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Readiness of Tertiary Level Educational System of Bangladesh to Cope with the Challenges of the Fourth Industrial Revolution

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Abstract

The global phenomenon is changing rapidly due to the advancement of technology and its usages in every sphere of life. It results radical changes in different sectors, terming it as a new revolution, the fourth industrial revolution. The fourth industrial revolution has brought challenges on the one side and it has also brought opportunities on the other side globally. The developed countries have already undertaken many initiatives to face the challenges and to capitalize the opportunities of the 4iR. But like many other developing countries, Bangladesh will face many challenges, including losing thousands of jobs in different sectors. To cope with the challenges of the 4iR, it is time to be ready with necessary skills. Considering the burning issue, this study intends to assess the readiness of the tertiary level educational system of Bangladesh. Rajshahi University was taken as case for this study. Eight departments under five faculties were purposively selected. Syllabus of these departments were reviewed to assess the readiness in terms of the 4iR. The study reveals that there are many limitations in offering teaching-learning activities at the tertiary level in Bangladesh in the era of modern information and communication technology. Among many others, some are: acute shortage of ICT-enabled infrastructural facilities, low speed internet connection, lack of lab facilities, its kits and modern equipment, lack of enough research grants, scholarships, mind set of faculty members, lack of professional development training of faculty members, lack of motivation of learners to face challenging situation, and so on. The existing campus political culture practised by both teachers and learners is considered another problem at the HEIs in the country. Despite such limitations, most of the faculty members are mentally ready to cope with any challenge caused by the 4iR. However, to cope with the challenges and capitalize the opportunities of the 4iR, the study puts some policy suggestions, including development of ICT-enabled infrastructure, modernization of curriculum incorporating global phenomenon, enhancement of lab and research facilities, establishment of a specialized training

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institute for professional development, introduction of research visit for faculty members and researchers , development of linkage between GO-University, development of academia-industry collaboration, organization of conferences and seminars regularly, keeping HEIs free from politics and ensuring safe and secured campus for students.

Keywords: Fourth Industrial Revolution, Higher Education, Readiness, Rajshahi University, Bangladesh

Introduction

With the invention of modern technologies and their rapidly changing features, the world has experienced various revolutions. From the invention of `Steam Power' which later led to the invention of `Electrical Energy' and `Automation' using computers and electronics, the global village has been moving fast forward tremendously. Thus, digital transformation touches every sphere of life profoundly. Now it is embedded from the planning to production that leads to consumption and feedback. Men to Machinery goes beyond Machinery to Machinery (M2M) and now men get taste only for services. Consequently, the global citizens experienced another revolution in the history of civilization which is branded as the fourth industrial revolution (4iR). The German scientists observed the revolution in 2011 while they were formulating a hi-tech strategy for their Government. Later, Professor Klaus Schwab advocated the issue profoundly at the 46th World Economic Forum Annual Meeting held in 2016. The meeting theme was `Mastering the Fourth Industrial Revolution' (World Economic Forum, 2016). It has been observed that the 4iR is the current and developing environment in which disruptive technologies and trends such as the Internet of Things (IoT), robotics, virtual reality (VR), and artificial intelligence (AI) are changing the way we live and work. Now the wave of 4iR has encompassed every sector very intensively. As a result, digital evolution embraces all over the world creating opportunities for those who can bag its fruits and pushing in challenges for those who cannot get benefits from it. Therefore, it is very important to get ready to cope with the challenges of the 4iR. Hence, among many other sectors, this study assesses the readiness of the country's higher educational system in line with the 4iR.

Some related literature review

The global village has been moving around the wave of the 4iR. To overcome the challenges of the 4iR, the developed countries have already undertaken necessary initiatives and set up strategies accordingly. So, a bunch of works is found in the international academic world. Some of the literature are stated below.

The World Economic Forum is considered as the pioneer for advocating the 4iR issues all over the world. It predicts its challenges and opportunities in public and private administration, business, environment, health, education, civil society, and so on. Founder and Executive Chairman of the World Economic Forum Professor Klaus Schwab explained that this era to be marked by breakthroughs in emerging technologies in the fields such as robotics, AI, nanotechnology, quantum computing, biotechnology, IoT, industrial internet of things, 5G technologies, additive printing, and fully autonomous vehicles (World Economic Forum, 2018).

The World Bank forecast the possible impact of the 4iR globally on employment. In its World Development Report titled *The Changing Nature of Work* states that:

> *Some service jobs are also vulnerable to automation. Mobileye of Israel is developing driverless vehicle navigation units. Baidu, the Chinese technology giant, is working with King Long Motor Group, China, to introduce autonomous buses in industrial parks. Financial analysts, who spend much of their time conducting formula-based research, are also experiencing job cuts: Sberbank, the largest bank in the Russian Federation, relies on artificial intelligence to make 35 percent of its loan decisions, and it anticipates raising that rate to 70 percent in less than five years. "Robot lawyers" have already replaced 3,000 human employees in Sberbank's legal department. The number of back-office employees will shrink to 1,000 by 2021, down from 59,000 in 2011. Ant Financial, a fintech firm in China, uses big data to assess loan agreements instead of hiring thousands of loan officers or lawyers (World Bank, 2019b).*

The 4iR would also embrace the education sector globally. Online education and training may be equally affected. Reaves observes that the future of work and the future of education are closely connected and the 4iR would bring changes in the nature of work and careers as well (Reaves, 2019).

A study jointly conducted by the a2i and International Labor Organization (ILO) reveals that as many as 54 lakh jobs of five major areas in the country would be at risk by 2041, which would be 60 percent of jobs in the garments sector alone (The Daily Star, 2018).

The Cabinet Division of the Government of Bangladesh through the Access to Information (a2i) programme identified five major sectors in the country which are supposed to be faced future skills challenges due to automation in these sectors. The major sectors are readymade garment and textile, leather and footwear, agro-food, furniture and tourism and hospitality. The study explored the jobs at risk in these sectors and put policy recommendations to tackle the challenges of automation in the country (GoB, 2019b).

A study conducted by the Bangladesh Computer Council under the ICT division explores the opportunities of the 4iR in the ICT sector in the country. The study finds that about 15 categories of major products have the opportunities to get the advantages of the 4iR. It also reveals that about five thousand professionals are involved in technologies related to the 4iR and it needed more than six thousand professionals having the 4iR technology competency by 2021. The study discloses that the existing academic programmes of Computer Science and Engineering offered by the reputed universities could not meet the requirements needed in the IT industry for leveraging the 4iR. The study states that the educational institutions in the country have a weakness to nurture 4iR related ten major soft skills among students due to lack of proper objectives and pedagogical limitations (GoB, 2019a).

