE CAN LAY THE FOUNDATION OF STRONG FUTURE AND GENERATE MOVE EMPLOYMENT

I LIKE THIS PROGRAM VERY MUCH I LIKE THAT YOU APPRECIATE US TIME TO TIME AND HELP US 24*7 AND I LIKE MY MENTORS AND HELPERS AND IN THIS PROGRAM I COKE TO KNOW THE SCIENCE CLOSELY IN MY DAILY AND I WANT TO GIVE ONLY ONE SUGGESTION THAT IS YOU SHOULD ORGANISE THIS TYPE OF PROGRAM EVERY YEAR.

MY EXPERIENCE WAS GREAT. ACCORDING TO ME THIS IS A GREAT LEARNING OPPORTUNITY AND ONE SHOULD NOT MISS IT. IT MADE ME UNDERSTAND THAT SCIENCE IS NOT ONLY ABOUT LEARNING THINGS BUT THAT THERE IS A FUN ELEMENT IN IT. THE EXPERIMENTS I DID WERE REALLY THRILLING, EXCITING AND MADE ME MORE INTERESTED TOWARDS SCIENCE AS A SUBJECT. IT MADE ME UNDERSTAND THAT SCIENCE WAS ALWAYS FUN AND WILL ALWAYS REMAIN LIKE THIS AND THAT IS THE REASON THE SCIENTISTS IN THE PAST HAVE MADE GREAT INVENTIONS AND DISCOVERED NEW THINGS WHICH WE DID NOT KNOW BEFORE. I GOT TO LEARN A LOT OF NEW THINGS AND LEVELED MYSELF UP. THIS COULD HAVE BEEN BETTER IF THERE WAS NO SUCH PANDEMIC IN THE WORLD RIGHT NOW BUT EVEN AFTER BEING AT HOME MY LEARNING FROM IT WAS AT ITS BEST. HENCE I APPRECIATE THE EFFORTS MADE BY THE EVERYONE CONDUCTING THIS PROGRAM. HENCE IT WAS A GREAT EXPERIENCE FOR ME PERSONALLY.

MY SUGGESTIONS ARE SUCH PROGRAMS SHOULD HAPPEN MORE OFTEN IN AN YEAR AND MORE STUDENTS SHOULD BE MADE AWARE ABOUT THIS PROGRAM.

IT WAS A WONDERFUL EXPERIENCE TO BE A PART OF SUCH EDUCATIONAL, INNOVATIVE AND KNOWLEDGEABLE PROGRAM. I REALLY LOVED THE WAY TO UNDERSTAND DIFFERENT.

IT'S REALLY HELPFUL AND FANTASTIC INITIATIVE FOR VISUALISATION OF OPTICAL FOR STUDENT OF EVERY STUDENT.

YOU ALL WERE WAY TOO GOOD.GREAT MENTORS. EVEN AFTER THIS PROGRAM I AM GOING TO BE IN TOUCH WITH YOU ALL. REALLY HELPING. REALLY LEARNED A LOT FROM THIS. JUST ONE SUGGESTION THAT YOUR INLINE LIVE CLASSES WOULD HAVE BEEN SUCCESSFUL IF YOU HAD USE ANOTHER APP LIKE ZOOM.I LOVED THE WAY YOU ALL INTERACTED.REALLY APPRECIATE YOUR EFFORTS.

IT WAS AWESOME. YOUR EDUCATION PROGRAM IS SO PERFECT SO NO SUGGESTIONS ARE NEEDED.