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STATISTICAL ANALYSIS OF ONLINE LEARNING FOR EDUCATION DURING A PANDEMIC

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Abstract— The whole education system from primary to tertiary level has worsened during the lockdown period of the novel coronavirus disease COVID-19. The start of the pandemic has seen many crucial changes in human history. The COVID-19 pandemic has strongly impacted education. It has collapsed the education system. It has resulted in schools shutting down across the globe and impacted every child's education and growth. The complete education system has been shifted to the online mode which leads to the distinctive rise of e-learning. This pandemic is directly affecting the future of the current generation as the use of e-learning has increased significantly since COVID-19. This paper analyses the positive and negative impacts of the pandemic on education. The paper utilizes both quantitative and qualitative ways to study the characteristics and context of e-learning as experienced by both students and teachers. This paper concentrates on the impacts of the pandemic on children's learning, the role, and capacity of teachers in online methods, and the processes of teaching activities incorporated into the studies. To examine some areas of education in the pre and ongoing pandemic period, hypothesis testing is used. This also includes the relationship between students and teachers, the role of digital technology in impacting the pedagogy, and the solution bridge between the learning gaps.

Keywords— Covid-19, Online Education, Online Teaching Methods, E-learning, Hypothesis, Correlation and Regression, Z- test

I. INTRODUCTION

The Sustainable Development Goals are the blueprint of dignity to achieve a sustainable and better future for all. The United Nations General Assembly established these goals in 2015 and set a goal to be achieved by 2030. These goals are the universal appeal of action to protect the planet, end poverty, ensure complete literacy which ensures that every child has access to education, and ensure that everyone lives in peace and prosperity.

Each goal has the importance of its own and is dependent on each other by social incorporation, and environmental and economic sustainability. These goals promote social mobilization, with a focus on putting pressure on political leaders, spreading a network of expertise, knowledge, and practice into action, establishing a network across countries, sectors, and areas, coming together as considering the earth as their home. In this paper, Goal 4: "Quality Education" has been taken into consideration, it aims to "Ensure inclusive and equitable quality education and encourage lifelong learning opportunities for all," [1].

Since 2000, there has been high progress towards achieving this universal target "Quality Education" [2]. There is an increase in the rate of enrolment in both urban and rural areas reaching 90% in developing areas in 2005, and a key step is the gross enrolment of girls also increased, which is a



remarkable achievement. The biggest challenge in achieving this goal is a prominent level of poverty, narrow-minded thinking, and armed conflicts. Obtaining an inclusive and high-quality education reinforced the belief that education is one of the most powerful tools for long-term growth. It assures that both girls and boys complete primary and secondary education by 2030 by offering equal opportunities, inexpensive vocational training, and universal access to high-quality education, all of which serve to reduce gender, caste, and wealth inequities [3].

COVID -19 is a highly contagious sickness or disease caused by the severe acute respiratory syndrome coronavirus, which started in Wuhan, China, and has since spread to every corner of the globe, threatening civilization [4]. Because of its intensity, COVID-19 is described as a pandemic and one of the largest global health crises in human history. Everything was on hold because of the ability of the virus to spread easily. This halt led to the collapsing of economy, and improper education.

COVID-19 has impacted all the facts of Goal-4 which had impacted the complete education system. Approximately 260 million children including students are impacted by this pandemic which made the situation worst [5]. As it is a communicable disease that spread at an extremely high rate the education system has shifted to online mode because of shutting down of all education institutes for an indefinite time as there is no other option left. The only way that was visible to restrict or control the virus was to control the movement of people, which arose online education changing the entire definition of the learning and teaching process. Nowadays, Lockdown is the most common rule that is implemented as soon as the coronavirus cases increase in a particular region.