However, the Government of Bangladesh has adopted a National Strategy for Artificial Intelligence in 2020 and identified seven national priority sectors namely—public service

delivery, manufacturing, agriculture, smart mobility and transportation, skill and education, finance and trade, and health. The strategy has also set six strategic pillars to achieve the slogan `AI for Innovative Bangladesh'. The strategy states:

> *If we can reskill our population in the right direction, we can join the new era of the fourth industrial revolution successfully. We need to engage higher academic graduates to innovate next-generation capital machinery and change Bangladesh's labor-intensive manufacturing strategy to knowledge-intensive eco-systems (GoB, 2020).*

The foregoing discussions make it clear that although there are some works on the 4iR, few studies have been conducted focusing on the readiness of tertiary level education in the country. Therefore, it is believed that this study would contribute to this academic field.

Statement of the problem

The world is progressing fast due to rapid changes in technologies. Global citizens are experiencing changes or modifications in technologies almost every day. Innovative usages of technologies have brought massive impacts on every sphere of life. Consequently, the world observes that 4iR is evolving exponentially and transforming entire systems of production, management, and governance. It creates opportunities on one hand and brings threats to employment on the other hand. The invention of robots and their usages creates immense threats to employment as it would replace the human workforce with machines or robots. According to the World Bank, about 57 percent of jobs in OECD countries, 47 percent in the USA, and 77 percent in China may be at risk due to an increase in automation (World Bank, 2019b). It is forecast that about 75 million jobs would be displaced by 2022 (Hawksworth, 2018). According to a study conducted by the a2i of the Government of Bangladesh, about 55 lakh jobs would be at risk due to the impacts of 4iR by 2040 in the country (GoB, 2020). So, Bangladesh would face challenges with employment issues in the years to come.

Therefore, proper policy decisions must be made to face the challenges of 4iR in the country so that people could bag the benefits of it. Hence, this study is conducted to get guidelines for policy suggestions.

Rationale of the study

The Government of Bangladesh has undertaken multi-dimensional initiatives for leading the country towards an upper middle-income country by 2031 and a developed country by 2041. The healthy scenario of different financial and social indicators has already been inspired and recognized by different international organizations to achieve the targets. In the last decade, the country has witnessed a remarkable advancement and achievement in the information and communication technology (ICT) sectors contributing the nation to transform into digital generation. Various international study reports reveal that usages of ICT tools in different activities have been boomed due to the contribution of 4iR. The World Economic Forum states that the 4iR is profoundly different from the other industrial revolutions. It is featured by a range of new technologies that are combining physical, digital, and biological worlds, bringing

impacts on all disciplines, economies, and industries (World Economic Forum, 2021). On the other hand, the World Bank observes that usage of robots especially facilitated with artificial intelligence is increasing globally. Consequently, it replaces the human workforce, leading to the concern of a jobless economy (World Bank, 2019b). It is a very common observation for all countries throughout the world that the highly educated and high-skilled personnel are always in a better position to adopt new technologies while the low-skilled and less-educated employees become jobless or incur less income. Despite adverse impacts on various sectors, it is also forecast that it would create 133 million new roles as a result of the new division of labor between humans and machines and algorithms for 4iR (World Economic Forum, 2018).

Under these circumstances, many questions are provoked such as is Bangladesh ready to cope with the challenges of 4iR? Is the country's educational system, especially the tertiary level, ready to cope with the challenges of the 4iR? Is this sector ready to capitalize the opportunities created by the 4iR? What types of initiatives have been undertaken for the huge number of graduates to enable them to face the challenges and capitalize the opportunities of the 4iR for their future employment?

Therefore, a proper education system, especially at the tertiary level, can be one of the most important tools to utilize the benefits of the 4iR in Bangladesh. A total of 151 universities both public and private are offering tertiary level education in the country. Among them, 46 are public and the rest are private universities (UGC, 2020). Among the public universities, 17 universities are treated as general universities and provide the lion's share of graduates for the job market every year in the country. According to the UGC's statistics, as many as 4085291 students were studying under public universities and more than 82 percent of the students are studying under the Faculty of Arts and Humanities, Social Science, and Business Studies**.** Generally, the students of these faculties remain far from ICT and other technical education owing to the nature of the curriculum. Consequently, it is an issue of great concern in the age of 4iR for their future employment. Therefore, it is very imperative to conduct research on this emerging issue for the sake of national interest.

Objectives of the study

As the wave of the 4iR touches every sector, proper curriculum and management of tertiary level education can contribute enormously to get benefits from it. Keeping in mind the reality, the main objective of the study was to evaluate the readiness of the tertiary level educational system to cope with the challenges of the 4iR in the country. However, the specific objectives were as follows:

- To review the status of the curriculum of the tertiary level education for addressing the issue of 4iR;
- To explore the readiness of the faculty members and students to face the challenges and capitalize the opportunities of the 4iR;
- To make policy suggestions to cope with the challenges of the 4iR for the country's education sector, especially higher-level education.

Methodology of the study

A mixed-method approach was followed in this study. Consequently, both qualitative and quantitative data were used to interpret the findings. For a systematic empirical investigation of observable phenomena via statistical, mathematical, or computational techniques (Bhawna and Gobind, 2015), the quantitative method is useful, and while the nature of the investigation is explanatory and exploratory, the qualitative approach is appropriate. This study followed both approaches. Therefore, the mixed-method approach was deemed appropriate to fulfill the objectives of this study and interpret the findings.

Sampling

All the general universities were considered for this study. But it was not possible to bring all universities under this study due to time constraints. Consequently, Rajshahi University being one of the largest general universities was selected purposively for this study as a case. There are 59 departments under 12 faculties, 6 Institutes and two research centres in Rajshahi University. It is believed that Rajshahi University, also the oldest one, would represent all the general universities and the findings can be considered from the perspective of general view for the tertiary level educational system in the country.

Study population and sample size

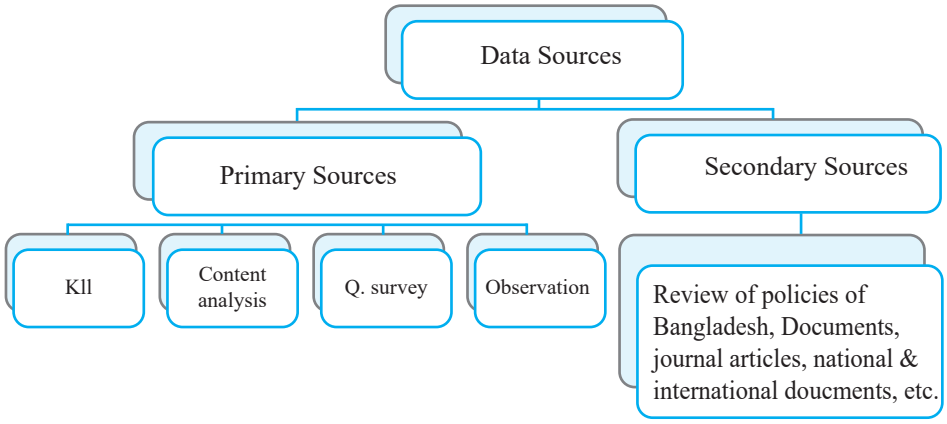
All populations engaged in tertiary level education would be considered as a population for this study. Specifically, populations include teachers, policy makers, ICT experts, personnel engaged in education administration, curriculum experts, and students. So, considering the case-oriented qualitative research, a reasonable number of respondents were selected purposively as a sample size. It is shown in the table-1.

