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A Survey on ICT Education at the Secondary and Higher Secondary Levels in Bangladesh

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Abstract: In this study, we show the status of ICT education and find the gaps between rural and urban institutions for providing ICT education in secondary and higher secondary institutions in Bangladesh. For this purpose, we use primary data collected using a survey questionnaire that is answered by ICT teachers engaged in those institutions. The variables used in the questionnaire are the name of the respondents, educational qualification, locations of the institutions, syllabus structure, the total number of students for ICT courses, number of computers, etc. The data were collected from institutions located in urban and rural areas. We apply several statistical functions along with conditional logic to our data for getting the desired result. We find that the students-teacher ratio in secondary (resp., higher secondary) is about 288:1 (resp., 212:1), existing teachers have a heavy academic workload. We also find that there exist low facilities in rural institutions compared to the urban institutions because students-computer ratio (SCR) is 46 in rural areas whereas SCR is 22 in the urban area. Moreover, we find that more than 80% of the teachers conducting ICT classes have graduated from the discipline other than ICT or related discipline. Furthermore, teachers who cannot complete at least 80% of the ICT syllabus in time are mostly non-ICT graduate. Based on these findings, we propose some recommendations to meet the above gaps of the current ICT education in Bangladesh.

Index Terms: ICT, Survey, IT, Education, Students-teacher ratio, Students-computer ratio.

1. Introduction

Information and Communication Technology (ICT) has made a revolutionary change in communication, manufacturing, health and medicine, and education [2] over the world. After the outbreak of the COVID-19 pandemic, every country is using ICT tools (such as Zoom, Meet, Google classroom, Skype, etc. [6]) for conducting online meetings, classes, quiz contests, viva-voce, and so on. In 2016, Chris indicated that ICT has a significant impact on teaching and learning in tertiary institutions in Nigeria [13]. Later on, Mbalamula [14] investigated the role of ICT in learning on the influencing lecturers on their students. Furthermore, Ali [15] found that teaching staff and administrators had a strong desire to integrate ICT into teaching-learning processes. Bawa et al. [16] proposed a model on the role of ICT education in Africa and showed that improvements in ICT education enhance the potentiality in science, technology, and humanities for sustainable development. Moreover, UNESCO has declared ICT as an emerging tool that can complete and enrich education [17]. Therefore, ICT education is indispensable for modern education and leading modern life.

1.1. What is ICT Education?

ICT education is the technique of teaching information and communication technology to the students so that the students may be familiar with modern ICT technologies. Through this education, students can learn about computer

basics, hardware (input devices, processing devices, output devices, memory or storage devices), operation principles of hardware, operating system, networking fundamentals, communication devices, Internet, programming basics, and so on.

1.2. Motivation

The government of Bangladesh has already understood the importance of ICT education in the modern world. Furthermore, the world is moving towards digital due to the extensive use of digital devices such as laptops, computers, tabs, smartphones, and many other devices. Therefore, Bangladesh is also moving towards digital. To accomplish this mission, the Government of Bangladesh (GOB) is converting its manual services into digital. Bangladesh government has started to store its information in digital media especially in online storage so that people can get services remotely through the Internet. Moreover, GOB has installed computers and printers with internet facilities in most of the offices in the Union, Upazila, District, and Division levels. Besides these, most of the private and public offices are equipped with computers, laptops and printers to perform their official jobs and publish their reports. Therefore, every employee working in these sectors should know how to operate computers. They also should have training on some office packages such as Microsoft office packages (MS-Word, MS-Excel, MS-PowerPoint, etc.). Therefore, Bangladesh needs many ICT literate manpower in every sector of its public and private services. For this reason, GOB has emphasized ICT education in secondary and higher secondary levels as well as at the graduation level. According to national education policy 2010 [1], Bangladesh Government has introduced ICT education from class VI to XII. The GOB introduced ICT for class six, seven, and eight students in 2012, 2013, and 2014 respectively. In this respect, GOB introduced ICT education which comes into effect into the curriculum of secondary school certificate (SSC) and higher secondary school certificate (HSC) levels in 2013 [12].

In addition, Bangladesh is a densely populated country. Most of the people of Bangladesh live in rural areas. The educational institutions of Bangladesh are distributed all over the country. Most of the expert teachers are working in the urban areas with all modern facilities. But the facilities are inadequate in the rural areas of Bangladesh. The students read in urban institutions get more facilities than rural institutions. Since the world is moving rapidly into digital, the role of ICT in every job sector has become very important. For example, without any computer training, it is difficult to manage a job in any financial organization and multinational company. Furthermore, the implementation of ICT in these sectors is a great challenge in a developing country like Bangladesh.

Moreover, we know that Bangladesh is a country of more than 160 million. About 20,47,779 and 13,67,377 students were registered for secondary and higher secondary examinations respectively in 2020 in Bangladesh [19, 20]. If these students can acquire ICT knowledge from ICT courses during their study, it would help them to get official jobs in the current job market after their study. Besides, Asian Development Bank (ADB) [7] investigated the use of ICT for education especially focusing on Bangladesh, Nepal, and Sri Lanka. In this investigation, detailed information on the ICT in education programs and projects in Bangladesh is presented. They also presented the strengths, weaknesses, opportunities, and threats of the projects in Bangladesh [7]. Therefore, our aim of this paper is to represent the current status of ICT education in secondary and higher secondary levels and finding the gap between rural and urban institutional facilities in terms of ICT education. It is indispensable to recommend how to minimize the gaps for the facilities of the rural and urban areas.