Formal and non-formal form of education is tremendously affected. This is the only time to ponder on the education system [6]. The shifting of education from traditional to completely modern digital mode on zoom, google-classroom, and teams, from seminars to webinars. Previously e-learning is considered a non-formal mode of education, but it completed changed to the formal mode of education till the situation becomes well. One of the e-learning application which makes a revolution of them are e Start.me, Neo, Class time, Google Classroom, Backpack, Pronto, Skill share, Blackboard Learn, Parlay, and many more. However, it fosters children's curiosity at the same time. It is a situation in which both students and teachers feel compelled to embrace e-learning. Students are continuing their studies in digital mode, but there is a risk of cyber-attacks on these platforms, which provide an increased risk of a data breach, resulting in the loss of educational possibilities. COVID-19 is causing an enduring impact and threat to the education system from primary to tertiary education.

The digital model is impacting the psychological stress, efficiency of studies, and learning process of every individual. Continuous classes, assignments, and online competitions lead to an increase in screen timing. The life of students is under

constant pressure and work through online education. The exposure gained in physical mode, the experience with peers and teachers, and activities that involve personality development are missing in the digital model. Due to a sudden shift in the learning model, children and students have lost this opportunity to experience their school and college life. Education entails not only classroom learning but also learning about everything and everything. Children today live a sedentary, anxious, and depressed existence compared to pre-Covid eras. Furthermore, this period has seen a rise in computer usage and a decline in physical exercise [7].

The challenges faced by the students and the teachers during the online mode of studies have been described with the help of a hypothesis test. The hypothesis can be defined as an explanation for an observable event. In general, it is an idea that can be true or false based on evaluation criteria which is some pre-defined test and methods. If the hypothesis is true and confirmed it can be useful in some predictions or can expand to become a theory itself. Mostly, hypotheses have a mathematical model but sometimes, they can also be presented as statements. A useful hypothesis enables us to do predictions by efficient reasoning. While framing a hypothesis, one does not know the result of a test or survey done based on that hypothesis. In such cases, the test or survey potentially increases the probability of showing the truth of the hypothesis [8].

II. OBJECTIVES

To study the quality of education during the pandemic by analyzing the positive and negative impacts of online education. The following objectives are taken into consideration: -

- To study the efficiency of studies and topic clearance before and during Covid-19.
- To study and examine the performance of students during pandemics.
- To analyze the various aspects that affect the education system due to pandemics.

III. METHODOLOGY

We analyze 'students' and 'teachers' impressions of the online teaching and learning process using both qualitative and quantitative approaches.

3.1 Sample and population

Various students of different institutions have been taken participation in the online survey which was further considered as "Population." There were students from different fields such as Computer Science, BBA, Design, M Tech, and others. A total of one hundred ninety-six students participated in the survey to assess their perception of the process of e-learning and online class. All the respondents are permanent students of Indian nationality. They were all engaged in a regular educational program.

3.2 Procedure of data collection



A questionnaire was created to evaluate the students' perceptions of e-learning for quantitative and qualitative analysis. Various factors were taken into consideration such as perception, experience, and opinion regarding the current scenario of the e-learning process. We have also collected valuable suggestions, experiences, and feedback while collecting the data. For both quantitative and qualitative data, descriptive statistics were used to analyze data acquired from various references and resources.

To study the effects of Online Education, secondary data of 350 students have been collected from “Kaggle”, which help us to carry forward the study. The data was studied in three different geographical areas which are Urban, Suburban, and Rural.

Table 1: List of Questions asked in an online survey

Sr. No.	List Of Question	Result
1	Online Class Rating (out of 5)	3
2	Medium of online classes	Laptop
3	Time spent on studies before Covid-19	5-7 hrs.
4	Time spent on studies during Covid-19	3-5 hrs.
5	Network issues faced during online studies	Moderate
6	Sleeping hours before Covid-19	6-8 hrs.
7	Sleeping hours during Covid-19	7-9 hrs.
8	The efficiency of studies before Covid-19 (out of 5)	4
9	The efficiency of studies during Covid-19 (out of 5)	2-3
10	Topic clearance before Covid-19 (out of 5)	4-5
11	Topic clearance during Covid-19 (out of 5)	4-5

	primary education	
3.	Are there students who stopped enrolling in secondary education	45
4.	Can students observe the deterioration of basic services in school	246
5.	Do the school and the teachers have a proper internet connection	237
6.	Concept clearances	79
7.	Did teachers leave the educational system	192
8.	Do children have an internet connection	281
9.	Electricity issue	167
10.	Does the home show a severe deficit of electricity	0

3.3 Findings

This section describes the objective-wise analysis of the data collected.

