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EFFECT OF COVID-19 ON STUDENTS PERFORMANCE AT K-12 LEVEL: PLANS FOR STEM EDUCATION

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ABSTRACT
It was decided by the government of Pakistan to close all educational institutions on 13th March, 2020 and all citizens were strictly advised to remain at their homes to prevent the spread of COVID-19 in the country. Due to the global pandemic, it was hypothesized that it would have a negative impact on K-12 students in their annual examinations of 2020 in science, mathematics, and technology subjects. There was constant hike in the COVID-19 cases and due to lack of technological resources in Pakistan, the country has been facing very difficult time since pandemic, especially in the area of STEM education. The data was collected from three teachers at a government secondary school in Malakand District Khyber Pakhtunkhwa province in Pakistan. These teachers were specialized in mathematics, natural sciences and technology respectively. The researcher gathered insight of teachers on the possible effects of COVID-19 on the performance of students in their respective subjects by using a semi-structured interview technique. The study unveiled that if the COVID-19 epidemic persisted for a long time, it is possible that the proportion of the secondary school students in the annual examinations would be decreased due to the disturbed academic calendar of schools.
Keywords: COVID-19, STEM Subjects, Mathematics Education, Pakistan Education

INTRODUCTION
The outbreak of coronavirus disease 2019 (COVID-19) spread rapidly from its' origin in Wuhan, Hubei Province, China (Kraemer, 2020). COVID 19 is a highly contagious virus called the COVID 2019 novel coronavirus (WHO, 2020). This new virus can be transferred very quickly through droplets, air or touching anything, which have been affected from a person that are affected with this disease. Although, elder people are more vulnerable to this virus, nobody is immune to this new infectious disease, once it hits the body, everyone suffers from its' devastating effects (WHO, 2020; Mujayanto, Rochman & Recita, 2020). COVID-19, also known as Severe Acute Respiratory Syndrome Coronavirus is the worldwide issue, having devastating effects for everyone. On March 11, 2020, World Health Organization (WHO) declared Covid-19 as a pandemic. The virus affected not only health sector but almost all the global sectors and departments (De Santanu, 2020). The COVID-19 pandemic, since its outbreak in 2019 in China, has affected the world economy. Mseleku (2020) observes that the Covid-19 outbreak affected every single aspect of human life and economy, not only in developed and developing countries but across world (Bacher-Hicks et al., 2020; Johnson et al., 2020; Raaper & Brown, 2020; Jacob et al., 2020). In terms of education, school examinations have been severely affected by the quarantine protocol followed across the country. Similarly, Grade 12 students who had examinations have also suffered, especially since there is no better e-learning platform for schools. In the third term of the academic year 2020, teachers are nervous about completion of course work (Phiri & Sintema, 2018). In the mid of March 2020, the government of Pakistan announced that all the educational institutions in the country would be closed on 13 March

2020 due to the fear of the spread of the COVID-19 global pandemic that has adversely affected all parts of the world, specifically China, USA, Spain, Italy, and Iran.

This announcement of the closing of schools left the secondary level students without attempting the end-of-term tests as usually all the government and non-government schools conduct such kind of assessment tests in the last term of the academic year before the examinations. There is not an abundant literature on COVID-19 in the perspective of education. All the literature that we found is related to the medical field (Chinazziet et al., 2020; Hopman et al., 2020; Kraemer et al., 2020; Wu & McGoogan, 2020; Zhu et al., 2020). It is not because this global pandemic has no effects on education but it is because the studies have rarely incorporated the effects of COVID-19 on education and learners all over the world. Medical workers have been working day and night on the prevention of virus and scientists in preparation of vaccine to get rid of this deadly disease. It has brought a big challenge for the economists who are making their efforts to manage the economic impact of COVID-19, which has affected business across the globe due to the restricted mobility of humans and worldwide lockdown (Kraemer et al., 2020). The number of COVID-19 cases are increasing and the government of Pakistan began to worry and took the required steps to prevent the spread of this outbreak in the state. In 26th February 2020, the first COVID-19 case was identified in the Khyber Pakhtunkhwa province of Pakistan, who was a pilgrim of Iran. There were 21 confirmed cases of COVID-19 in the country on March 12 and on March 13, subsequently the government of Pakistan announced the closure of all public and private educational institutions in the country along with the closure of the western borders with Iran and Afghanistan.