Sources of data and methods of data collection

Data were collected from both primary and secondary sources. For primary data, a questionnaire survey and key informant interview methods were followed. These were conducted using both modes—online (virtual/telephonic) and offline—considering the pandemic COVID-19 situation in the country. Moreover, the curriculum/syllabus of the selected disciplines/subjects were also reviewed for primary data. On the other hand, policy reports of the government, documents, academic reports, books, journal articles, international documents, and so on were reviewed to collect secondary data. Figure 1 shows it at a glance.

Figure 1

Data sources & methods of data collection



Reliability and validation of the study

Maintaining validity and reliability are two key aspects of every research. In the current study, the validity and reliability were maintained in a professional way.

The draft survey questionnaires were presented before the panel of experts at NAEM for obtaining final validation and after complying the opinions of the expert panel, the questionnaire and other data collection tools were finally validated by the experts. As a part of validation, before going to collect data, the research team had a one-to one meeting with the experts assigned by the NAEM authority at the NAEN premise.

Methods of data analysis and presentation

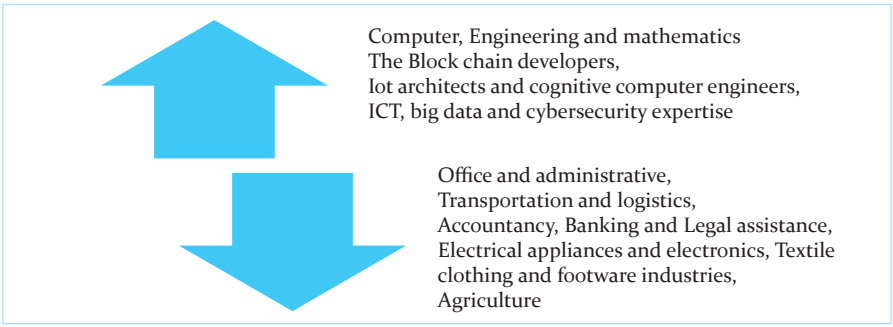
Three types of data were collected and analyzed to obtain the findings empirically for in-depth analysis. First, the secondary data and information were used to make an exhaustive literature review for obtaining validity and reliability of the study as well as set authentic criteria for making a survey on selected higher education institution (HEI). Second, the primary data were obtained through a survey and analyzed using quantitative tools like descriptive statistics. And third, KII, curriculum review, and physical observation were made to get qualitative data and analyzed in the descriptive form. However, the collected data were analyzed using different software like MS Excel and SPSS, and so on. Various forms of pictorial presentation such as a table, bar diagram, pie chart, column, line graphs where applicable were used in presenting results and inferences of the analysis. Finally, the quantitative inferences were compared, validated, complemented, and even quashed after comparing with qualitative findings (Bhuiyan, 2017). The observations and opinions of qualitative data were checked to whether the findings were seen as consistent enough with the research problem and context. Basically, the qualitative data were analyzed in a thematic manner. The major and important opinions were grouped into several thematic areas and then before taking any conclusive findings, the issue of corroboration, cross-examination, and repeated arguments were considered carefully.

Challenges and opportunities of 4iR

The fourth industrial revolution will bring both challenges and opportunities in different areas. Klaus Schwab observes that the 4iR has the potential to raise global income levels and improve the quality of life for people all over the world. He also observes that technology has made possible new products and services that increases the efficiency and pleasure of personal lives. Referring to the economists Erik Brynjolfsson and Andrew McAfee, he points out that the revolution would also bring inequality, particularly the labour markets would face the challenges severely. He further says that talent, more than capita, will represent the critical factor of production in the future. This will multiply the gap between low-skill/low-pay and high-skill/high-pay, increasing in social tensions (Schwab, 2016). Broadly, the 4iR will bring impacts on business, government systems and administration, and population. Balliester and Elshikhi observe that the 4iR will bring impacts on different occupations in different sectors. It will increase occupation opportunities on the one side and it will also decrease job opportunities on the other side in different sectors. The following figure 2 shows the expected increase or decrease in occupations and industries (Balliester, T and Elsheikhi, 2018).

Figure 2

Impacts of the 4iR: expected increase or decrease in occupations and industries



Note: adopted from (Balliester, T and Elsheikhi, 2018)

To face the challenges and capitalize the opportunities of the 4iR, different types of initiatives are needed. Among them, modernization of the higher educational system is very important and one of the most vital factor that would facilitate many other skill development initiatives.

Discussion and major findings

This section is dedicated to data analysis and the presentation there of in different ways. The whole discussion is divided into two sub-sections: the quantitative and qualitative parts. And, in the later part, findings are presented and recommendations are also stated accordingly.

Respondents, method of data collection, sample size and sampling technique

The following table-1 shows the number of respondents, selection method and respondents' categories. It was finalized at the research methodology and tools presentation workshop organized by the NAEM authority on December 7, 2021 where the researchers met one to one with the experts designated by the sponsoring authority. However, all the data collection tools were finalized at the workshop.

Table 1

Respondents' categories, methods of data collection & sampling, sample size

Data Collection Technique	Respondent Category	Sample size	Sampling Method
Content Analysis	5 faculties	8 departments	Purposive
KII-47	Representatives of policy makers (personnel of education ministry) ICT Expert (ICT Div/a2i Education administrator/ UGC personnel Deans Chairmen Curriculum experts (Academic-8, Employer-8, Alumni-8)	1 1 1 12 8 24	Purposive
Questionnaire survey (QS)-44	Professor Associate Professor Assistant Professor Lecturer	12 12 12 8*	Purposive
QS_Students-30	Current students	16	Simple random
Total QS-74	Ex-students	14	Simple random

Note: Based on Primary Data

* No lecturer under four faculties during the stndy period.

To know the policy issues and its implementation, it is very important to talk to the representatives of the policy makers and the people involved at the implementation stages. This is why, a total numbers of 47 people were interviewed as the key informants (KIs).

Besides, to explore the readiness status of HEIs, a numbers of 44 faculty members from twelve faculties were brought under questionnaire survey. Moreover, a total of 30 students were also brought under questionnaire survey to assess the readiness of the HEIs in terms of the 4iR.

Rajshahi University: Faculty, Student and teacher-student ratio

The following table-2 represents the numbers of faculty members, students and teacher-student ratio. It represents the figures of the last six years. It indicates that the number of faculty members were decreasing every year from 1230 in 2015 to 1097 in 2020. On the other hand, the number of students were increasing every year. Consequently, teacher-student ratio has widened every year accordingly. Further, it is noticed that the number of faculty members of different categories (Associate professor, assistant professor and lecturer) were decreasing over the time. It is observed that it happened due to promotion to upper layers. It is also observed that there was an embargo on teachers recruitment in the Rajshahi University. Consequently, it makes widen the teacher-student ratio. However, the university authority has reduced the number of students in different departments from the current academic session 2021-2022. It is believed that it would contribute to maintain the standard of teacher-student ratio in the university.