Objective 1

To analyze objective 1, a survey was conducted to calculate the percentage and ratios of efficiency and topic clearance while studying and their outcome during the pandemic. In this questionnaire, we collected data related to the devices used by the students and their impacts were analyzed. We analyze the relationship between the efficiency of studies and the topic clearance before and during the pandemic by using correlation and regression. This method is useful in finding the interdependence and outliers between the two entities. For this, we build a hypothesis that claimed that efficiency and topic clearance are correlated to each other by analyzing python using the Pearson method. Below Fig 1 represents the pattern of data collection and how it is analyzed.

Table 2: Representation of Questions of secondary data

Sr. No.	List of questions	Score
1	Online Class Rating (out of 5)	1
1.	Were students 3 to 17 years enrolled and did not return to school	190
2.	Are there students who stopped enrolling in	51

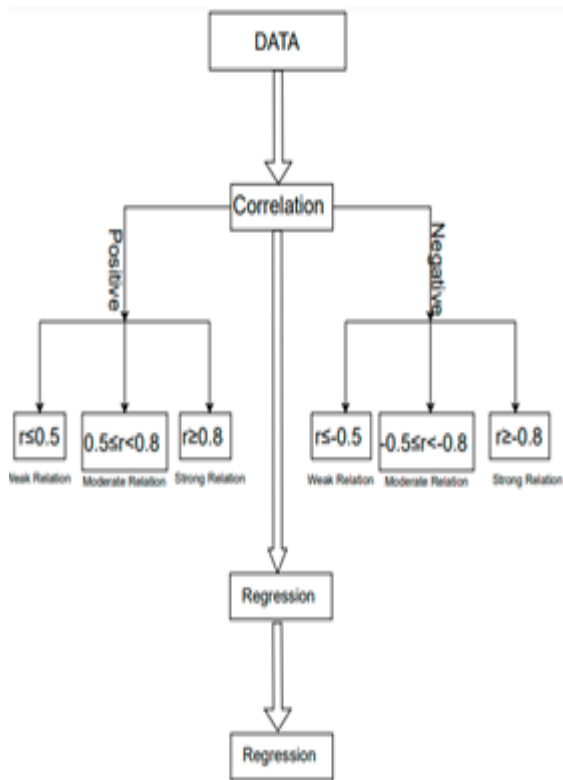


Fig. 1. Correlation and Regression flow chart

Objective 2

To acquire the results of objective two i.e., to study the performance of students by analyzing the time devoted to their studies and factors that impact their study time. In this questionnaire, we collected data about how much time the students devote to their studies and the network issue they face while studying. The main aim is to identify the impact of network issues on study duration. According to the report launched by ACT (American College of Testing), it shows that about two-thirds of first-year students struggle with online learning during a pandemic [9]. There could be several reasons behind their struggle like network issues, unaffordable electronic gadgets, lack of technology knowledge, and many more.

Objective 3

Students are the future of our nation and to build a powerful country the foundation of students should be extraordinarily strong which can be done only by giving them quality education. When COVID-19 started to spread across the globe schools and colleges were among the first sectors to shut down and no one was aware that this pandemic will last so long. The effect of the pandemic on education was worse than anyone thought. After waiting for a few months, the whole education system shifted to online platforms. Due to online classes at

once the education got started but after some time it was realized that the efficiency of learning was highly decreased, students lacked the practical knowledge and had long sleeping hours, which have affected their mental and physical strength. Due to a lack of resources mostly in rural and suburban areas students cannot return to education in online mode. Through the below pie chart, we have represented the percentages of students who enrolled in schools earlier but now they skipped. Through this objective, it will get clearer the effects of Covid-19 with statistical values.

