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A Case Study about the Impact of COVID-19 at the Level of Mathematics of High School Students in Nepal

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***Abstract*-The shift of teaching-learning practice from in-person to online in Nepal has created a biased opinion in people that the online classes are not effective and such classes have degraded the level of Mathematics. The purpose of this study is to investigate the impact of COVID-19 on the level of Mathematics at high schools in Nepal. A virtual sample survey was conducted in 18 high schools of Nepal to collect information about the availability of technical goods and Mathematics teaching-learning methods.The collecteddata was interpreted using quantitative analysis methods. It was found that the Nepalese teaching-learning system could not cope with the immediate demand for practicality in learning Mathematics. Lacking a feasible internet facility or reliable technical equipment, or having a traditional teaching-learning approach were the reasons. However, the demand for practicality in learning Mathematics has also improved exam-performance and brought a positive change in giving homework to students after COVID-19. Therefore, this study asserts that there is a significant negative impact by COVID-19 on the level of Mathematics in Nepal, but also does not overlook any positive outcomes of online classes. Hence, the study does not fully support the impact of COVID-19 to be negative.**

***Keywords*-biased opinion, level of Mathematics, technical goods,Mathematics teaching-learning methods, practicality**

I. INTRODUCTION

Mathematics is the scientific instrument for study of numbers, patterns, shapes, or anything we can possibly imagine in the universe. It holds the power to rationally answer any problem through imagination, logic, reasoning, and abstraction. It is all around us because we use it in everything we do. Today, from mobile devices to the entire computer technology, money to the entire banking system, small painting to the entire art and architecture, small fitness exercise to the entire modern sports, everything uses Mathematics. Therefore, such a diverse discipline is studied as a separate subject in schools, colleges, and universities worldwide.

The study of Mathematics will be useless for students unless a proper level of Mathematics is maintained. Here, saying proper level of Mathematicsmeans various things: the expertise of students in this subject, students' habit of exploration in Mathematical topics, students' ability to express Mathematical ideas, students' participation in Mathematical events and programs, and so on. And by saying proper, it means that students' level is updated based on time and demand.

In Nepal, it can be seen that there is a good Mathematics curriculum, whether for schools, colleges, or universities, according to Basnet (2018). However, the curriculum is vastly drill and practice oriented, according to Belbase (2019). The Nepalese Mathematical Society (NMS), an organization established with the objectives of enhancing academic excellence in studying, teaching, research, and applications of Mathematics, was founded only in January 1979. Also, the focus on study or research in Mathematics is shallow in Nepal. And Nepalese students have very less trend of participating or doing well in Mathematics competitions. Take an example of the International Mathematics Olympiad (IMO), where Nepalese students have started to take part only from 2017. Also, to date, only two honourable mentions have been bagged by Nepal. [3] From these examples, it is logical to state that the level of Mathematics in Nepal was already poor before COVID-19.

Talking about the study pattern, all the classes after COVID-19 have moved online for any level. Moving all the classes online has significantly changed the practices of teaching and learning of any subject. The same has happened for Mathematics, which has obviously changed the level of Mathematics of Nepalese

students. However, it is quite uncertain about guessing which way the change has gone: a positive or a negative way. Regardless of the continuation of schooling via online methods, people have been quite sceptical about online classes. People have fixed thoughts on online classes that they are not effective and traditional teaching-learning methods are way better than online classes. Even parents and guardians don't accept the teachers' hard work simply because the system has flipped upside down. Also, the students take this system of learning very lightly. However, the opinions of people are quite biased and they may be wrong. The opinions are biased because a lot of factors like teaching style of teachers, learning habits of students, exam performances, etc may have affected people's opinions. Hence, the impact of COVID-19 on the level of Mathematics is unanswered or unfairly responded in Nepal.

Recognizing the problem became the motivation to commence thisstudy. Considering all the classes would make this paper bulky.Hence,only the high school level is considered. The following parameters are used in this studyto assess the level of students in Mathematics (before and after COVID-19).