1.3. Problem Statements

To complete the survey and find the status of ICT education, we formulated a set of questions to collect various information regarding teachers and students in ICT classes, teaching materials, logistic support, education procedure, institute location, and so on. For proper ICT education, ICT graduates should be engaged as school and college teachers. Moreover, a computer laboratory with multimedia equipment is very important to hold practical classes for giving hands-on experience to the students. Facilities of different institutions for teaching ICT courses are not equal. If we can measure the facilities provided by every institution to teach ICT courses, we can get an overall idea of ICT education. Therefore, it is indispensable to determine provided facilities in every institution to know the status of ICT education in Bangladesh. In this respect, we have determined the following parameters to achieve our objectives of this study as follows:

i. Statistics of students and teachers
ii. Students-teacher ratio
iii. Statistics of computers in the ICT lab
iv. Students-computer ratio
v. Educational background of ICT teachers
vi. ICT syllabus completion status

Section II reviews some literature to find out the recent status of ICT education. Section III highlights the material and methods for this study. Section IV outlines the results in detail. Section V reports some findings and recommendations. We conclude this paper through Section VI.

2. Review of Literature

In 2016, Shamim and Raihan [3] identified the effectiveness of using ICT to promote teaching and learning through a survey on the faculty members of the Government polytechnic institutes of Bangladesh. The authors found that lack of ICT skills among educational staff, inappropriate educational materials, inadequate motivational techniques, and lack of training of the teachers on ICT are the major problems to improve the quality of the ICT technical education in Bangladesh. Bairagi et al. [4] worked on the status and role of ICT in educational institutions in the Khulna division, Bangladesh and offered comprehensive recommendations to build a digital society in Bangladesh. This paper concluded that the level of use and infrastructure of ICTs is not highly satisfactory in all forms of educational institutions to meet the current demands of ICT. In 2013, Khan et al. [5] identified the various impacts of ICT on education systems focusing on the rural schools in Bangladesh. Major lacking found in this study are holistic approach, ICT infrastructure, and training. In 2018, Osadebe and Ojukonsin [9] found that computer studies teachers' constraints in the use of ICT in teaching differed significantly concerning gender, location, experience level, and qualification. Buabeng-Andoh [10] investigated personal, institutional, and technological factors that encourage teachers' use of computer technology in teaching and learning processes. The author concluded that identifying the barriers affecting individuals and institutions for using ICT may help in deciding on how to tackle them. Mwalimu and Bwalya [11] found that implementation of the ICT policy in Government-owned secondary schools was slow. The study further revealed that teaching was theoretical due to a lack of computers. On the other hand, private secondary schools were more resourced with ICT facilities.

As mentioned above, none of authors worked with status of ICT education whereas they worked on using ICT tools in education and teaching-learning activities and identified the barriers of using those tools. Therefore, finding the status of ICT education in secondary and higher secondary level in Bangladesh is necessary.

3. Materials and Methods

3.1. Data Source

In this study, we collected primary data from the ICT teachers employed in different secondary and higher secondary institutions of Bangladesh and uploaded to GitHub repository[1]. We choose one ICT teacher from each institution for answering our questionnaire. We collected the data from 102 (one hundred and two) institutions through a questionnaire which contains the name of the respondent, educational qualification, types and locations of the institutions, syllabus completion status, the total number of students enrolled for ICT course, number of computers, and so on. The respondent spontaneously gave the answers to all the questions except the result-related questions.

3.2. Statistical Methods

To determine the status of ICT education up to secondary and higher secondary levels in Bangladesh, we have analyzed our dataset regarding some parameters which are explained in the following subsections.

A. Statistics of Students and Teachers

Through this parameter, we find the number of students enrolled in the ICT class of an institution. From this parameter, we can find the average number of students enrolled in an ICT class. On the other hand, the number of teachers engaged in each institution is very important to ensure quality education. We find the average number of teachers employed in each institution.

B. Students-Teacher Ratio

The student-teacher ratio (STR) means the number of teachers in proportion to the number of students at every institution. We can measure the students-teacher ratio in two ways. First, STR can be measured by the following equations:

$$STR = \left\lceil \frac{S_{total}}{T_{total}} \right\rceil \tag{1}$$

where S_{total} indicates the total number of students attending an ICT class in an institution and T_{total} defines the total number of teachers employed in an institution for conducting the ICT class. Using equation (1), the ratio can be expressed as $students: teacher = STR: 1$. This parameter helps us to determine how many institutions have sufficient teachers for their students to conduct the ICT course.

C. Statistics of Computers in the ICT Lab

[1] https://github.com/tusharcsebd/Survey-on-ICT-Education-in-BD/

In this case, we calculate the total computers allocated to the ICT lab in each institution at the secondary and higher secondary levels. We also calculate the average number of computers for each institution by dividing the total number of computers by the number of institutions. From this parameter, we can figure out the adequacy of computers for ICT students.

D. Students-Computer Ratio

Here we calculate the students-computer ratio (SCR) which means the average number of students assigned per computer (students/computer) in secondary and higher secondary levels separately. Here we calculate SCR by the following equation:

$$SCR = \left\lceil \frac{S_{total}}{C_{total}} \right\rceil \tag{2}$$

where S_{total} indicates the total number of students attending an ICT class in an institution and C_{total} defines the total number of computers installed in the ICT lab of an institution for conducting the ICT class. Here the ratio is expressed as $students: computer = SCR: 1$ with the help of equation (2). From this parameter, we also can calculate the average SCR in secondary and higher secondary institutions.