IV. ANALYSIS

To analyse the outcome, a hypothesis test is used. In objective 1, correlation and regression tests are used on the sample of 196 students to find the relation between the efficiency of studies and topic clearance before and during the pandemic as seen in Table 3.

In objective 2, the proportion test is being used to find the fact that efficient sleep improves performance as seen in Table 4.

Table 3: Analysis of the efficiency of studies before and during Covid-19

OBJECTIVE - 1		
Null hypothesis (H ₀)	$\rho=0$ (ρ =efficiency of studies and topic clearance are not related)	$\rho=0$ (ρ =efficiency of studies and topic clearance are not related)
Alternative Hypothesis (H ₁)	$\rho \neq 0$	$\rho \neq 0$
Level of Significance (α)	0.2	0.2
Test Statistic		
Sample Size (N)	196	196
Correlation Coefficient (r)	0.671	0.732
Z _{$\alpha/2$}	1.282	1.282
Z	11.32	12.92
Criteria of rejection	Null hypothesis rejected	Null hypothesis rejected
	$ Z > Z_{\alpha/2}$	

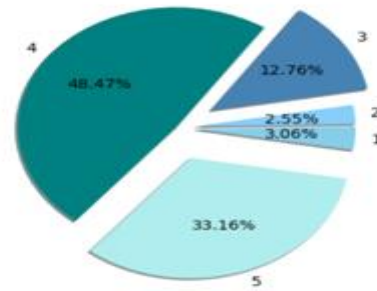
Table 4: Analysis of the performance of students during the pandemic

OBJECTIVE - 2		
Parameters	During COVID-19	Parameters
Null hypothesis (H ₀)	po<=53.06% (PO = at most 53.06% of network issue leads to a decrease in study time)	Null hypothesis (H ₀)
Alternative Hypothesis (H ₁)	po>53.06%	Alternative Hypothesis (H ₁)
Level of Significance (α)		
Test Statistic		Test Statistic
Sample Size (N)	196	Sample Size (N)
Proportion (p)	36.26%	Proportion (p)
Z _{α}	1.645	Z _{α}
Z	-5.701	Z

V. RESULT AND DISCUSSION

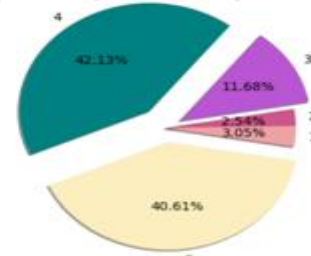
All the graph plotted for the analysis has been done with the help of python using 'The Matplotlib library. Objective-1 analysis shows that the correlation coefficient is 0.671 and 0.732 before and during pandemics, respectively. This shows that there is a moderate relation between the efficiency of studies and clearance in the topic. It shows that whatever the mode (in-person/virtual) of the classes, the relation is valid.

Efficiency scale (5:Excellent, 1:Poor) (before covid-19)



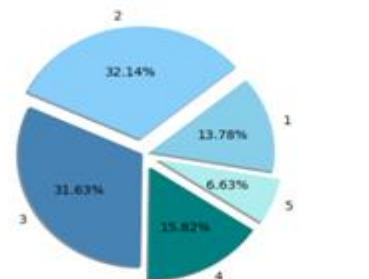
(a)

Topic clearance [5:Excellent, 1:Poor] (before Covid)



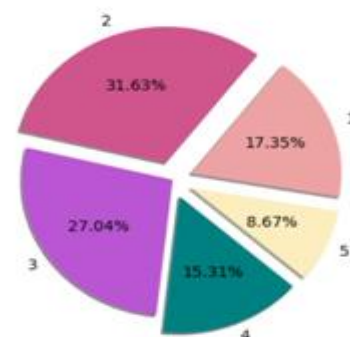
(b)

Efficiency scale (5:Excellent, 1:Poor) (during covid-19)



(c)

Topic clearance [5:Excellent, 1:Poor] (during Covid-19)



(d)

Fig. 2. (a-d): Pie Charts on the topic clearance and efficiency before and during Covid



In Figure 2, a and b part explains that the efficiency of studies is more in the physical classes, which is why the clearance in the topic is more. On the other hand, virtual classes have decreased the efficiency which in turn affects the topic clearance as seen in the c and d parts of Figure 2. Hence, there is a moderate correlation between the efficiency of studies and topic clearance.