A. Availability of technical goods

For this parameter, boththe high school teachers and students were asked about their accessibility to technical goods such as computers, unlimited internet, mobile phones, and Mathematical tools.

B. Mathematics teaching-learning methods

B.1 Participation of Students inside and outside Mathematics class

For this parameter, students were questionedabout their participation in Math activities inside and outside of the class. These activities included helping friends, doing homework on time, involving in class discussions, preparing presentations related to Mathematics, participating in Math seminars or workshops or competitions, etc.

B.2 Homework and Exam Assessment

For this section, high school teachers were asked about their homework giving patterns and exam assessment methods. Moreover, they were also asked about the students' overall performance before and after the pandemic.

II. AN OVERVIEW OF THE AVAILABILITY OF MOBILE PHONES, COMPUTERS & INTERNET

Over the last few decades, Nepal has undergone significant growth in mobile technologies and internet. Going long back is not required because the Internet in Nepal was made customary only in 1994. In the same year, the first commercial E-mail service was started. Then, within a year, a lot of private internet companies were founded. This newly found market was extremely promising, which raised an urgency to create an organization that could act as an umbrella for the expansion and operation of Nepal's telecommunication services. As a result, the government of Nepal founded the Nepal Telecommunication Authority (NTA) in 1997. From then on, a lot of private companies have been established, which provide telecommunication services in Nepal [4].

As a result of significant growth in telecommunication services, the mobile, computer, and internet users in Nepal has also grown. According to NTA, the number of active internet users in Nepal reached 18.2 million by mid-March 2019. By mid-March 2020, this number had reached 21.9 million, which shows a net increase of more than 20%. Also, the Management Information System (MIS) report published by NTA in January 2020 revealed that the number of mobile users in Nepal reached 40 million, which is 7.6% more than January 2019. This shows that mobile users in Nepal are equivalent to more than 100% of country's total population [5-6].

A. Availability of mobile phones, computers, and internet to high school students

The sample survey used for this study included a questionnaire that would help assess the availability of mobile phones, computers and the internet to high school students. The bar-diagram of Fig. 1 summarizes the students' responses.

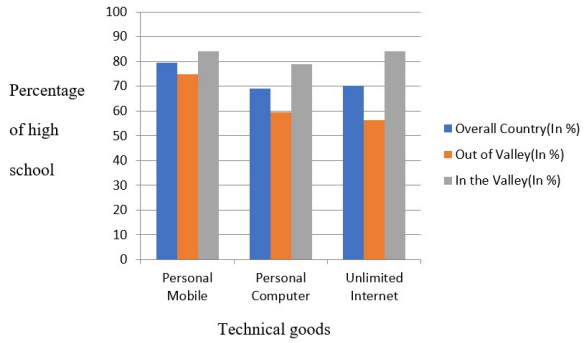

Fig. 1 Percentage of high schools versus access to Technical-goods

Looking at the diagram, it can be seen that the percentage of students with a personal computer is approximately 70 and the percentage of students with a personal mobile is around 80. Additionally, another question was also asked to the children who had no personal mobile or laptop—that whether their parents had these gadgets or not. Their responses showed that 100% of their parents had these gadgets. Coming back to the diagram, it can be seen that students with an unlimited internet facility are approximately 71%. Calculating the percentage of internet users using NTA's data, it approximates to 77%. The fact that the survey was done only for high school students compensates for the 6% difference. It is simply because the 77% calculated from NTA's data also includes the private sector, business firms, and other organizations of the country that deviate the original data. Considering all these facts, it can be said that the data published by the NTA report is consistent with high school students' data.

B. Relationship between availability and student's place of residence

Looking at Fig. 1 more deeply, it can be seen thatthere's a significant difference in the percentage of out-valley students and in-valley students.To analyze this difference, a rating for the availability of technical goods for in-valley and out-of-valley schools (Section IV.D.1) was devised.With the help of a Man-Whitney U test (one-tailed) – Appendix-D, it wasfound that school location affected the rating for the availability of technical goods. As the test was one-tailed, it also meant that in-valley students had a significantly higher rating than out-valley students. Therefore, out-valley students have remarkably bad availability of technical goods—meaning mobile phones, computers, or feasible internet are quite deficient there.