COVID-19 will affect education systems around the world, there are signs suggesting that it could have a lasting impact on the trajectory of learning innovation and digitization (El Said, 2021). The aim of this research was to examine the effect of the sudden shift from campus learning to online distance learning due to COVID-19 lockdown. COVID-19 has dramatically reshaped the global education. Millions of learners were affected by closure of educational institution due to the pandemic (El Said, 2021). The limited research evidence does, however, suggest the COVID-19 pandemic is negatively affecting students' academic performance (Hinrichs, 2021).

COVID-19 and STEM Education Pakistan

By closing educational institutions, government of Pakistan had taken a wise and timely decision to save the lives of many students from the deadly virus of COVID-19 because it was difficult to prevent the spread of this virus in the school environment. COVID-19 has brought a devastating economic impact on developing countries. However, there has been little discussion about the effects of COVID-19 on education, specifically on the academic performance of secondary level students who will appear in forthcoming annual examinations. Therefore, the purpose of this research study is to record the opinions of mathematics and science teachers about the effects of COVID-19 on the performance of students in education, particularly on STEM subjects.

The present investigation is essential, which delivers useful data to the Ministry of Education to prepare for minimizing the negative effects of the virus on education. This study is also significant for educational researchers to prepare for the adverse effects of this global pandemic on education. This study will also contribute to the valid literature on educational research, particularly on mathematics that can help the researchers in the upcoming researches associated with COVID-19 and education.

In Pakistan, there is an annual system of education till secondary level in all public and private schools in which students have to appear in the examinations at the end of the academic year. However, students are not always provided the smooth and undisturbed learning due to planned and unplanned activities throughout the year and their academic year is not entirely spent on preparation of examinations conducted at the end of the academic year. Planned activities include sports events, which usually take place in spring and affect the academic year of schools. While unplanned activities include serious issues like terrorist attacks or health-related problems, such as COVID-19 cause schools to be closed by the government to save the lives of students. In both of these cases, unplanned events affect schools' calendars more than planned activities as those events occur suddenly and create uncertainty. In the current scenario, all schools are closed by the government of Pakistan and all citizens are encouraged to isolate themselves at homes to prevent the spread of the outbreak. This closure of schools prevented school going children to remain at home till next notification. Therefore,

this outbreak of virus will adversely affect the performance of secondary level students in upcoming examinations and they will not be able to prepare for the examination due to the countrywide lockdown in all kinds of educational institutions.12 grade students, who had to appear in Board examinations were affected as they had not provided with effective learning as the country has not yet developed a convenient E-learning platform for students. Consequently, STEMS subjects will be affected the most as these subjects needs demonstration to understand. In Pakistan, COVID-19 highly disturbs the curriculum of STEM education and academic performance of students in Science, Mathematics, and Technology.

METHODOLOGY

In this study, the qualitative design has been employed by using the case study approach. The researcher has studied the three cases, whose views have been presented and analyzed in this study.

Participants

In this study, the interview was conducted by the researcher from three teachers of the government secondary schools in Malakand District Khyber Pakhtunkhwa province in Pakistan. These three teachers belonged to the fields of Mathematics, Science, and Natural science respectively. There were predefined criteria of selection of these teachers as; (i) they must be specialized teachers in one of the fields of Mathematics, Science, biology, chemistry or physics at the secondary level, (ii) they must have at least 12 years' experience of teaching in their specialized area, (iii) they must have basic information about COVID-19 availed through any means of communication such as media, social media or any other sources. In this way, four teachers were selected as participants while one of them withdrew before the interview.