E. Educational Background of ICT Teachers

Here we collect information about the educational background of the ICT teachers engaged in both secondary and higher secondary institutions. Then we work with the following two parameters.

- *Percentage of Graduate and Post Graduate Teachers:* The responders give information about their last degrees (graduation or post-graduation) before they join the institution. From this field, we measure the percentage of teachers between these two-degree.
- *Percentage of ICT and non-ICT graduate teachers:* Moreover, we also get information about the educational qualification level of ICT teachers in every institution whether they are graduated from the ICT-related departments (such as CSE, ICT, ICE, EEE, ETE) or not. They respond with their major of graduation from there. We find the total number of ICT graduate exists in an institution or not. After that, we calculate the total number of teachers for ICT. To get non-ICT graduates, we use the following formula:

$$N = T_{total} - I \tag{3}$$

where N is the total number of non-ICT graduate teachers and I is the total number of ICT graduate teachers. After finding the number of non-ICT graduates and ICT graduates, we calculate the percentage of these two types of graduates.

F. ICT Syllabus Completion Status

This parameter represents the ICT syllabus completion status within the time. That means how many institutions can complete their syllabus within the time. Here we determine the percentage of teachers who can finish the syllabus more than equal to 80% or less than 80% of the ICT syllabus adopted in secondary and higher secondary levels. Here we also measure how the ICT graduate and non-ICT graduate teachers are performing for the completion of the syllabus.

4. Result Analysis and Discussion

After collecting the answer to these questions, we have converted our data in a structured format in MS-Excel. We use MS-Excel functions and python programs for performing mathematical operations which help us to generate our desired results.

Table 1. Data collection status of secondary and higher secondary institutions.

Number of Secondary Institutions	Number of Higher Secondary Institutions
63	39

Table 2. Data collection status of rural and urban institutions.

Number of Institutions at Rural Area	Number of Institutions at Urban Area
39	63

Table 1 and Table 2 show the information data collection status from secondary and higher secondary institutions. As shown in Table 1, we collected data from 63 secondary institutions and 39 higher secondary institutions. Among these institutions, 39 institutions are located in rural areas and 63 institutions are located in the urban area as shown in Table 2. The results of processed data are shown in this section. We have analyzed our data to find out several statistical information as follows.

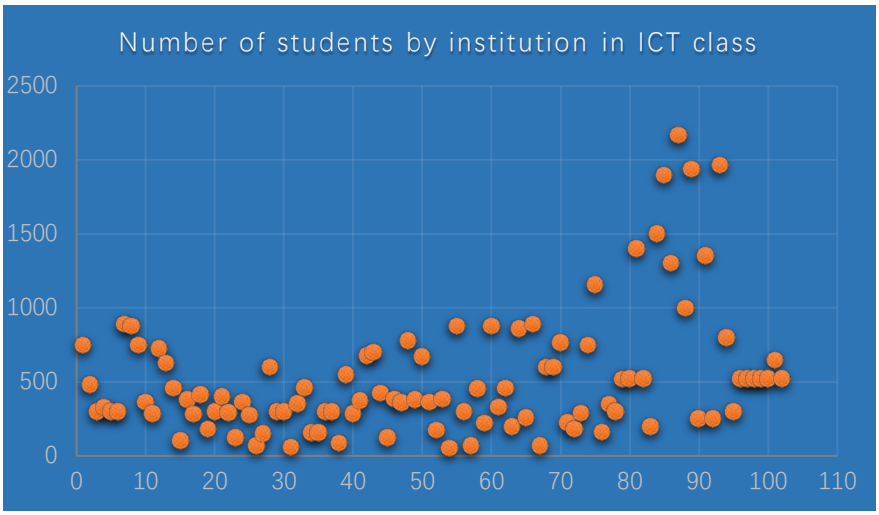

Fig.1. Number of students enrolled in the ICT classes by institution.

4.1. Statistics of Students and Teachers

Fig. 1 shows the number of students enrolled in the ICT classes from 102 institutions. Here we observed that most of the institutions have less than 1000 students in the ICT class. Moreover, only 9 institutions have more than 1000 students. Here we found that the average number of students is 524 in all institutions. Since ICT is a common course taught to all students enrolled in secondary and higher secondary levels, the average number of students in the ICT class is high.

Remark: During the data collection, the respondent from 7 institutions cannot give the exact information of their students, therefore we replace them using the mean [18] obtained from the rest of the 95 institutions.