III. AN OVERVIEW OF MATHEMATICS TEACHING-LEARNING METHODS

The curriculum for Mathematics in Nepal is designed by the Curriculum Development Center (CDC) under the National Curriculum Framework (NCF) issued by the Ministry of Education, Science, and Technology. The curriculum is designed by organizing seminars on curriculum improvement and textbooks. It helps CDC collect the problems and issues related to the aspects of school curricula. CDC also establishes a relationship with school teachers and identifies student matters related to textbooks and curriculum. Then, it finally develops Camera Ready Copies (CRC) of the scripts of educational materials. Considering all reference materials and issues of the seminars, it ultimately designs the curriculum [7].

Although designing the curriculum seems quite profoundly organized, it still practices traditional teaching and learning methods. The methods used to teach the students help them be theoretically proficient in any Mathematical topic they are studying. However, their proficiency is limited only up to theory because the curriculum is not designed to explore the topic they have learned. The homework is either a textbook exercise or an exam paper practice, and the exam grades are solely dependent on the numbers obtained at a 3 hours exam. Therefore, there is a traditional teaching method, and most of the teachers are limited only in books and boards.

A Inside Math Class participation

Active involvement inside Math class can explain the theoretical proficiency of Nepalese students. Therefore, in the sample survery, questions about the participation of students inside their Math class was asked. The table below summarizes the responses from high school students for inside Math class participation—before COVID-19.

Activities/ Number	Always	Many times	Sometimes	Never
Involvement in class discussion with friends/ 1	112	141	100	7
Asking questions to teachers/ 2	148	105	100	7
Voluntarily presenting ideas at class/ 3	35	85	190	50
Teaching friends and clearing the doubts/ 4	92	162	92	14
Carefully listening to the teachers/ 5	170	113	70	7
Taking down notes during class/ 6	127	92	105	36

From the table, it can be seen that 33% of total students responded, "Always," 32% of students responded, "Many times," and 30% of students responded, "Sometimes." It can be said that there was a reasonably good amount of participation in all activities, considering that 95% of total students had some amount of involvement in Math class, and 65% had a significant Math class involvement. Hence, the claim that Math class involvement has produced theoretical proficiency in Mathematics for Nepalese students can be justified.

Now, the question was to know whether COVID-19 had an impact on the involvement inside Math Class. Thus, for each school, a rating for involvement inside Math Class – before and after COVID-19 (Section IV.D.2) was calculated. The information for "after" COVID-19 was gathered using the same questionnaire by modifying "before" with "after" in the title. Using a Paired-sample sign test (one-tailed) – Appendix-E, it was found that there was a significant difference in the "before" and "after" rating. As the test was one-tailed, it meant that COVID-19 had adversely affected the involvement inside Math class.

Moreover, teachers were also asked to rate themselves in their teaching ability: in-person teaching and online teaching. The average rating of their teaching ability before COVID-19 (in-person teaching) was 4 out of 5; however, the average rating for teaching ability after COVID-19 (online teaching) was 2.7 out of 5.

B Outside Math Class participation

Nepal's education system has always been limited to curriculum because very few students explore Mathematics – outside of the class. It can be proved by interpreting the stacked bar-diagram of Fig. 2, which is drawn based on students' responses to a questionnaire intended to assess students' involvementin Mathematics – outside of class (before COVID-19).

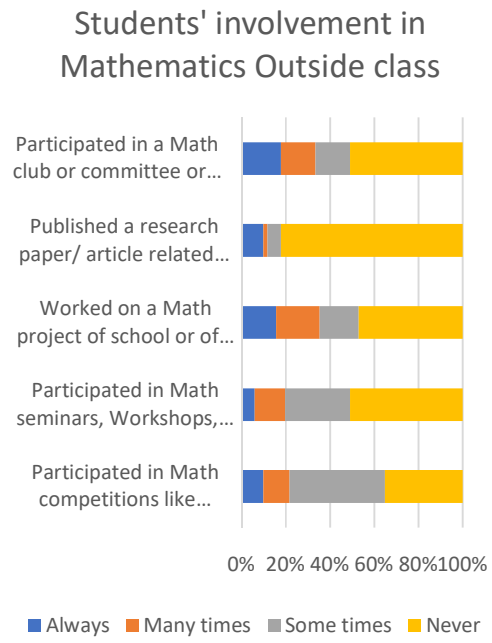

Fig. 2A stacked diagram showing students' involvement in Mathematics outside class