Regression line:

The graph has been plotted with the help of python and the regression line equation will be used to make predictions.

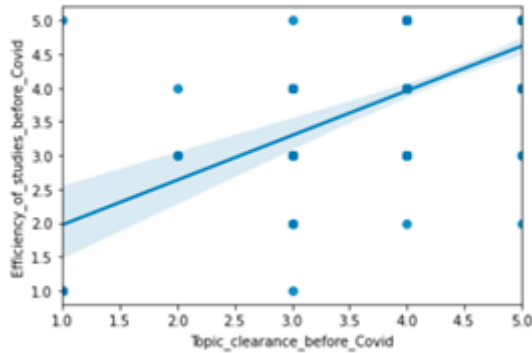


Fig. 3. Regression line between topic clearance and efficiency of studies before covid

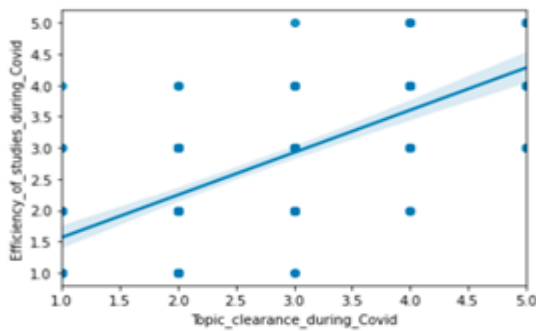
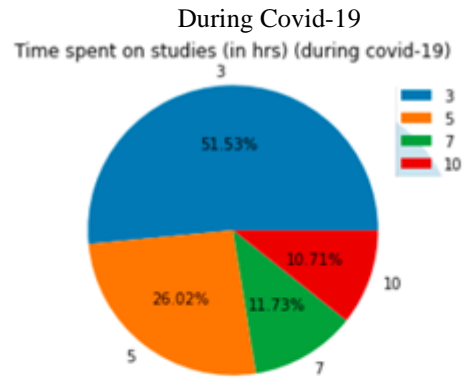


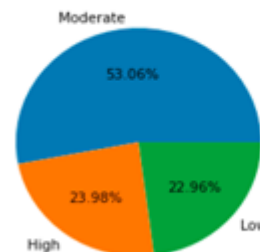
Fig. 4. Regression line between topic clearance and efficiency of studies during covid



The regression equation is
 $Efficiency_of_studies_before_Co = 1.313 + 0.6609 \text{ Topic_clearance_before_Covid}$

(b)

Network issue

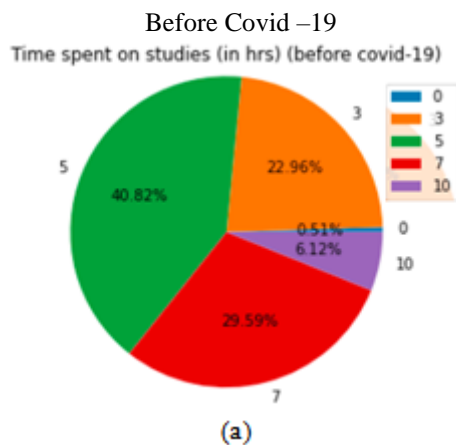


(c)

Fig .5. (a-c): Pie charts on time spent on studies before and during COVID-19, and network issues faced during studies