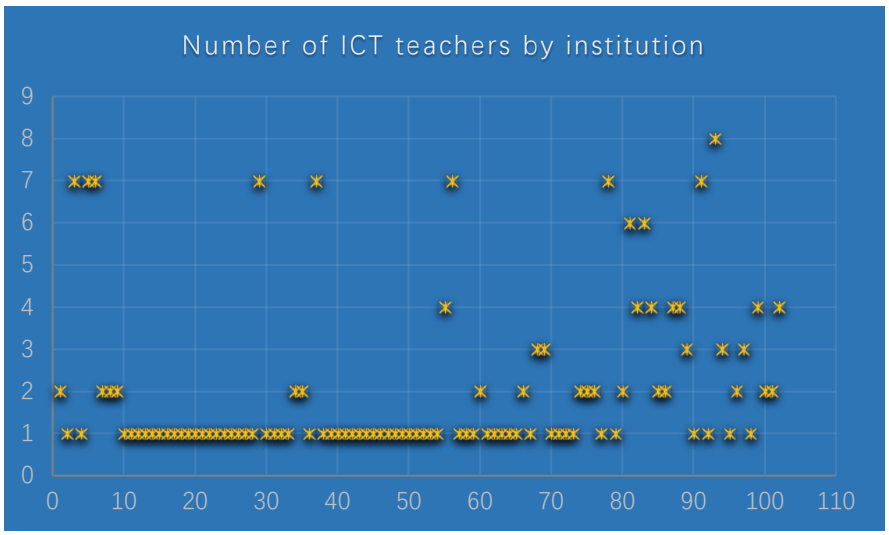

Fig.2. Number of teachers by institution.

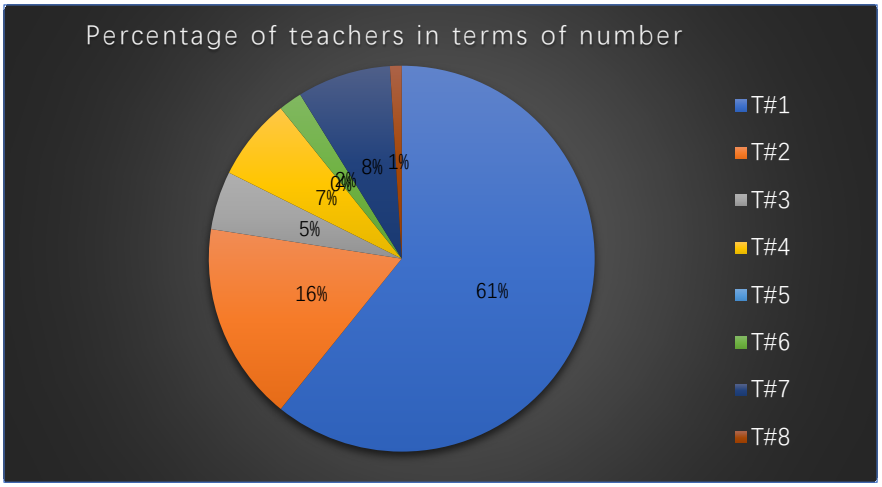

Fig.3. Percentage of teachers in terms of their number in all institutions.

From our collected data of 102 institutions, we show the number of teachers by institution is shown in Fig. 2. In Fig. 3, T#n ($n = 1, \ldots, 8$) represents the percentage of institutions having n teachers. From this figure, it is cognizable that most of the institutions (61%, see Fig. 3) have only 1 teacher for conducting ICT classes. Moreover, 16% of the institutions have two teachers and 5% of the institutions have 3 teachers. In addition, 7% (resp., 2%) of the institutions have 4 (resp., 6) teachers. Furthermore, 8% and 1% of the institutions have 7 and 8 teachers respectively, which is depicted in Fig. 3. We also found that 215 teachers were engaged in 102 institutions, i.e., every institution has nearly 2.11 teachers on average.

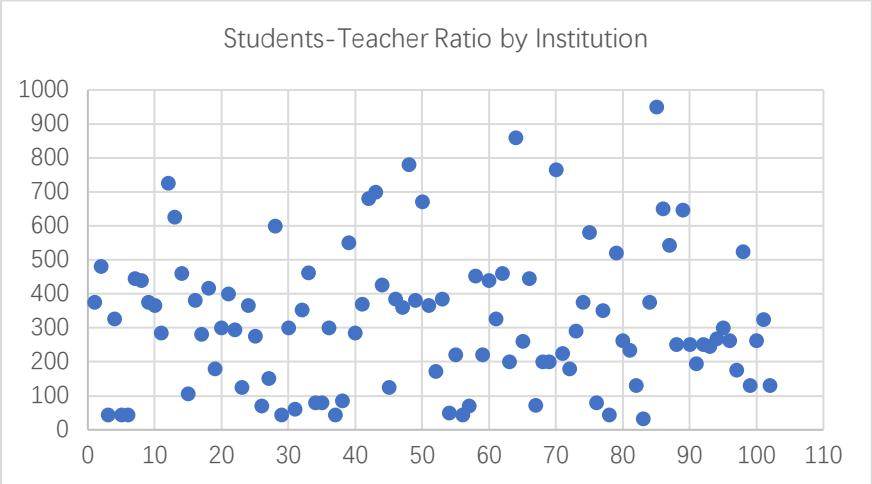

Fig.4. Students-teacher ratio (STR) by institution.

4.2. Students-Teacher Ratio

Generally, we show the students-teacher ratio (STR) by institution from our collected data in Fig. 4 which indicates how many students are assigned in a class per teacher in each institution. In this figure, we see that very few institutions have less than 100 students per teacher. The number of students varies from 100 to 800 mostly as shown in Fig. 4. In addition, two institutions have 860 and 950 students per teacher respectively.