Looking at the diagram, it can be seen that more than 60% of high school students responded "always" or "never" to all the questions. It shows that more than half of the Nepalese students do not participate in the activities that help explore Mathematics outside of the class, which clarifies the claim that there is shallow involvement in activities outside Math class.

Now, the question was to know whether COVID-19 had an impact on the involvement outside Math Class. Thus, a rating for involvement outside Math

class for each school – before and after COVID-19 (Section IV.D.3)was calculated. The information for "after" COVID-19 was gathered using the same questionnaire by modifying "before" to "after" in the title. Using a Paired-sample sign test (one-tailed) – Appendix-F, it was found that there is a significant difference in the "before" and "after" rating. As the test was one-tailed, it meant that COVID-19 had adversely affected the involvement outside Math class.

Besides, a questionnaire was asked to teachers from each school, which helped us assess the teacher's encouragement to participate in outside Math class activities. Approximately 38% of teachers said they have never encouraged students in activities like participating in Mathematics competitions and seminars, writing a research paper, and working in Mathematics clubs.

C. Homework

The homework giving patterns in Nepal have never induced practical learning before COVID-19. Therefore, it was pivotal to know how the homework giving patterns amongst teachers differed after COVID-19. For this purpose, teachers were also asked a questionnaire that said "Tick all the assignments you gave to the students before and after COVID-19". The stack bar-diagram of Fig. 3 summarizes the teachers' responses.

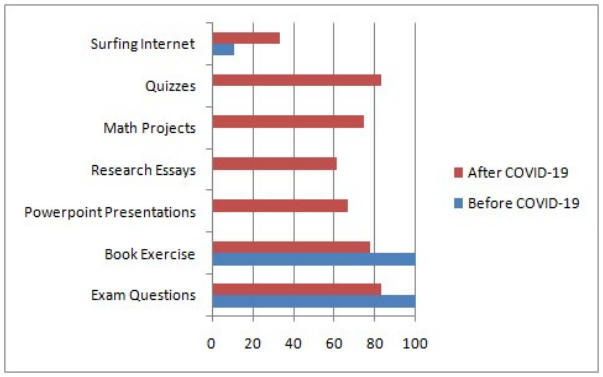

Fig.3A stacked diagram showing teachers' homework giving pattern before and after COVID-19

From the diagram, it can be seen that every teacher before COVID-19 gave homeworkoriented to examinations and theory. However, none of the teachers gave such an assignment that induced practical learning of Mathematics. It is because none of them gave quizzes, research essays, and Math projects as homework. In contrast to this, after COVID-19, most of the schools introduced an online teaching-learning system. As a result of this, a practical learning system can be perceived to be grown. From the diagram, it can be clearly seen that after COVID-19, more than 80% of the teachers gave quizzes as homework, and more than 70% of the teachers gave research essays, PowerPoint presentations, and Math projects as homework. Meanwhile, the exam questions and book exercises have been given as homework but less frequent than before. It proves that many teachers changed their homework giving patterns, which has induced practical Mathematics learning – after COVID-19.

D. Exam-Assessment method

In Nepal, the National Examination Board (NEB) conducts exams for high school students of 10, 11, and 12. The Mathematics exam weighs 100 marks, and the total weight is solely dependent on the exam paper's performance. For grade 9, everything is the same except that the exam is conducted by the respective school where a student is studying. However, after COVID-19, the exam-assessment ways have changed. The grade 9 and grade 10 students for the batch of 2019-2020 have been promoted to the next class based on teachers' predicted marks [8-9].