Table 5: Percentage of study hours and network issue

5 hrs. study % (Before CO VID-19)	5 hrs. study % (During COVID-19)	
40.82	26.02	
NETWORK ISSUE		
High	Moderate	Low
23.98%	53.06%	22.96%



(a)

According to our survey on the cohort of 196 students, it is found that there is a reduction in the study duration during the pandemic. Before COVID-19 about 40.82% of students spend 5 hrs. per day to studies but during COVID-19, it has been decreased to 26.02%. This means that the time spent on studies has been reduced by 36.26% during COVID-19. It has been claimed that due to moderate network issues faced by at



most 53.06% of students, there is a reduction in the study duration during a pandemic.

In our data, there were 4.08% students of age-group 8-15 years devotes an average of 8.75 hours and 6 hours to studies before and during the pandemic, respectively. There were 95.02% students of age group 16-23 years devotes an average of 5.48 hours and 4.69 hours to studies before and during the pandemic, respectively from the above analysis (Figure 5(a-c) and Table 5) it can be concluded that at least 53.06% of students are facing moderate network issues. This shows that it can be the main factor for the decrease in the study duration during the pandemic.

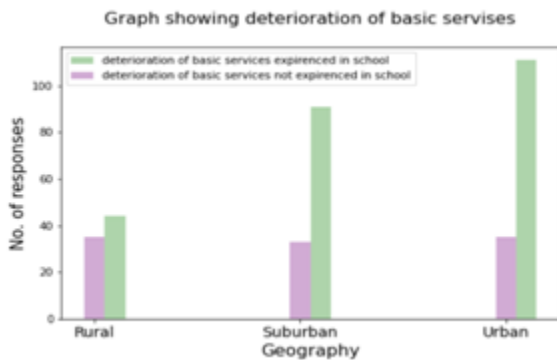


Fig. 6. No. of responses & deterioration of basic services

54.44% of the students resumed their studies, and 45.56% skipped. Many people lived their lives as daily wage workers; in the lockdown, it was difficult for them to pay for their meals; in these situations, it was impossible to afford online studies resources for their children.

Further, we have tried to analyze how many students have enrolled and skipped primary and secondary education in rural, suburban, and urban areas.

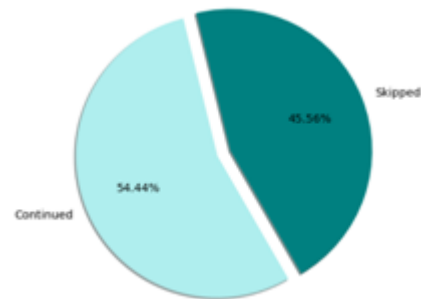


Fig. 8. Graph showing deterioration of basic services

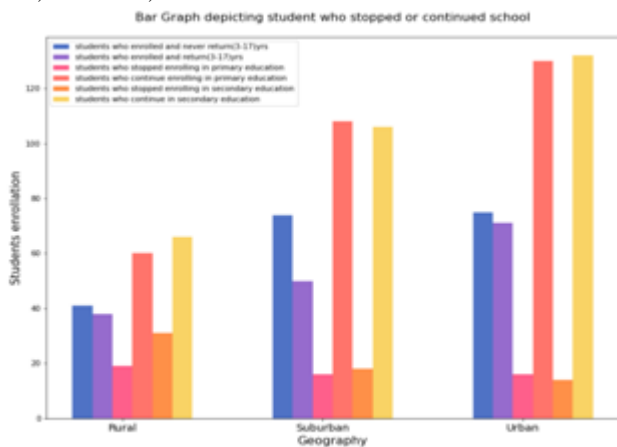


Fig. 7. Bar graph depicting students who stopped or continued school

From Figure 7, the enrolment scenario in rural, urban, and suburban areas has been described easily. The graph shows

that the number of students who enrolled and never returned to school was the highest in suburban areas, followed by rural and then urban. Few parents in rural areas did not give importance to primary education and due to a lack of knowledge of the online mode of education enrolment process was decreased. Few were not that eligible to pay the high fees of online classes. Every household does not have internet connections and the electricity bills that were generated during the lockdown period were expensive as all the devices need to charge due to heavy usage and not everyone can afford an expensive bill. These are the few reasons that primary and secondary education was skipped in those areas. But to study the whole graph we can say that most of the students continued their studies.