Now we also calculate the average number of students in secondary and higher secondary levels of ICT class per teacher, which means, we calculate the average students-teacher ratio (STR) from our dataset by equation (1). Then we compare these values with the students-teacher ratio of Bangladesh data in secondary and higher secondary levels which are collected by UNESCO and stored in the world bank data repository [21, 22] as shown in Fig. 5. Here it is perceivable that the average STR for all courses at the secondary level in Bangladesh (2018) was 35.095 whereas our STR is 288.106 ($29963/104 = 288.106$) such that 29963 is total number of students and 140 is the total number of teachers in secondary level. Here STR for providing ICT education is very high which can be a barrier to provide quality education to the students. From our dataset, in higher secondary level, total number of students was 23510 and total number teacher was 111. In this respect, STR for ICT course at higher secondary level is 211.802 ($23510/111 =$

211.802) whereas it is only 28.669 for all courses in Bangladesh in 2018. Therefore, if STR is high in case secondary and higher secondary levels for ICT education, it will be difficult to provide quality ICT education for the students.

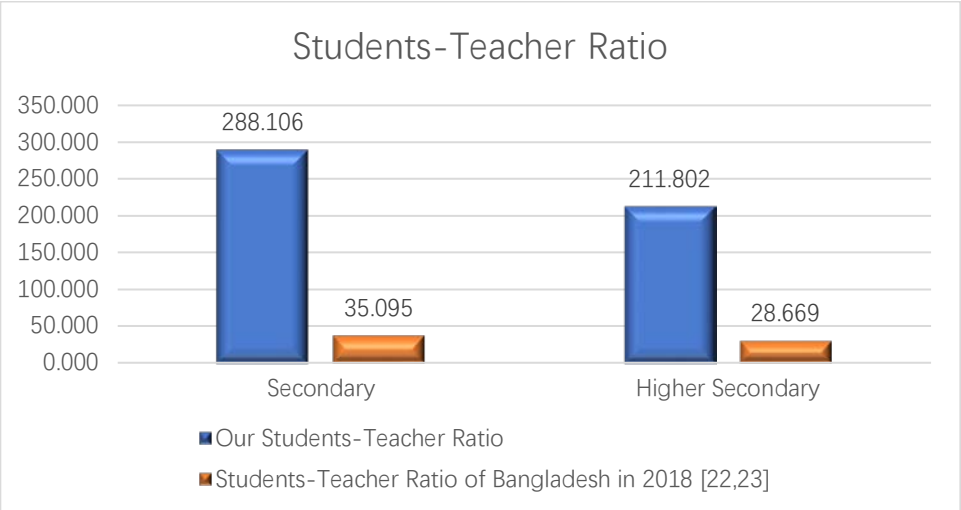

Fig.5. Comparison of students-teacher ratio between world bank data of Bangladesh in 2018 [21, 22] and our data.

4.3. Statistics of Computers in the ICT Lab

The number of computers in each institution is shown in Fig. 6. Here it is sensible that most of the institutions (76 institutions) have less than or equal to 20 computers for conducting ICT classes. Moreover, 7 institutions have 100 computers. The rest of the 19 institutions have 21-62 computers. Here the average number of computers in each institution is 20.75 such that $2076/102 = 20.75$, where the total computers is 2076 and the total institution is 102.

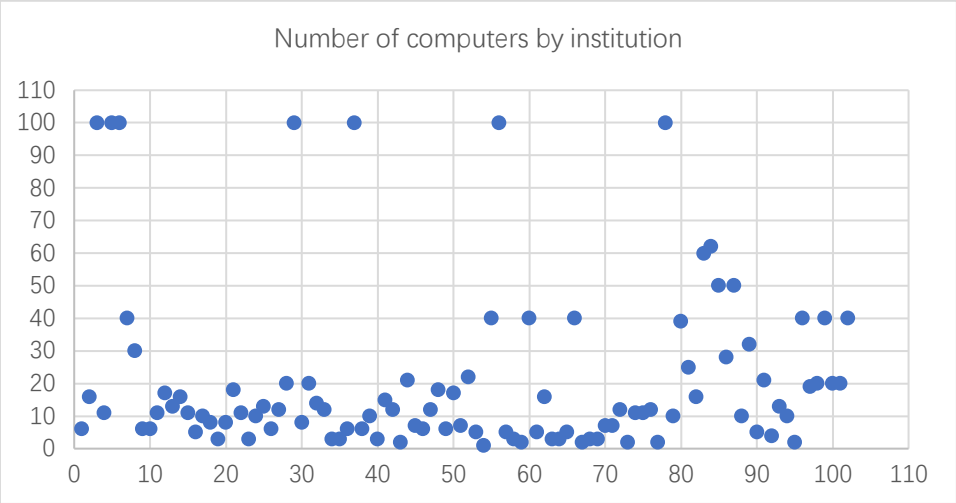

Fig.6. Number of computers by institution.

4.4. Students-Computer Ratio

The students-computer ratio (SCR) by institution is shown in Fig. 7. Severin and Capota [8] show that 1:1 computing has a positive impact on computer-based education especially ICT education, i.e., every student should be given one computer. Here the SCR by intuition is calculated by equation (2). From Fig. 7, it is graspable that no institution has one student assigned per computer. The value of SCR is as low as 3 and as high as 350.