In the survey intended towards teachers, teachers were asked about the things they used in making an exam assessment (before and after COVID-19). Their responses showed that they used only exam performance for exam-assessment (before COVID-19); however, now they have started to see factors like class involvement, presentations, projects, homework, exam performance, and attendance. It shows that the exam-assessment in Nepal has shifted to be based on a holistic academic performance of students.

The average Mathematics marks of high school students(before and after COVID-19) was also asked in every school. When compared, it could be seen that the average marks for the in-valley students was increased after COVID-19, and the average marks for out-valley students was decreased after COVID-19. Itwas apparent that the increase of marks for in-valley schools was due to a change in the exam-assessment method. This was showed using a Wilcoxon matched-pairs signed-rank test (one-tailed)- Appendix-G. It found that there was a significant difference in the average Mathematics mark

for the in-valley schools based on the assessment method used. As the test was one-tailed, it meant that average marks had increased by implementing a holistic performance assessment method.

It was doubtful whether the assessment marks were fairly given because there was a significant decrement in class performance – both inside and outside the class (proved by 3.1 and 3.2). Therefore, the data about the attendance, class-presentations, class-projects, and homework time was also taken. The data in the table below summarizes them.

Question	**Response summary – before COVID-19**	**Response summary – after COVID-19**
Attendance of Math class	Average attendance in a high school class was 107.	Average attendance in a high school class was 102.
Class-presentations	Average number of class-presentations was 0.347/month	Average number of class presentations was 1.533/month
Project-works	Average number of project works was 0/month	Average number of project works was 1/month
Homework time	Average time to complete Math homework was 2.10/day	Average time to complete Math homework was 2.15/day

From the table above, it canbe seen that average attendance is almost constant both the time. Also, the average frequency of getting and doing class-presentations and project works has increased after COVID-19. Besides, the average time to complete Math homework has also increased after COVID-19. These factors compensate for the decrement in class performance and eventually have led to an increase in marks of in-valley students after COVID-19.

In contrast, more than 60% of the out-valley students were found to have no online classes in their schools. Due to this, they don't have the opportunity for a holistic performance. It explains why out-valley students had their marks decreased after COVID-19.

IV. METHODOLOGY

A. Research design

"The impact of COVID-19 at the level of Mathematics of high school students in Nepal" is a tricky question because Mathematics is an immensely versatile subject, and there are numerous factors which define the level of students in this subject. To get an in-depth view of a student's strength in Mathematics, all the parameters which primarily or secondarily influence a student should be considered. Getting the level of Mathematics of a student based on various parameters is also not enough. Comparingstudents' Mathematics level (before and after COVID-19) is also required because it helps reach a valid conclusion. Therefore, this research is designed so that it covers most of the fundamental parameters that influence the Mathematical strength of high school students, which helps differentiate between the Mathematical strengths (before and after COVID-19).

The fundamental parameters studied in the research include both the primary and secondary parameters that directly or indirectly influence the students' Mathematical strengths. These parameters include the availability of technical goods to high school students and the Mathematics teaching-learning methods at high schools of Nepal. The research has studied the availability of technical goods like computers, mobile phones, and the internet for the first parameter. Meanwhile, it has studied the inside-class activities, outside-class activities, homework, and exam-assessment method for the second parameter.

In the research, both quantitative and qualitative data were collected because the descriptive research design can be made highly effective using both of them. By interpreting both types of data, various observations and claims were made; they were proved by quantitative analysis methods later.

B. Sampling

The sampling frame for this study constitutes 18 schools that were from 5 different provinces of the country. The schools in these 5 provinces were randomly selected because the city where these schools are present or the people's living standard or any such thing was not taken into account. Out of 18 schools, 12 schools were out-of-valley schools, and 6 were in-valley schools. These 18 schools belonged to 12 different districts of the country, namely: Illam, Jhapa, Dhanusa, Kathmandu, Bhaktapur, Lalitpur, Sindhuli, Baglung, Kaski, Rupandehi, Dang, and Banke. Besides, 8 of these schools were higher secondary schools, and 10 were secondary schools.