Table 2

Rajshahi University: Number of teachers, students and teacher-student ratio

RU at a glance

Number of teachers & Students (2015-2020)

Category of teachers	2015	2016	2017	2018	2019	2020
Total teachers	1230	1230	1216	1210	1150	1097
PhD teachers	571	570	555	764		
Professor	455	489	483	568	592	568
Associate Professor	317	299	294	270	286	285
Assistant Professor	334	348	345	275	224	188
Lecturer	124	80	80	92	48	56
Absent with permission	142	107	113	100	70	55
Student	34165	33200	36437	38230	38291	38291
Teacher-student ratio	1:28	1:27	1:30	1:32	1:33	1:35

Source: RU 50 Years Master Plan & UGC Report, 2018, 2019, 2020

Note: Based on Primary Data

Quantitative Part: Survey data presentation and discussion

Data have been categorized into different groups such as survey data, KII's data, and observation data. In the first section, survey data have been presented followed by KII, and observation. The quantitative data were collected using a structured questionnaire survey.

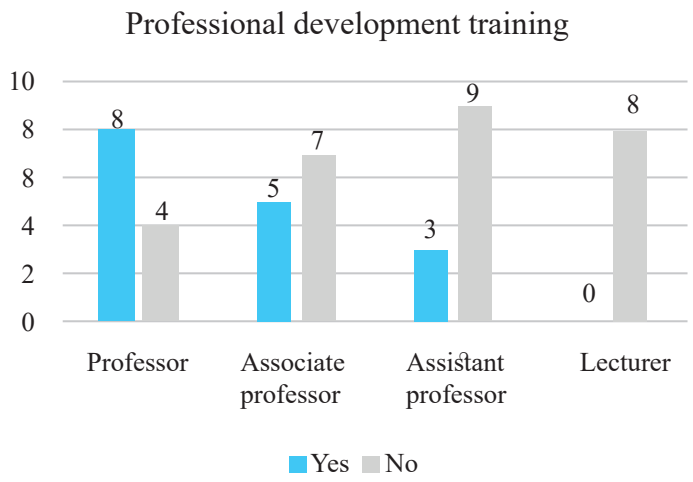
Faculty part: number of respondents

A total of 44 faculty members were brought under questionnaire survey in this study. Among the faculty members, 12 professors were selected from 12 faculties and in the same way, 12 associate professors, 12 assistant professors and the rest 8 lecturers respectively were selected from the twelve faculties. They were selected purposively for the research convenience. According to the Rajshahi University Diary 2022, there was no faculty member as lecturer under the Faculties of Arts, Fine Arts, Fisheries, and Veterinary and Animal Sciences (Rajshahi University, 2022). The faculty members observe that it is happened due to promotion to upper grade from lecturer to assistant professor. Besides, there was an embargo on teacher recruitment in the university. As a result, the number of lectures has been decreased. It is shown in the table-2 above.

Professional development related information

Figure 3

Professional development training

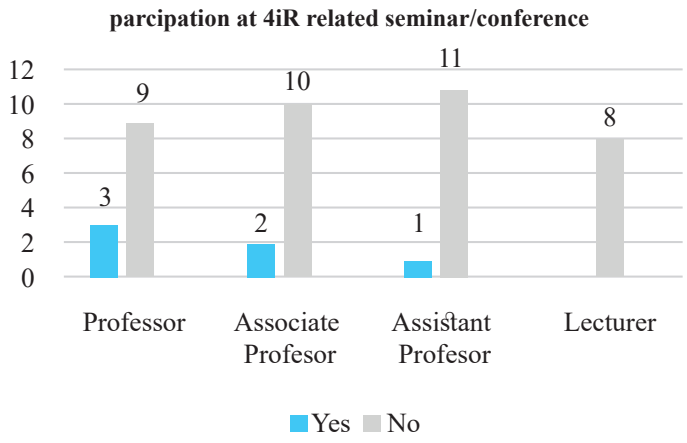


The figure 3 shows information about professional development training of the faculity members about professional development. It shows especially that lecturers do not have any traial about it.

Participation at training/workshop/seminar/symposium/conference related to 4iR

Figure 4

Participation in 4iR related seminar/conference



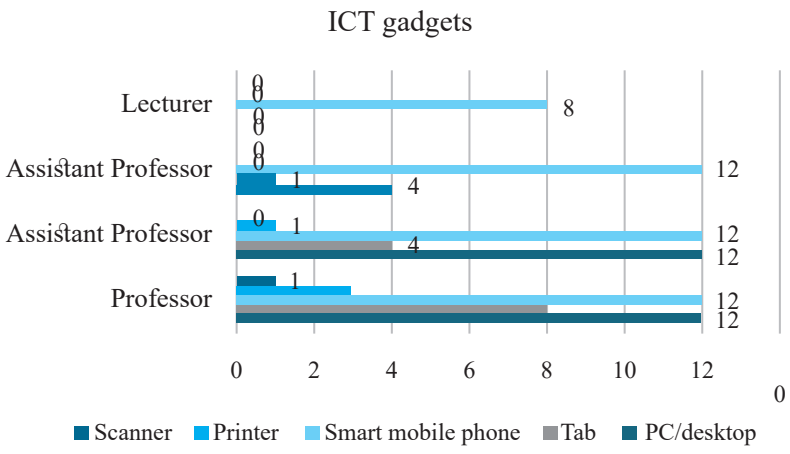
The figure: 4 shows information about participatign at the 4iR related seminars / conferences ley the faculty members. It also shows that the lecturers have not participated in such events.

Personal ownership of ICT gadgets

In the era of ICT and super communication, ICT gadgets are a must to be updated or to run daily life. Now, there is no work that happens without using ICT tools. There are various types of ICT gadgets in world markets. Everybody uses those as his/her own requirements. In education sector, the use of ICT tools is different from that of business organization. Some limited ICT gadgets are considered enough to continue teaching-learning activities smoothly. Moreover, in the era of 4iR, it is very essential to have own ICT gadgets. However, this study investigates to know about ownership of some ICT gadgets of the faculty members of the university. The figure-5 shows that all the faculty members have smart mobile phone set. Some also have tab and some have all such as desktop, smart mobile phone set, tab, printer and scanner and most of the respondents belong to professor category group. The figure shows that the lecturers have only smart mobile phone set. However, it is revealed the shortage of personal ICT gadgets of the faculty members.