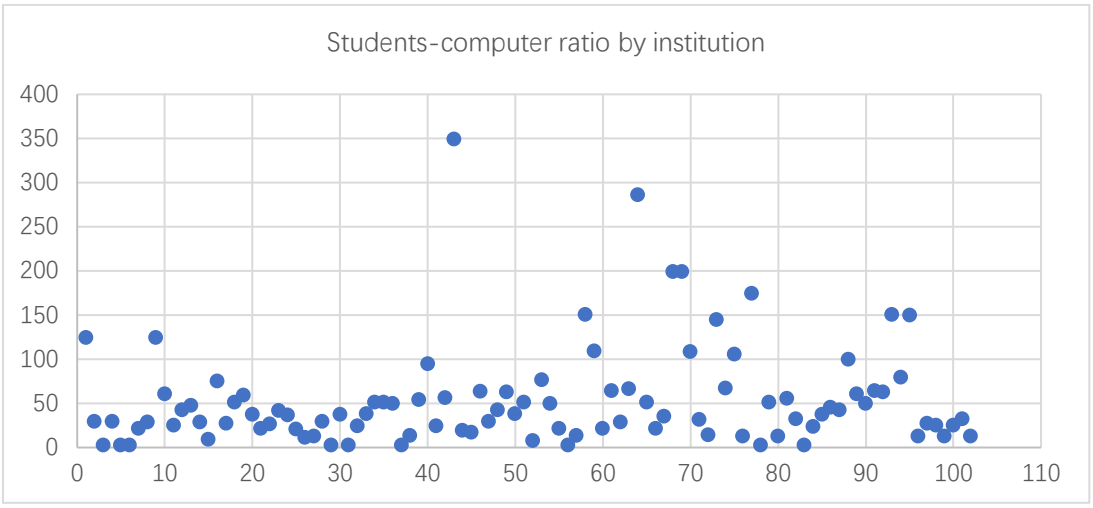

Fig.7. Students-computer ratio by institution.

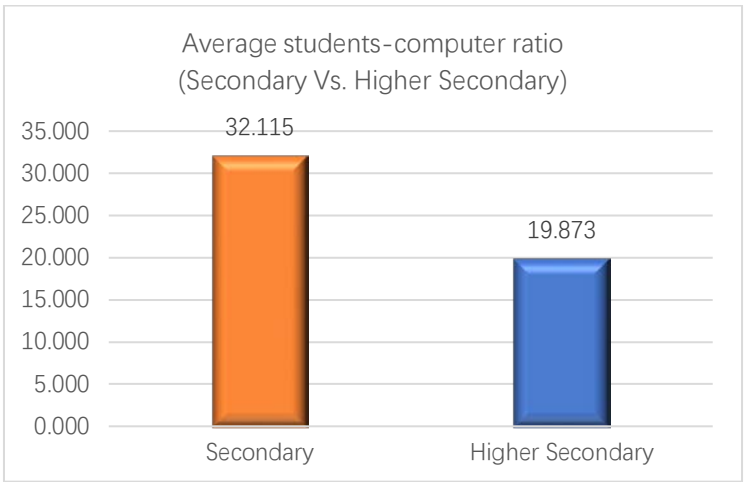

Fig.8. Average SCR of secondary versus higher secondary levels.

The comparison between secondary and higher secondary levels in terms of average students-computer ratio (SCR) is shown in Fig. 8. Here we get the average SCR in the secondary is 32.115 such that $29963/933 = 32.115$ where 29963 is the total number of students and 933 is the total number of computers in secondary level. On the contrary, SCR in the higher secondary is 19.873 such that $23510/1183 = 19.837$ where total number of teachers is 23510 and the total number of computers is 1183 in the higher secondary level. Here it is understandable that computers assigned to the secondary institutions are less than the higher secondary institutions.

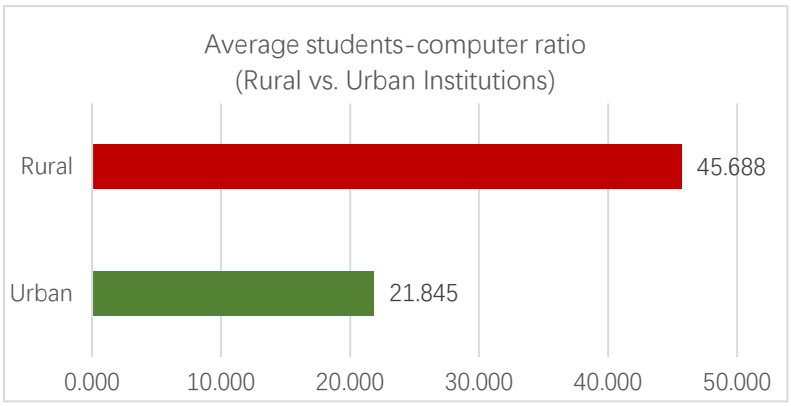

Fig.9. Average students-computer ratio between rural and urban institutions.

The average students-computer ratio between the institutions in rural and urban levels is shown in Fig. 9. From this graph, we find that about 46 students are assigned per computer (SCR) in rural institutions whereas about 22 students are assigned per computer in urban institutions. From Fig. 9, it is clear that urban students can use more computers than rural students. Therefore, institutions in rural provide fewer facilities to their students than the institutions in urban for utilizing computers.

4.5. Educational Background of ICT Teachers

From our collected data about the education background of 102 ICT teachers, we check their educational qualifications whether they are only graduate or they have also completed their post-graduation degree. Moreover, we also determine the percentage of ICT graduate and non-ICT graduate teachers.