C. Data collection

Both the quantitative and qualitative data were collected using a virtual sample survey. Twogoogle forms were prepared: one for the students and one for the teachers. The links for the google form is available in the appendices: Appendix A and Appendix B. These forms were basically designed to help assess both the parameters that were beingconsidered for the research. Reaching out to the Mathematics teacher(s) of all 18 high schools was done using friends' and teachers' network of the researcher. With the help of these teachers, the sample survey was virtually conducted in each school.

Additionally, the total number of responses for students' form was 360, and the total number of responses for teachers' form was 36. The responses reached 360 for students because10 responses from students of class 9 and 10 was collected for each secondary school and 5 responses from students of class 9, 10, 11, and 12 was collected from each higher secondary school. And the responses reached 36 for the teachers becauseresponses from two Mathematics teachers was collected from all 18 schools.

D. Data Analysis

The diagrams like vertical bar-diagrams, horizontal stacked bar-diagram, and tables were used to interpret quantitative and qualitative data obtained from the virtual survey. After this, the observations were established as claims and were tested using appropriate non-parametric statistical tests: The Man-Whitney U test, Paired-sample sign test, and Wilcoxon matched-pairs signed-rank test. The data used in these tests were not raw data; however, a processed one. These processed data were a specific form of data, like rating of something or average of something, obtained using various steps and factors. The non-parametric tests used in the analysis of data with their calculations (if any), are provided in the Appendix D-G. The calculations for ratings are included in the following sub-sections of Data Analysis.

D.1 Calculating the rating for availability of technical goods

1. Calculate the total number of students from each school with each equipment/service: mobile, computer, and internet.
2. Calculate a weighted mean for each school using all the three values from 1. Take 40% weight from the computer, 40% weight from the internet, and 20% weight from the mobile.
3. Calculate the out-of-ten value for this weighted mean by dividing the weighted mean by the sample size and multiplying by 10. It gives the final rating for each school out-of-ten.

Things to know:Computers are weighed more because they are a feasible option to conduct Math class than mobile phones. And, the internet is weighted more because an online class can't be attended without it.

D.2 Calculating the rating for involvement inside Math class

1. Calculate the average rating for each question of the questionnaire-1 from Appendix-C—for every school.
2. Take questions 2, 3, and 4 as "Additional involvement questions," and 1, 5, 6 and 7 as "General involvement questions." Now, find the mean additional involvement marks for each school.
3. Calculate a weighted mean for each school. The mean General involvement mark weighs 40%, and the mean Additional involvement mark weighs 60%.
4. Calculate the out-of-twenty value for this weighted mean by dividing the weighted mean by 3 and multiplying by 20. It gives a final rating for each school our-of-twenty (before COVID-19).
5. Repeat steps 1-4 for questionnaire-2 from Appendix-C to get the finals rating value for each school out-of-twenty (after COVID-19).

Things to know: Additional involvement is weighed more because it provides data of participation due to interest in the Math-class. Most of the time, students do not want to do some tasks; however, they do it because that task was a compulsion. These kinds of tasks generally fall in General involvement

D.3 Calculating the rating for involvement outside Math class

1. Calculate the average rating for each question of the questionnaire-3 from Appendix-C—for every school.

2. Calculate a weighted mean for each school, using all the five values from 1. Questions 1, 2, and 3 weigh 10%. Question-4 weighs 40%, and Question-5 weighs 30%.
3. Calculate the out-of-twenty value for this weighted mean by dividing the weighted mean by 3 and multiplying by 20. This gives a final rating for each school out-of-twenty (before COVID-19).
4. Repeat steps 1-3 for questionnaire-4 from Appendix-C to get the final rating value for each school out-of-twenty (after COVID-19).

Things to know: Questions 1, 2, and 3 are weighed less because these activities are generally encouraged in all the schools. However, a research paper is usually rare. So, question 5 is weighed the most.

V. RESULTS & DISCUSSIONS

A. The availability of technical goods to high school students

From section II. A, it can be said that the availability of mobile phones, the internet, and computers to high school students in Nepal is found to be reasonably high. Understanding that after COVID-19, all the classes in Nepal have either stopped or gone online, it becomes quite necessary that every student who is attending the online class has a good internet facility. Meanwhile, any student should also have a technical gadget like mobile phones or computers to join the online classes. Therefore, knowing that the technical goods are highly available to the high school students shows their ability to join the online classes.