Instrumentation

The researcher developed the protocol of interview that initially consisted of ten semi-structured questions. Then the face validity and clarity of items were got checked by two experts from the field of mathematics. Those experts showed their consent for seven items while the remaining three items were removed from the instrument. Then the instrument was applied to one mathematics teacher for pilot testing to check the clarity of items.

Data Collection and Analysis

As there was strictly instructed by the government to maintain social distancing and self-isolations, the interviews were conducted through telephone. All the responses of the participants were recorded on a phone call recorder accessed through Google Play Store. The researcher transcribed and analyzed the responses by using the qualitative data analysis techniques and each interview consisted of twenty-minute duration. The process of coding and transcription was conducted by the researchers while all kinds of inconsistencies and discrepancies were conferred in great detail. For increasing the validity and reliability of the data, all the participants were given the transcription of their interviews to verify their response and views presented during interviews.

RESULTS

Interviewer: What do you think about how COVID-19 global pandemic will possibly affect the performance of students in science subjects of their annual examinations?

Science Teacher: It is not just about annual examinations but in fact, their internal assessment will also be affected and ultimately it will affect their performance in their final examinations as many of the students will not be able to contact their concerned teachers.

They have already reached the time of examinations and it will adversely affect their performance. As many students have missed online classes and relied on private coaching academies for the preparation of their exams.

Natural Science Teachers: Students can do their learning independently as well as they can learn through school and get schools based assessments. But their remaining time before examinations has been reduced due to the sudden closure of schools that will leave students without any practical assessment before their examinations. Due to this issue, we are not able to conduct practical assessments of students and it will certainly affect their performance.

The mathematics teacher, in consent with his colleague, described that due to lockdown, learners cannot learn and teachers cannot teach.

Interviewer: What do you think that how the effects of the COVID-19 outbreak will affect the performance of students in the subject of mathematics in forthcoming examinations?

Mathematics Teacher: Secondary school students are usually assisted by private coaching centers that have been also closed due to the COVID-19 outbreak. In this situation, all teachers and students are afraid to teach and learn respectively. Secondly, if the COVID-19 prevails for a longer period then it will not be possible to conduct scheduled examinations. When it was asked by the researcher from mathematics teacher that whether the annual examinations of secondary school students will be affected by the outbreak, he replied that the effect could be observed right after when the schools were closed due to COVID-19 spread.

Interviewer: Do you think the COVID-19 outbreak will affect students' performance of K-12 students in mathematics subjects in their upcoming exams?

Mathematics Teacher: Before the closure of schools all students were instructed to prepare for the exams in two to three weeks, but suddenly this outbreak caused schools to be closed and it affected students learning. When schools are open, students get assistance from teachers where they feel difficulty or any hindrance, but due to the closure of schools, students have lost this opportunity and now they are deprived of explanations provided by their teachers when they need it at the time of self-study at homes. Secondly, their daily routine has also been adversely affected as now they have no organized routine and schedules of study.

The science teacher explained that various learning strategies are employed by teachers to enhance students' learning efficiency to help them in their preparation for examinations and it will now be affected.

Interviewer: Do you think the COVID-19 outbreak will affect the performance of K-12 students in science subjects in their forthcoming examinations?

Science Teacher: They will certainly be affected to a great extent. Many students have slow pace while studying through e-learning and few has adjusted with it. Some students are capable of getting the concepts of things, while others depend on the explanations provided by teachers at schools. The sudden and untimely closure of schools for an unknown period has caused students to think that annual examinations will also be delayed and many students have not even touched the books. So this academic year will mark reduced contact hours between teachers and students. And this will affect greatly to slow learners and they will be disadvantaged.

When it was asked by the researcher about the possible effects of COVID-19 on the results of science subjects, the science teacher expressed his fear that there will be a great drop in the performance of many students in the annual examinations of 2020. On the other hand, he also expected to maintain the results if the outbreak could be controlled and schools opened before examinations.