Figure 5

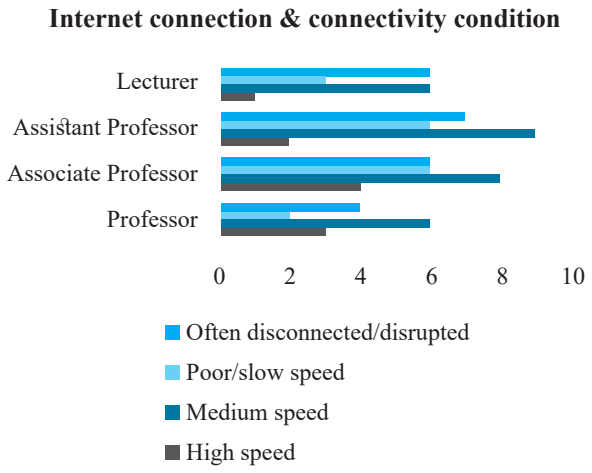
Personal ownership of ICT gadgets of faculty members



Internet connection, speed and satisfaction

Figure 6

Internet connectivity condition



In the era of 4iR, speed of internet is considered very important. This study investigated the issue among the faculty members of the university. The figure-6 shows that almost all the faculty members have the internet connectivity as medium speed. They hardly got high speed of internet connection in doing their works. But they have some bitter experiences such as often they face disconnection of internet during their works and slow connection is very

common phenomenon in the campus. Besides, while talking to the researcher, they describe that they also face `non-connection' of internet for days after days for different `unacceptable/ without notice' reasons. For this, sometime they miss important meeting and communication, they assert. So, under this situation, most of the faculty members are not satisfied over the speed of internet facilities.

On the other hand . the figure-7 shows the available facilities at the university. It reveals that majority of the repondents are satisfied over the facilities. But it needs to improve the facilities. However, the figure-8 shows that it needs more to do on different aspects including ICT facilities to meet the readingss for copiag with the 4iR Challenges in the corenty.

Figure 7

Satisfaction over the available facilities at the HEIs

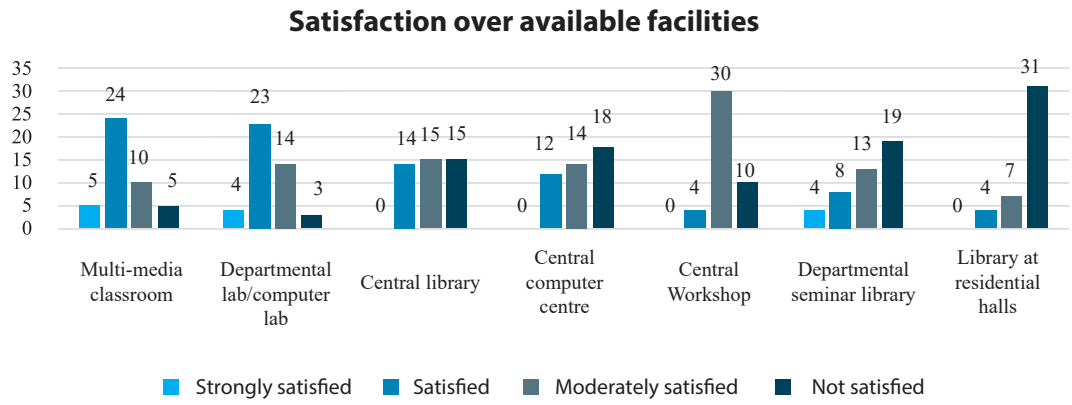
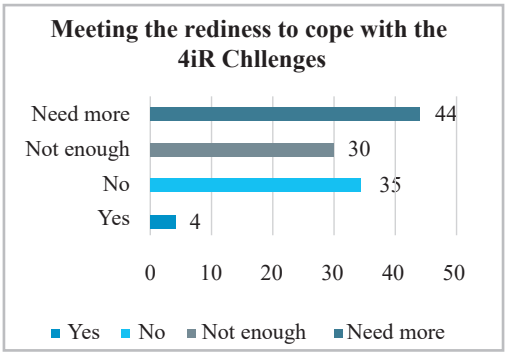


Figure 8

Meeting the readiness to cope with the 4iR challenges (multiple answer)



Student part

Are the students ready to cope with the challenges of the 4iR? This study tried to explore the readiness of the students in this respect. For this, a questionnaire survey tool was finalized with the consultation of the expert designated by the NAEM authority.

Social background of the respondents

Most of the students brought under the survey were from rural background. It is a common phenomenon in the public universities in the country. Because, still the educational expenses in the public universities are less than that of the private universities in the country. The figure-9 shows that 70 percent of the respondents come from rural social background while the rest come from urban areas. The figure-10 also shows the financial handship of the students faced by them during their academic life.

Figure 9

Social background of the respondents

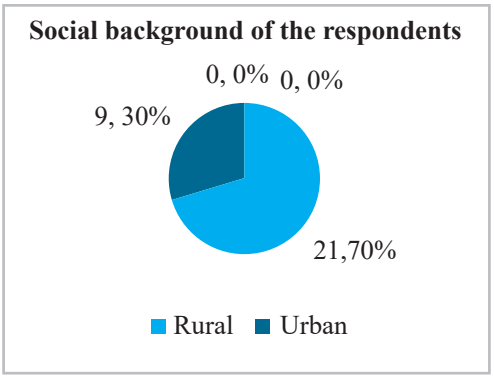
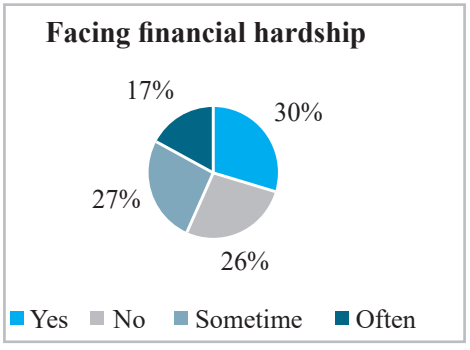


Figure 10

Financial condition of the respondents

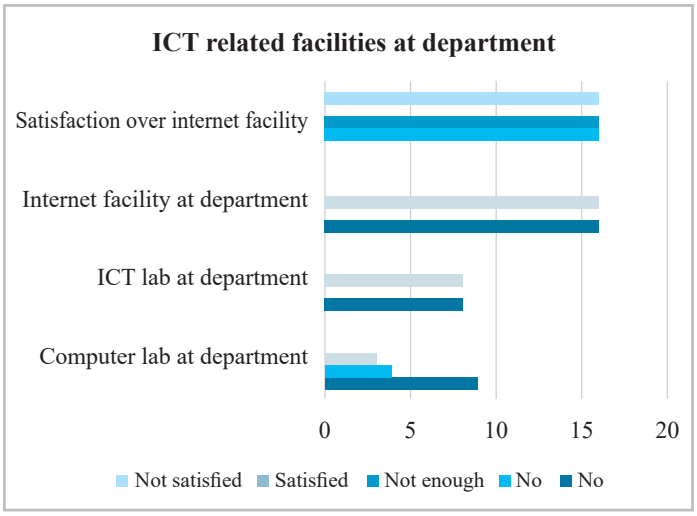


ICT related institutional available facilities

The respondents asked to reveal the ICT related facilities available at their departments in the university. Most of the respondents reveal that they have computer lab, ICT lab, 4iR lab and subject related lab at their departments. All the respondents assert that they have also internet connection at their departments. A few respondents assert that they have lack of such types of facilities especially computer and ICT labs at their departments. Though there are ICT facilities at their departments, they are not satisfied over the facilities they enjoy. The figure-11 shows the level of satisfaction over the ICT related facilities at the departments in the university.