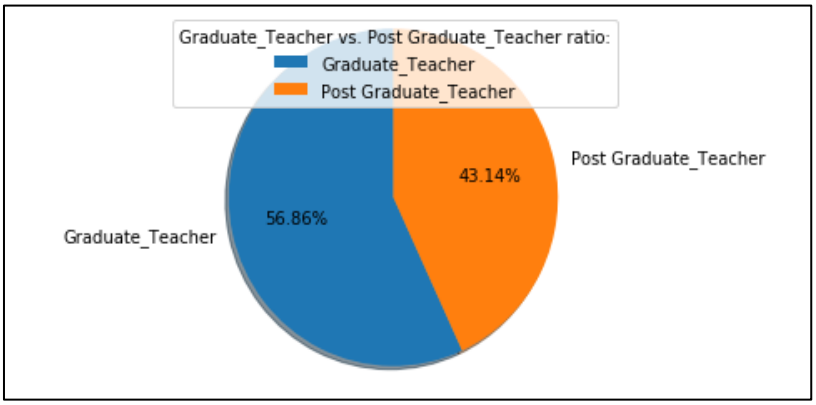

Fig.10. Educational qualifications of ICT teachers

- *Percentage of Graduate and Post Graduate Teachers:* Fig. 10 shows the educational qualification statistics of ICT teachers. From the figure, it is evident that about 56.86% of the teachers have completed their graduation, and the rest of them (43.14%) have completed their post-graduation.

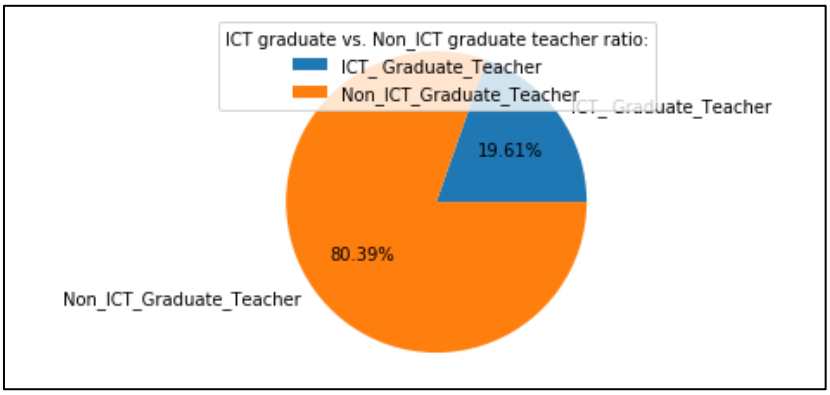

Fig.11. Percentage of ICT graduate teachers in all institutions.

- *Percentages of ICT and non-ICT Graduate Teachers:* We know that we have collected information from 102 institutions where 215 ICT teachers were employed. From these institutions, 102 teachers took part in our survey. Therefore, we check the education background of 102 teachers only. Fig. 11 shows the percentage of ICT graduates among these teachers in all institutions from our collected data. Here we found that only 19.61% of teachers have completed their graduation ICT discipline whereas 80.39% of teachers did not receive any ICT degree. That means, a vast number of teachers engaged in this profession have only ICT training.

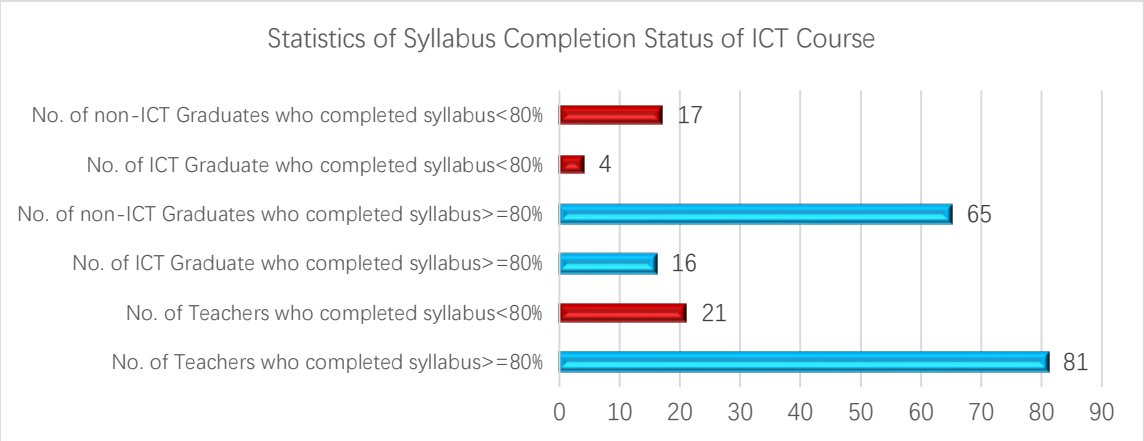

Fig.12. Number of ICT and non-ICT graduate teachers in all institutions completing or not completing ICT syllabus.

4.6. ICT Syllabus Completion Status

Fig. 12 and Fig. 13 show the number of teachers who can complete the syllabus of the ICT course more than and equal to 80% and less than 80% in time. As depicted in Fig. 12, 81 teachers (79.41%, see Fig. 13) were able to complete their assigned syllabus of ICT course in time, whereas 21 teachers (20.59%, see Fig. 13) were not able to complete the syllabus in time. Moreover, 16 out of 81 teachers had ICT degrees and the rest of 65 teachers were non-ICT background teachers who engaged in the institutions of our survey as depicted in Fig. 12. Furthermore, 21 teachers who did not able to complete the syllabus in time are mostly non-ICT graduates, i.e., 17 out of 21 teachers were non-ICT graduates. That means, about 81% of the teachers who did not able to complete the syllabus in time were non-ICT graduates and the rest of 19% were ICT graduates.