Interviewer: I have looked at the past trends of 2018 and 2019 annual examinations and I have noted the improved results in science subjects specifically in chemistry, but due to threats of COVID-19 that has caused schools to be closed, do you think that you will manage to maintain their performance or improve it further in the subject?

Science Teacher: Although I cannot figure out the effects, yet I think it will affect students' performance and due to negative effects there will be certainly a downfall in the trend. At this time, it is difficult to say that whether we will be able to maintain or improve the results, but if the COVID-19 persists for a longer time, the effect will be significant.

In the same way, the mathematics teacher expressed his concern that if the COVID-19 exists longer, the passing ratio in mathematics subject will decrease.

Interviewer: The analysis of the 2018 and 2019 annual examinations have shown improvement, as a senior teacher do you think that the results in this academic year will be affected by the COVID-19 effects?

Mathematics teacher: It is a matter of grave concern for us. As I have mentioned earlier that the commitment of students for their studies in the absence of teachers have been reduced.

There are very few students who can study independently without teacher's involvement. Hence, I think that the result will be greatly affected as students are studying on their own without any assistance provided by teachers.

When it was asked by the researcher to devise any strategies to reduce the negative effects of the COVID-19 outbreak on the performance of mathematics and science subjects, the mathematics teachers suggested the intervention by the Ministry of education to take some steps, while the science teacher was in the favor of school-based intervention.

Interviewer: What kind of strategies will your schools adopt to reduce the effects of COVID-19 that can help learners in their preparation for final examinations?

Science Teacher: Now it depends on the Ministry of education to device some strategies. The ministry should compensate for this loss by decreasing the number of holidays when the schools will be opened. The education ministry can reschedule the timetable of annual examinations to provide adequate time to students and teachers to cover the remaining syllabus.

Natural Science Teacher: It is quite necessary to expedite the learning process so that we can protect the performance of students and their good results. I expect many teachers will be working in afternoons to help students in their preparation and some teachers will voluntarily teach students on weekends to cover the syllabus.

Interviewer: What kind of strategies will you adopt to reduce the effects of COVID-19 that can help learners in their preparation for final examinations?

Mathematics Teacher: Initially, I will look at the topics that students must study at the end of the year before examinations and they will be given a lot of homework and assignments. Students will be given a lot of homework to make them busy and compensate for the loss during the time of the COVID-19 outbreak.

The responses of all three teachers reveals that COVID-19 will negatively affect the STEM curriculum that has been introduced recently. The STEM curriculum is expensive to be implemented as it requires expensive resources for learning. Due to the bad economic conditions of the country, there will be limited funding for STEM schools and it will affect the academic performance of students.

Interviewer: What is your opinion regarding the effects of COVID-19 on the STEM curriculum in Pakistani Schools?

Natural Science teacher: Schools are the best place where students are facilitated with required learning material that is not available to them at home. As STEM curriculum is concerned more with science and technology that students cannot have access at home. That's why STEM schools need an extra budget to purchase all required resources. There is always a challenge of the lack of funding that schools face. So, if the COVID-19 will persist for a long time then its' effects will be significant on education.

DISCUSSION

It has been shown in the results of interviews conducted from science and mathematics teachers that the performance of grade-12 students will be likely affected due to COVID-19 generally and particularly in their annual examinations. The reason is that the contact hours of students have been reduced largely so that they are not able to contact their concerned teachers if they face any kind of difficulty in relevant subjects during their self-study. Upon investigating how COVID-19 will affect student performance in science subjects? the head teacher of natural sciences explained how these students will be affected by the school based practical assessment. When it was asked from teachers that how the COVID-9 can affect the performance of students in science subjects? they all mentioned reduced contact hours between teachers and students. The science teacher elaborated in detail how it will affect their school-based internal assessments also.