However, from section II. B, it can be said that technical goods' availability to high school students, which seemed high in section II. A, is actually biased and not valid for the whole country. It is because section II. B proved a relationship between the availability of technical goods and place of residence. It meant that the data of technical goods was deviated by the in-valley schools. Also, it leaves us with the fact that out-valley schools are deficient in technical goods. This deficiency means that the possibility of organizing an online class is uncertain there.

B. The Mathematics teaching learning methods at the high schools

From section III. A, it was found that the inside Math class activities or simply class participation are significantly degraded after COVID-19. The average rating of online teaching being low compared to the average of in-person teaching shows that teachers feel less confident about their teaching when it comes to online classes. Also, more than three-fourths of the students preferring in-person classes over online classes shows that they have relatively less faith in online classes. It also indicates that the quality of online classes, especially Mathematics classes, is relatively low. These might be the reasons for degrading class performance after COVID-19.

From section III. B, it was found that even before COVID-19, the involvement of high school students outside Math class was relatively low. It shows that there is no practical teaching-learning system in Nepal when it comes to Mathematics. It can also be said that Nepalese students are limited only in the curriculum. To prove this, 38% of teachers said that they do not encourage outside Math class activities, comes in use. It shows that a significant number of teachers limit students only in the curriculum. It also shows that they do not give a good platform for interested students to come out of their comfort zone and participate in Mathematics competitions, seminars, and many other things to learn Mathematics practically. Moreover, it was also found that the involvement outside Mathematics class is significantly degraded after COVID-19. Teachers' encouragement for outside Math class activities might have also decreased, explaining why this might have happened.

From section III. C, it was found that the Mathematics homework given to students before COVID-19 was oriented towards theory only; however, after COVID-19, the homework assigned has significantly induced practical learning of Mathematics. This is a positive change because the students can now explore Mathematics outside of the curriculum, and they can have an overall proficiency in this subject. Also, from section III. D, it was found that many high schools in Nepal have moved to a holistic academic assessment method after COVID-19. For such an assessment, they consider project works, quizzes, essays, and many other things to make an assessment. Doing some sort of research is needed to complete these homework types. It explains why surfing on the internet has increased. These ideas sum up to explain why the induction of

practicality in learning Mathematics – after COVID-19.

Additionally, from section III. D, it was found that the exam performance after COVID-19 has improved because of the holistic assessment method. It is a positive sign because even during this stressful pandemic period, students' mathematics level seems not to be hampered based on one parameter: the exam performance. It can also be a positive factor for students because they may be motivated to improve on other factors so that their Mathematics level is finally increased in all the aspects.

VI. CONCLUSIONS

COVID-19 has impacted the level of Mathematics in Nepal's high schools, both positively and negatively because it has divided the country into two parts: the privileged side and the under-privileged side. The under-privileged side has very few or no online classes: forget class participation, exams, homework, and involvement outside Math class. Despite having online classes, privileged students have also been impacted. The shift to online classes demands the teachers and students to be versatile and virtually informative and adapt to this new online class system. However, to a country with a traditional teaching-learning method, fulfilment of such a demand and adaptation to the new system has not occurred effectively. In contrast, the country seems to find a practical teaching-learning approach in giving homework and making an exam-assessment (after COVID-19). Such an approach induces practicality in learning Mathematics, and hence, improves the level of Mathematics.

VII. RECOMMENDATIONS

This research found that technical goods are available in an insufficient amount for out-valley high school students. For a sustainable solution, the government should establish an organization that formulates plans and policies to minimize the technical divide between the in-valley and out-valley schools. These plans should include annual monitoring of the technological divide and methods to reduce this division. The tasks like efficiently using taxpayers' funds to buy technical goods, supplying technical goods to deprived areas, and establishing various non-profit organizations that will serve in these deprived areas of the country may come under this plan. As a responsible citizen, we can start local level organizations that collect funds, buy technical goods, and reach out to the country's deprived places. The privileged ones can donate their technical goods to the deprived areas, instead of throwing or keeping useless at one corner of their home.