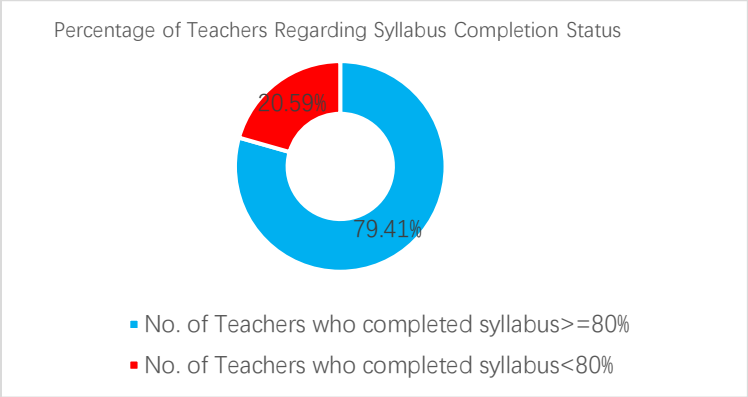

Fig.13. Percentage of teachers regarding syllabus completion status.

5. Finding and Recommendation

Now we explain our findings and recommendations in the following subsections.

5.1. Our Findings

As mentioned in the earlier section, we have analyzed our data regarding various parameters and found different results on the scenarios ICT education of secondary and higher secondary levels in Bangladesh. Based on the results, we have some findings of this study. These findings are listed as follows:

- Since STR in secondary (resp., higher secondary) is about 288:1 (resp., 212:1), existing teachers are burdened with heavy academic workloads.
- There exists a lack of lab facilities in the rural area compared with the urban area because about 46 students get a single computer in rural areas whereas about 22 students get one computer in the urban area for their laboratory works.
- Since about 80.39% of the teachers conducting ICT classes are non-ICT background. Therefore, there exists a great shortage of qualified teachers.

- About 19.61% of the teachers cannot complete 80% of their assigned ICT syllabus in time.

5.2. Recommendations

The government of Bangladesh has recognized ICT education as a major driver to drive the modern economy. But there is a gap between government vision and the actual implementation of that vision. In the previous section, we have found some of the factors which are the barriers to achieving the goal of ICT educations. GOB have to take proper steps to overcome the barriers so that Bangladesh can meet the demand for ICT. Based on the findings of this study, our recommendations are as follows:

- We know that ICT course is compulsory in every school and college in Bangladesh, that means, students from all groups, especially science, arts, and commerce, take part in the classes. But we found that many institutions have only one ICT teacher. To decrease the workloads of teachers, institutions need to increase the number of teachers conducting ICT courses in secondary and higher secondary levels. We recommend a maximum of 50 students per class and one teacher for a maximum of 50 students.
- It was also found from our study that there are limited facilities in rural areas such as the number of computers in the lab as well as the number of teachers. To decrease these gaps between urban and rural areas, virtual classrooms can be established where renowned teachers from urban can deliver lectures through the system and the students in a rural area can learn through the class. Therefore, we recommend that the education ministry and directorate of secondary and higher education of Bangladesh also should increase their budget in rural areas to provide the mentioned facilities.
- For ICT education in Bangladesh, inadequate number of computers are found in the ICT laboratory of the institutions. It is quite impossible to educate all the students of an institution utilizing one computer per 46 students in rural and 22 students in the urban area. Therefore, the ICT laboratory should be well equipped by increasing the number of computers in the lab as well as the space in the lab room. The GOB should allocate more funding to the institutions so that they can increase the number of computers and appoint required laboratory assistants.
- From the survey, we see that 80.39% of teachers involved in ICT education have a degree from the non-disciplinary subject. As a result, they cannot realize the actual need for their students as well as the demand of the subject and they are not familiar with the syllabus of the ICT course. Therefore, GOB should take steps to appoint more ICT graduates at secondary and post-graduate teachers at higher secondary institutions to give proper ICT education to the students.
- The engaged ICT teachers in all institutions should be trained up so that they can complete 100% of the syllabus of the ICT course in time.

6. Conclusion

Throughout this paper, we have shown the status of ICT education and the gaps between rural and urban institutions for providing ICT education through a survey on primary data collected from 102 ICT teachers of 102 institutions in Bangladesh. By analyzing the survey results, we have found some of the barriers for providing proper ICT education at secondary and higher secondary levels in Bangladesh. Most of the teachers are unable to give proper guidance to every student individually after the class since STR in secondary (resp., higher secondary) is about 288:1 (resp., 212:1) which is very high. Moreover, a lack of lab facilities exists in the rural area compared with the urban area. Since more than 80% of the teachers conducting ICT courses are non-ICT background, there exists a large shortage of qualified teachers in the institutions. We provide some recommendations to overcome those barriers. If we can increase the lab facilities and the number of qualified teachers with modern teaching equipment in the rural area institutions, we may be able to minimize the gaps between institutions in rural and urban areas. At the same time, GOB should take proper steps to achieve the goals for proving proper ICT education to the students. Due to the COVID-19 pandemic, all institutions are closed from March 17, 2019 to now. Therefore, we have been able to collect data only from 102 institutions, mostly from the Mymensingh district in Bangladesh. In future, we shall perform a comprehensive survey by collecting data from hundreds of institutions to explore its relation with other parameters to increase the quality of ICT education in Bangladesh.

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