Figure 11

Available ICT related facilities at department and satisfaction over it

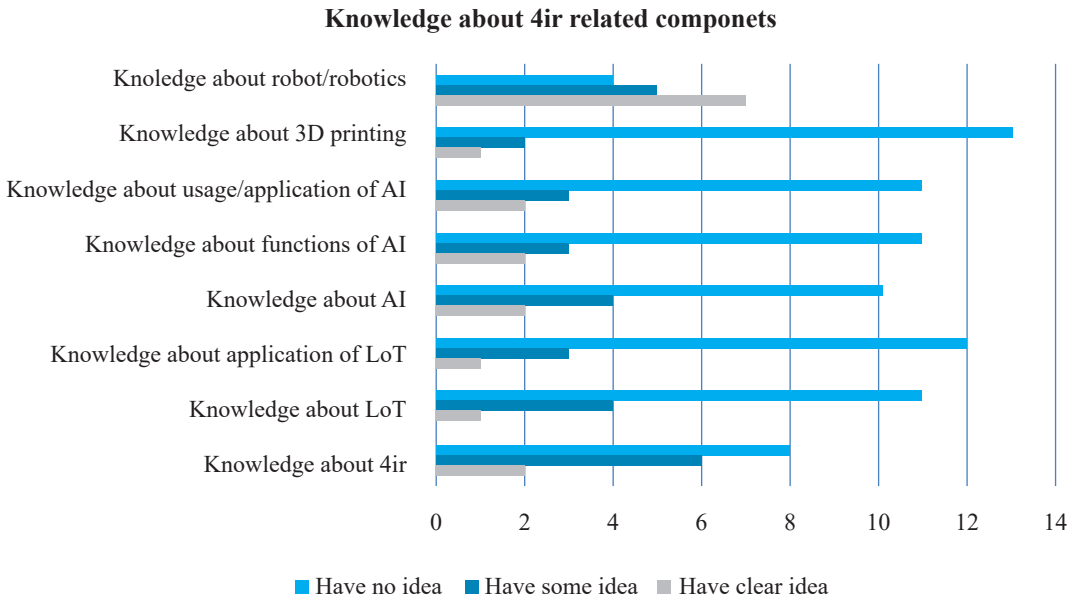


Knowledge about 4iR related major issues

The study tried to explore the perception and knowledge about the 4iR and its related issues among the students in the university. The study reveals that most of the students do not have much idea about the 4iR and its related issues/components. About robotics, the majority of the respondents especially the science background students have idea. It is also popular in the present global phenomenon. But the arts background respondents have some idea and some have said that they have no idea about robotics. They describe it as the matter of science disciplines. On the other hand, about 3D printing, most of the respondents do not have idea about it and its application. The same scenario is appeared regarding AI and IoT. Regarding 4iR knowledge, the study reveals that most of the respondents do not have much idea or knowledge about it. The figure-12 shows it. However, while talking to the students, apart from questionnaire survey, most of the respondents assert that the 4iR issue is comparatively new to them. The science background students are much aware of it than the non-science background students.

Figure 12

4iR related knowledge



Experiences of former students

The former students who were brought under the study shared their almost same experiences during their academic life in the university. What types of difficulties are they facing in the job markets after completion of their academic life? In reply to this query, most of the respondents assert that they were facing a lot challenges in the job markets. Referring to different types of experiences, most of the respondents told that in most cases there was a mismatch between academic study and job markets. They faced various tests or examinations for jobs/employment.

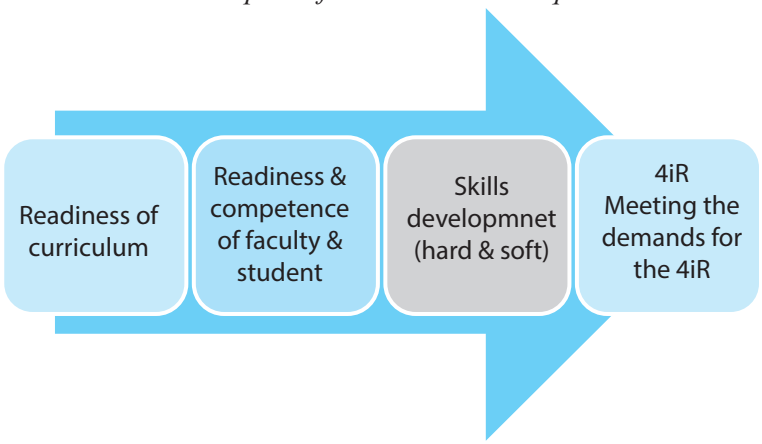
Qualitative Data Presentation

Data from Key Informant Interviews (KII)

The qualitative data were collected through conducting KIIs, in-depth interviews with the monitoring authority representatives, deans, chairmen, curriculum and ICT experts and employers. The key points of the interviews with KIs were checked through direct observations of the selected departments while visiting practically. The qualitative data were categorized into different thematic areas based on the following conceptual framework Figure-13 and discussed it accordingly. The gist of the theme-wise data related to the study is presented below. The figure-14 shows the curriculum approval process in Rajshahi university. Discussion has been presented accordingly.

Figure 13

Conceptual framework: Readiness path of the HEIs to 4iR requirements

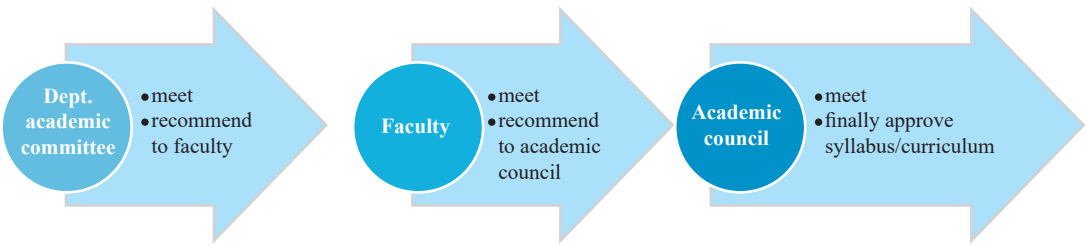


Responsibility of curriculum committee and syllabus approval process

The curriculum committee enjoys the supreme authority to introduce new courses and/or make all kinds of changes in the existing course contents of syllabus at the respective department. But it should be justified why new course (s) or any change is made. The curriculum committee is supposed to meet to finalize the syllabus before the starting of a new academic session. However, the departmental academic committee recommends and sends the `syllabus' to be offered for undergraduate and post-graduate as well as M.Phil and Ph.D to the Faculty for approval.