One of the main reasons for not having practicality in teaching-learning is the curriculum. Although it is quite good, it uses only traditional teaching-learning methods. So, when CDC issues a new curriculum, it should consider the practical teaching-learning methods that are missing in the curriculum now. In doing so, the teachers and students will be exposed to a platform where it is mandatory to learn Mathematics using practical methods. It will make COVID-19 only an incident, not an accident. The Mathematics curriculum should be designed so that teachers and students are mandatory to use PowerPoint presentations in class and give Mathematics projects and research papers as a part of Mathematics homework. Most importantly, the curriculum should be made flexible by including virtual learning, which will develop a practice of learning Mathematics virtually.

As the outside class involvement plays a vital role in improving the level of Mathematics, it becomes the role of every Math teacher to realize this. All the high schools in the country should form a separate committee inside the school, which will look after the outside class activities. They should organize Math Competitions, prepare students for Olympiads, and create Math clubs to explore Math topics outside of class.

Lastly, it was also found that the homework giving pattern and exam assessment methods have changed after COVID-19, and this change has induced a practical learning platform. Hence, such a wonderful change should be given continuity even after this pandemic becomes stable. In fact, the NEB should modify its exam-assessment method to holistic performance-based.

VIII. LIMITATIONS AND FURTHER RESEARCH

Studying the level of Mathematics at high schools throughout the country is a very complex task. Such a study requires a significant number of samples from every part of the country. Therefore, this study's sample size can't be considered reliable for covering all

country's regions. It is because these samples are minimal and cover only 12 districts and 5 provinces of the country. A new research should be designed to cover all districts of the country and obtain a larger sample. The researchers should take government help, typically the Ministry of Education, to get an official, reliable, and large sample of data related to the study's various parameters. The researchers should expand the contacts used in the research and reach out to the educational organizations working in every district to cover the whole country – not 4 to 5 provinces. Additionally, the data collection is solely based on a virtual sample survey where Mathematics teachers' and students' responses are taken as samples. However, in this complex study, doing such a task will collect only a one-dimensional kind of data. Such data can't help create a comprehensive solution to the problem. Therefore, the data collection methods of the new research should be modified. The modification should include a sample survey of parents, educational officials', and their interviews to cover a broader range of thoughts.

Moreover, the research finds that out-valley schools are deficient in technical goods availability, but in-valley schools are not deficient. However, there is no in-depth study and reasoning for why this may have occurred. Therefore, the new research should be designed in a descriptive and exploratory form to explain parameter-specific questions.

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XI. APPENDICES

Appendix-A:
Student's Mathematics Teaching Assessment Form
https://forms.gle/MTBcPgXNwrzKeBvV8

Appendix-B:
Teacher's Mathematics TeachingAssessment Form
https://forms.gle/U6VUzq6d7cWedcTh7

Appendix-C:
Rating Assessment Questionnaires
https://drive.google.com/file/d/1cLvy4ieTQzUHZ_A4xMKPNNAAPkg8HAmV/view?usp=sharing

Appendix-D:
Hypothesis test-1 (Man-Whitney U test)
https://drive.google.com/file/d/1yFXx3bwNpmx837IAF39hGicnADP11NoF/view?usp=sharing

Appendix-E:
Hypothesis test-2 (Paired-sample sign test)
https://drive.google.com/file/d/19N_aG4nC-jopuJEp7-fWnVzT7prU_8Sq/view?usp=sharing

Appendix-F:
Hypothesis test-3 (Paired-sample sign test)
https://drive.google.com/file/d/1gPaRUgENBENEuwd4Maj_fyLAOBZiz2m9/view?usp=sharing

Appendix-G:
Hypothesis test-4 (Wilcoxon matched-pairs signed-rank test)
https://drive.google.com/file/d/1FPfX__N5C7827Dra1T0HkyXVFU5r2web/view?usp=sharing