It has been found through the results of this study that there will be a negative effect of COVID-19 on education in Pakistan. It is because contact hours between teachers and secondary school students have been reduced and many students do not have the facility of e-learning that could help students to contact their teachers. Due to closure of schools, student's preparation of annual examinations will be affected as students will not be assisted by their teachers and they will have to depend on their home-based study that will also affect student's performance. Teachers are concerned that the performance of students in STEM subjects will be deleteriously affected in their annual examination if the COVID-19 outbreak continues to exist with an increasing number of cases. It is also suggested in results that teachers are adopting various learning strategies to ensure adequate learning of students for preparation of their examination. Results reveal that STEMS schools will

suffer more negative effects as teaching STEM subjects through e-learning is expensive and economic conditions of the country have been worsened due to COVID-19, hence it will be difficult to provide extensive funding to those schools. It has been shown in the results gathered from government school of Malakand District Khyber Pakhtunkhwa province, Pakistan that the passing ratio of students in grade 12 in annual examinations has been gradually increasing. There has been found improvement in the annual examinations of 2018-19 in the performance of students in STEM subjects. There was marked a significant improvement in the performance of students in Mathematics and computer science with 32.7% and 13.9% increase in the passing ratio, whereas chemistry and design and technology had100% passing ratio prior Covid pandemic. But, after the pandemic and followed lockdown, there was found a drop in the passing percentage of science subjects. When the schools were supposed to take effective measures to increase the passing ratio in the subjects of chemistry and technology, COVID-19 surfaced around the world and affect the overall academic performance of students in year 2020-2021.

The study indicated that there will be a significant impact of COVID-19 on the provision of education in Pakistan. It depends on how much longer the pandemic prevails, but it is hoped that teachers with the support of the Ministry of Education of Pakistan will develop certain strategies to benefit students as the future of Pakistan solely depends on the education of young generation.

CONCLUSION

It is shown in this study that there will be a significant impact of COVID-19 on the provision of education in Pakistan. It depends on how much longer the virus remains alive but it is hoped that teachers with the support of the Ministry of Education of Pakistan will develop certain strategies to intervene for the benefit of students as the future of Pakistan solely depends on the education of young generations. COVID-19 will have an impact on education provision in Zambia. It remains to be seen how long this epidemic will live but there is hope that Zambian teachers through the ministry of education will devise intervention measures that will benefit all school-going children in the country because the future of Zambia lies in the education of the young generation (Sintema,2020). COVID-19 will affect education systems around the world, signs are suggesting that it could have a lasting impact on learning innovation and digitalization (El Said, 2021). This research aimed to examine the effect of the sudden shift from face-to-face to online distance learning due to COVID-19 lockdown. COVID-19 has dramatically reshaped the way global education is delivered. Millions of learners were affected by educational institution closures due to the pandemic (El Said, 2021). COVID-19 pandemic and education in the United States for which research currently exists. First, the evidence suggests that the spread of the COVID-19 virus at schools has been low, although it may have spread through colleges at a higher rate. Second, while anecdotal evidence suggests that school closures have reduced labor force participation, the research evidence thus far does not find much support for this situation. Third, the limited research evidence does; however, suggest the COVID-19 pandemic is negatively affecting students' academic performance (Hinrichs, 2021).

Implications for Further Studies

It has been found in this study that there will be an impact of the COVID-19 outbreak on the annual examinations of K-12 students if it persists for a long time. This study has introduced a new line to conduct similar research. It is expected that other educational researchers will investigate the effects of COVID-19 on educational development and administration at the state scale. The findings of this study can be validated further by conducting extensive research that must consist of qualitative and quantitative data to have a deeper insight into the effects of this global pandemic. The researcher can also focus on the threats of COVID-19 in the perspective of funding provided by multinational organizations to poor nations. It will also be exciting for educational investigators to analyze the decrease of foreign scholarships provided to Asian students in Europe and across the world during the pandemic.

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