Figure 14

Curriculum/syllabus approval process



It may be mentioned here that the Faculty has the right to recommend any change in the proposed syllabus sent by the respective department. But the meeting never does it. The agenda generally are just read out at the meeting. Without knowing the titles of the courses or contents of the courses, all faculty members raise the voice for `pass' the syllabus as routine

matter and the Faculty Office sends it to higher authority for final approval. Therefore, the proposed syllabus received from the department is sent to the academic council without making any changes. The academic council is the final authority to approve the syllabus (figure-15). It is observed that generally the academic council at its meeting place all the agenda at a time of a respective faculty and requests or calls the respective dean to say `if there is any special agenda'. Then, the Dean stands up and say `there is no special agenda and all is routine matters' and if there is special agenda, then say, all is routine agenda but one or two is special which is needed to be discussed at this meeting and also is needed approval of this body. So, syllabus is approved as `routine matter' at the meeting. This is the supreme body for approval of the syllabus. It has all right to make any recommendations or changes in the syllabus of a department and it can instantly approve it or send back to the department to comply the observations or recommendations made at the academic council meeting. But it is learnt that it has never happened.

Review the readiness of curriculum

In this study, eight departments from five faculties were purposively selected for curriculum (syllabus review) analysis. Curriculum is one of the very import tools for quality education as well as readiness for future requirements. Curriculum analysis (contents of the syllabus) gives us a clear picture about its update and designed for meeting the future needs. A curriculum/ syllabus review checklist was developed with the consultation of the expert designated by the NAEM authority. To review the syllabus, faculty members of the respective departments were consulted. After reviewing the curriculum, it was revealed that the curriculum was designed based on their respective subject requirements. It was done very professionally.

However, every discipline has its own some basic areas to be covered for the undergraduate and postgraduate levels. Covering the basic areas of a particular discipline, some special courses are also designed in line with the current global phenomenon. Many of them claim that every year, when they design their curriculum at the beginning of an academic session, they review their course curriculum and if needed, they bring modification, inclusion and exclusion in the existing curriculum and also introduce new course(s) if it is deemed necessary considering the current local and global demand and phenomenon. Moreover, it depends on research/these level. If students are interested and the faculty members are engaged in research in the current issues, then it would be an effective to contribute on specialized areas, they observe. They also describe that the curriculum should always be updated in accordance with the current global phenomenon. They believe that their current curriculum more or less is ready to cope with the challenges of the 4iR in the country. But it is needed competent faculty members and necessary resources such as lab facilities, lab kits, modern equipment, proper environment and so on, they further observe. The major issues of the 4iR are artificial intelligence, robotics, internet of things, machine learning, 3D printing and so on.

On the other hand, in many cases, the tertiary graduates cannot meet the expected level of competency after completion of their graduation degree. It is supported by previous other studies. Some KIs observed that the existing curriculum can meet, in limited cases, the local and regional requirements of the job markets. But it is not enough. The curriculum should be

updated in line with the global phenomenon and it should be offered through proper pedagogical practices. The students must be able to acquire proper knowledge about their specific fields. Learning should be based on theory and practice where applicable, most of the KIs opined.

After presenting above data made by the KIs about curriculum, it is observed that data of the key informants reveal broadly in two dimensions. One is academic and another is business like. The academics see education from the philosophical perspective whereas the employers, another category of KIs, see education as like commodity. Graduates will be treated as competent human resources or like commodity and they will be hired in the job markets. They should be prepared accordingly for the job market, the employers observe.

On the other hand, the academics observe that there is a philosophy of education. All subjects should not be directly job market oriented. So, they observe that education is not a commodity but education through research develops the quality of commodities and brings diversification of commodities. Through research, it brings new invention, discovers new horizon and develops capability for adaptability in the ever changing global phenomenon. Through education, learners will be prepared for an enhanced capacity for complex problem solving, critical thinking, creativity, judgement and decision making, service orientation, negotiation and so on. That means both hard skills and soft skills are transformed into the learners through education, they observe.

Readiness and competence of faculty members

Competent faculty is very important to deliver the course curriculum effectively. Academic background, higher studies, professional development training, engagement in research, participation in conferences, seminars, symposiums, workshops and so on make the faculty competent and up to date with the ever changing global phenomenon. To know about readiness of the faculty members in terms of the 4iR, dean of all the faculties and chairmen of the selected departments were asked about it. The key respondents shared diverse answers. Most of the respondents claimed that except a few, all the faculty members are very competent to cope with the challenges of the 4iR. They need resources such as lab facilities, research environment, modern and sophisticated instruments, more financial grants, collaboration, incentives, recognition, appreciation, professional development training and so on. Some of the deans claimed that there are some very competent faculty members who are renowned in their respective fields in different disciplines. The key respondents observed that if proper resources and environment are provided and ensured, they would perform better.

The key respondents claimed that the faculty members are mentally prepared to face and cope with any challenge appeared due to the 4iR and other reasons. For this, it is needed strategic plans, resources and environment. The government should come forward with the strategic plans with the university authorities. The government should share their plans with the faculty members through various channels. That means a linkage between policy makers (government agencies) and university levels should be established so that the university can contribute to achieving national and international development targets through their research works, the respondents think. It is missing, they observe.

Regarding readiness in terms of the 4iR and quality of teaching-learning activities, the KIs think that quality teaching-learning activities depend on many factors. It needs quality teachers on one side and quality students are also important on the other side. Moreover, the usage of proper pedagogical methods, time-befitting and need-based curriculum, dedication to prepare lesson plans, lab facilities and research environment and its required resources are also very important for quality teaching-learning. These would help to be ready to cope with the challenges of the 4iR.

Readiness and competence of students

Apart from the faculty members, the study also explored the readiness and competence of students in terms of the 4iR phenomenon in the country. For this, the students were assessed from the view of the faculty members. However, almost all the deans, chairmen and faculty members think that despite many limitations, students prepare themselves accordingly as the educational institutions and faculty members want. But at the public universities specially in Bangladesh it is not possible due to various reasons, they observe, adding that most of the students come from rural areas and their socio-economic conditions are not so affluent. Consequently, they face, in many cases, shortage of required educational resources such as laptop, desktop, tab, and other ICT gadgets. The qualitative data are supported by the quantitative data stated above. Apart from socio-economic conditions, one of the deans said that

> *students should be prepared before entering into the university. Because, many students left a `particular department' after getting admission due to not having required prior knowledge to continue their study to this discipline and they may fear to fail in the examinations in the university. It might be happened due to `auto passed' or short syllabus at the HSC level. He further observes that due to lack of competence in the basic subjects, most of the students face difficulty at the university level.*

So, it is revealed that there is a lack of competence among the students to be ready to face the challenges of the 4iR.