For example, for a particular subject, 4 teachers were assigned to 200 students but if 2 teachers were terminated or resigned it is difficult for the remaining teachers to handle all 200 students because of this they cannot pay attention to each of the students properly. Even many parents' jobs got lost and due to these students must leave their studies and must search for jobs. The below graph is showing the deterioration of basic services.

The deterioration observed by students in different areas has been shown in Figure 8. It is observed that the deterioration rate was highest in the urban areas and then followed by suburban and rural areas. The reason is that in urban areas the facilities provided in the schools include cleanliness, availability of drinking water, maintained playground sports, and more as their basic amenities. Students also observe that in online mode it is difficult to do practice tests and when few schools reopened due to a lack of assistance, teachers, and management process, this tends to inadequate quality of education. In government schools, students were provided with the midday meal, but due to corona, all these basic amenities were affected as all the workers who were engaged in these activities were rural people who came to urban areas to earn a living but due to corona, they had to return to their native village due to lack of work and now they have begun with some other work in their villages as the on-going situation does not allow schools to reopen any time soon.

In the education system, teachers play a vital role to educate many peoples and sharing students' stairs to achieve goals. But

what if their ratio gets decreased or they will not be able to take class properly, it happened in this pandemic.

Pie Chart showing percentage of teachers not available at scheduled class time

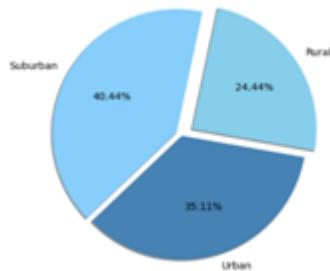


Fig. 9. Pie chart showing the percentage of teachers not available at scheduled class time

Figure 9 shows that 40.44% of teachers in suburban, 24.44% in rural, and 35.11% in urban areas were not available. As no one was aware of this pandemic, teachers never let down the efficiency of sharing knowledge. Most of the teachers were not acquainted with the online teaching platform, but they managed and learn all of them so that the teaching process could be unstoppable. Even the ratio of teachers who resigned or got terminated by schools and colleges is almost the same in all areas.

Graph showing teachers resigned the schools

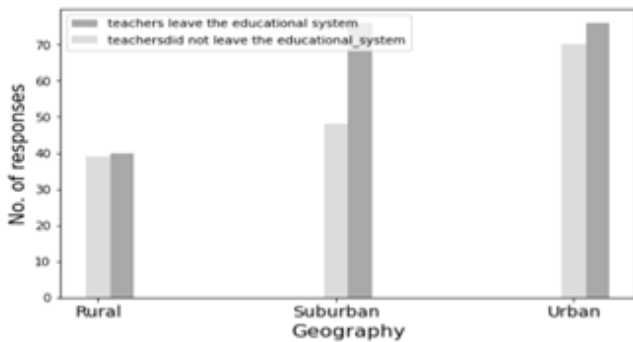


Fig. 10. Bar Graph showing teachers resigned the schools

Most of the teachers are above 40 years and, due to their poor health condition and more pressure on them tends to lose their health. But after vaccination, teachers are coming back to hit their target.