However, most of the chairmen and faculty members observed that they are at the *`initial stage'* in terms of readiness to cope with the challenges of the 4iR. Therefore, it will take time to prepare the country's higher educational system to go for advanced stage to face the challenges of the 4iR and to capitalize the opportunities of the global transformation, most of the respondents observe.

Findings of the study and recommendations

The study reveals several limitations and the strategic gaps in terms of readiness in the era of 4iR in the country. The forthcoming paragraphs are dedicated to present findings obtained from forgoing discussions.

Curriculum development and review

The study reveals that the curriculum has been designed professionally based on respective discipline's requirements. Some of the science and engineering based departments have already covered many issues, covering the 4iR components. But there is still scope to incorporate more issues or contemporary topic or even course (s) at the different departments. The science and engineering based disciplines have more opportunities to do than that of non-science disciplines. However, the non-science disciplines have the opportunity to accommodate the soft skills.

ICT based teaching materials

It is also revealed that there is a huge shortage of ICT gadgets required for teaching-learning activities in the era of the 4iR. The faculty members faced shortage of ICT gadgets in one hand, the students also faced same case on the other hand. It is badly revealed during the Covid-19 at the HEIs in the country.

Resources and facilities

The study explored the educational resources available at the university, departments and residential halls or messes. However, educational resources include: books, journal articles, instructional technology, ICT gadgets, laboratory kits, and so on. On the other hand, facilities include: libraries with e-access, research laboratory, computer lab, internet connection with high speed facility, multimedia classrooms, teachers' accommodation, and so on. The study reveals that books are available at the central library of the university. Except a few departments, most of the departments have available books. But there is a paucity of relevant books at the residential hall libraries. On the other hand, required journal articles are not available at the departmental and hall libraries. But the central library provides virtual opportunities to access soft copies of journal articles to its users. However, there is shortage of resources such as ICT gadgets, laboratory kits and so on.

Although there are multimedia classrooms at the departments, facilities such as laboratories with kits, computer labs, high speed internet connection, teachers' accommodation are not adequate in the university. There is no e-library facility in the university.

Support to students

Support to students refers to providing sound educational environment, availability of educational resources with e-access to library, journals, modern lab facilities, internet with high speed connection, providing ICT gadgets, if possible, safe and secured environment for living with nutritious foods supply. A standard teacher-student ratio is another supporting issue for good mentorship in the university. The study reveals lack of these supports to students in the university.

Quality faculty members

Quality faculty members are very important for quality education and research in the university. It is a universal issue. So, for quality development, training is considered as one of the most important mechanisms. The study reveals there is no provision for professional development training either on pedagogical issues or research in the university. On the other hand, the study also explores that there is some mind set up problems among many faculty members over the teaching-learning practices in the university. The study further reveals the shortcomings in faculty recruitment policies in the university.

Quality students

The study reveals that most of the students studying in public universities in the country have come from rural background. Consequently, they belong mostly to disadvantaged group in terms of readiness to updated world. Therefore, they need grooming to be updated in line with the current changing local and global phenomenon. But the study reveals lack of this grooming practices in the university. Rather, they live under threat in many cases especially the university residential halls.

Policy coherence

It is revealed after literature review that the government has already undertaken some policy strategies in line with the 4iR challenges. In response to the challenges, the government adopted national policy strategies on artificial intelligence, robotis and IoTs (GoB, 2020). Most of the KIs in the university have little information about these national strategies. So, the study reveals that there is a lack of policy coherence between the government agencies and universities in the country.

Recommendations:

After presenting the findings, it can be said that the tertiary level educational system is facing a lot of problems and limitations in the country. With these problems and limitations, it is very difficult to face and cope with the challenges of the 4iR in the country. It is also difficult to capitalize the opportunities benefitted by the 4iR. So, initiatives should be undertaken to solve the problems and overcome the limitations. However, based on the findings, the study puts some policy implications for the betterment in adopting policies and preparing to face and cope with the challenges of the 4iR in the country.

Short-term

Update curriculum

As there is scope to modify course curriculum every year, curriculum should be updated in line with the current global phenomenon. One or two courses or topics related to current demands may be introduced at the departmental level in the university, considering the local and global phenomenon.

Training programme

Professional development training programmes should be organized regularly in the university. Professional development training for the young faculty members should be made compulsory. All faculty members should be brought under the training and information dissemination programmes in phases.

Research cell set up

A central research cell should be set up at the university level where all research works will be archived and displayed in the website. All research works should be coordinated through the research cell. The cell should be entrusted authority to monitor the progress of research works regularly. It would hold events for progress report dissemination regularly with a certain time interval.

Mid-term

Research and lab facilities

ICT facilities, high speed internet connection facilities, lab facilities, research resource facilities, publication facilities, and foreign research lab visit should be planed for the dedicated faculty members in the university. For this, allocation of financial resources should be increased logically.

Conference/seminar organization

Each faculty should be asked to hold international conference every year and the faculty members of the respective faculty should be encouraged to participate with research works/papers. Students should be encouraged to participate in the conferences. Besides, national conference, seminars, symposium, workshops should also be organized regularly under the leadership of each faculty.

Long-term

Training Institute

A national professional development training institute should be set up for the university faculty members and for the personnel engaged in teaching-learning activities in the country as there is no provision for mandatory professional development training for the university faculty members.

Academic-industry collaboration

There is still lack of understanding about academic-industry collaboration in the country. For this, motivational programmes for the industrialists and entrepreneurs should be undertaken to enhance the collaboration. It is observed that the businessmen/industrialists prefer to import goods in many cases rather than producing it locally. They hardly visit the

local universities for exploring their requirements and needs. On the other hand, the university authorities also hardly invite them to visit their research works and share the potentialities of the faculty members and students in the country.

Intervention at the policy level

Develop policy linkage (GO-University)

Strategic policy linkage should be developed between the government agencies and universities in the country. It would facilitate policy information dissemination among the stakeholders in the country. It would also contribute to updating course curriculum in line with the policy strategies and current requirements locally and globally. For example, a 6-member delegates lead by a director (joint secretary) of Bangladesh Hi-Tech Park Authority visited University Innovation Hub of Indian Institute of Technology (IIT) in India and University of Putra, Monash University, Sunway University in Malaysia from 13-17 May 2022. All the expenses in this connection will be borne by Digital Entrepreneurship and Innovation Eco-System Development Project. All the members were bureaucrats involved in ICT division (GoB, 2022). There was no university faculty member in the delegation team. so, it needs Go-university Collaboration and linkage.

Intervention at the institutional level

Safe and secured campus

Campus should be safe and secured for the members of the university (faculty, students, employees). It should be ensured that the campus is safe for the students. The residential halls should be safe and secured for the students. It should be ensured that there will be no feeling of insecurity or threat to life in the halls and on the campus.

Conclusion

The global phenomenon is changing with the advancement of ICT and its usages. It brings both opportunities and challenges. To cope with the challenges of the 4iR, it is high time to take a proper strategic plan, focusing the tertiary level educational system in the country.

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