Bar Graph depicting concept clearances and network issues

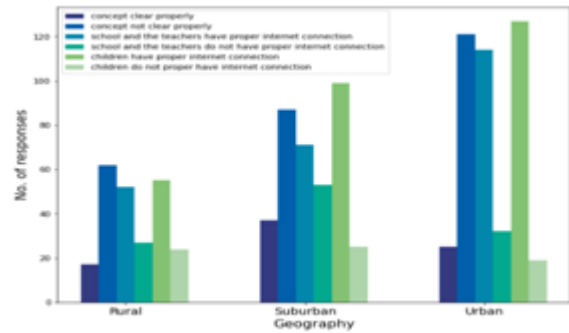


Fig. 11. Bar graph depicting concept clearness and network issue

Figure 11 shows whether topics were cleared to students or not. The topic clearing of students was highly affected due to disturbance in network issues. This led to inefficiency in studies and their performance. In that, it is also observed from the perspective of teachers whether they have access to good bandwidth internet connection or not. The problem was majorly highlighted in rural and suburban areas. Moreover, the Lack of communication gap between students and teachers hindered the concept building of the students. Also, students could not apply the concepts taught to them due to a lack of connectivity. Due to a lack of concentration in the classroom students engaged themselves in other activities such as surfing on social media networks.

The curriculum that was followed before the pandemic was such that it helped students be engaged in co-curricular activities and helps them stay active in their studies and refresh mentally. The below graph shows regular curriculum is followed or not.

Pie Chart showing regular curriculum is followed or not

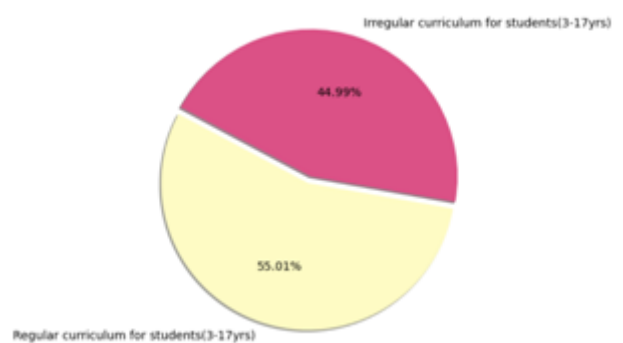


Fig. 12. Pie chart showing regular curriculum is followed or not

Figure 12 brings us to the conclusion that only 55.01% of the students agree that the lockdown and pandemic have not affected the curriculum of the school that they were following whereas 44.99% of the students have experienced a change in the curriculum during the lockdown. Which has affected their



mental health because now their screen timing has increased, and they do not have any activity in between which makes the lecture very boring and makes it difficult for them to concentrate on their studies.

VI. DISCUSSION

In this paper, we examined the students' and teachers' perception of the online learning-teaching methods during the COVID-19 pandemic. It has been discovered that the initiative for online education began with government guidelines. The education followed the received instruction, but for an effective outcome, various challenges were faced. During the pandemic, the complete schedule of both students and teachers was drastically affected. The screen time increases to a great extent which leads to eye strain and early tiredness which results in a decrease in their performance and effective learning. The sleep and academics of a student are interdependent. The students were unable to focus on their studies as they were facing lots of network issues which leads to a reduction in their study time. It leads to a downfall in their performance and efficient learning. Again, there were various online teaching-learning tools like YouTube, Unacademy, etc. accessible to professors and learners which were put to requirements-based use. This is again a factor that increases screen time and the performance of studies. Most of the teachers received hands-on training due to which it was difficult for them to deliver the knowledge on online mode. The difference between face-to-face and online modes of teaching was liberated during training. It was a challenging task to use modern technology and efficiently continue with them. Due to the topic being delivered through online mode, it was inefficient which leads to the loss of interest of students in classes. The students were not able to inculcate what had been taught to them and were unable to implement it. This results in a fall in their mental ability and other aspects.

VII. CONCLUSION

The quality of education has worsened significantly during the pandemic due to the shift of education to virtual mode. This leads to the rise of online tutoring platforms and e-learning apps that require advanced technology but there is no one-to-one interaction between student and teacher, which leads to a decrease in the interest of students in studies that directly affects their self-study duration. Network issue is another major reason for the students to lose interest and due to this, they are unable to clear the concepts which have a direct impact on their efficiency. During the pandemic, sleep time increases but this does not emerge as a major factor in increasing the efficiency of the students during a pandemic.

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