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Ph.D. Dissertation of Philosophy in Education

**Development of Instructional Design
Principles for Using ICT in the Context
of Secondary Schools in Bangladesh**

방글라데시 중등학교 맥락에서의 ICT 활용을 위한
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To my enthusiastic research participants
standing in the very forefront to lead the educational development
in Bangladesh using ICT

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ABSTRACT

Development of Instructional Design Principles for Using ICT in the Context of Secondary Schools in Bangladesh

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Since early 2000, there have been an increasing amount of ODA projects and academic discussions regarding “Information and Communications Technology (ICT) in education” particularly in developing countries. Indeed, integration of ICT into education has been one of the significant issues in the field of educational development and cooperation. This is a crucial discourse to understand as many developing countries have been trying to reform their educational systems using ICT. In the case of Bangladesh, the integration of ICT into education related to an important policy agenda to achieve a “Digital Bangladesh,” in order to improve their education system with the use of ICT. However, a lack of teachers’ pedagogical use of ICT in the classroom has been raised as one of the challenges that impede the successful integration of ICT in education in Bangladesh. Although the current government of Bangladesh has committed to providing teachers’ professional development for using digital content, teachers’ use of technology in the classroom remains basic, with PPT presentations and teacher-led learning without instructional strategies.

Under these circumstances, this research aims to develop an instructional

design principle for using ICT in the context of secondary schools in Bangladesh. By employing the “development research” method from the field of educational technology, this research developed a first version of instructional design principles based on conducting a literature review and field research in Dhaka, Bangladesh. The first version of instructional design principles was verified three times via internal validation tests by expert reviews. Then the instructional design principles were consistently elaborated on by modifying them based on the feedback from the experts. The revised version from the internal validation results was again re-verified to determine if it could work in the research context of secondary school in Bangladesh through conducting a usability test with the help of Bangladesh secondary school teachers. Through an individual in-depth interview with secondary school teachers in Bangladesh via ZOOM, teachers commented on the applicability and usability of the principles in a real classroom environment in Bangladesh.

As a result of the usability test, strengths, weaknesses, and improvement of each principle and specific guideline were confirmed, and teachers made several suggestions for improving the final version of the principles. While most of the principles and specific guidelines were applicable in the actual classroom in Bangladesh, some principles such as “organizing an appropriate environment for multimedia class,” “provision of guideline to the learner before starting the class with digital content,” and “facilitating participatory approach with digital content” were noted as difficult to apply in the context of Bangladesh and needed more improvement. Based on the usability test result, the final instructional design principles were made up of five components, ten principles, and 22 specific guidelines. The final principles constitute mainly two parts: (1) teacher’s preparation for using ICT in the classroom (principle 1 - 5) and (2) teacher’s use of ICT during the teaching and learning activities (principle 6 - 10). Also, two distinctive factors were noted to be critically considered for developing the

instructional design principles in the context of developing countries: (1) the role of ICT expert teachers and (2) students' participation in utilizing ICT for learning.

Lastly, based on the results of this research, some implications were raised for the discussion on developing and applying the instructional design principles in the context of developing countries from two aspects: “educational technology” and “educational development and cooperation.” First, from the perspective of educational technology, it was discussed how the instructional design principles of this research had been developed in order to enhance the ICT capacity for Bangladeshi teachers. Also, this research provided a practical implication for applying the instructional design principles in the context of developing countries; (1) the system of teachers' professional development for ICT integration in education should be changed to a more flexible and collaborative teacher training programs by utilizing a teacher community led by expert teachers, and (2) the concept of “ICT in education” should be further extended by encouraging students' use of ICT for their learning. Second, in the discussion from the perspective of educational development and cooperation, it emphasized that teachers' pedagogy should be more prioritized than the technology itself. Thus, it addressed a structural contradiction of the government policy for multimedia classroom establishment that has influenced to prioritize more teachers' technology than pedagogy due to the lack of practical guidelines for “how to use ICT” in the classroom. Lastly, this research contends that providing practical instructional design principles for teachers' capacity development is highly necessary to successfully implement ICT in education developing countries.

Keyword: Instructional System Design (ISD), Educational Technology in Developing Countries, Bangladesh, ICT in Education, International Educational Development

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LIST OF ACRONYMS

A2i	Access to Information
ADB	Asian Development Bank
BANBEIS	Bangladesh Bureau of Educational Information and Statistics
BOU	Bangladesh Open University
CDT	Component Display Theory
CIDA	Canadian International and Development Agency
CPD	Continuing Professional Development
CVI	Content Validity Index
DFID	Department for International Development
DSHE	Directorate of Secondary and Higher Education
EFA	Education For All
ET	Elaboration Theory
GBS	Goal Based Scenario
GDP	Gross Domestic Product
GED	General Economics Division
GOB	Government of Bangladesh
GCE	Global Citizenship Education
HDI	Human Development Index
ICT	Information and Communication Technology
ICT4D	Information and Communication Technology for Development
ICT4E	Information and Communication Technology for Education
ID	Instructional Design
IER	Institute of Education and Research
IRA	Inter Rater Agreement
ISD	Instructional System Design
IT	Information Technology
JICA	Japan International Cooperation Agency
KOICA	Korea International Cooperation Agency
LDC	Least Developed Countries
MMC	Multimedia Classroom
NAEM	National Academy for Educational Management
NIP	National ICT Policy
ODA	Official Development Aid
OER	Open Educational Resources
PBL	Problem Based Learning
SDG	Sustainable Development Goals
TPACK	Technological Pedagogical and Content Knowledge

TQI-SEP	Teaching Quality Improvement in Secondary Education Project
TTC	Teacher Training Colleges
UDL	Universal Design for Learning
UITRCE	Upazila ICT Training and Resource Center for Education
UNDP	United Nations Development Programme
UNESCO	The United Nations Educational, Scientific and Cultural Organization
USAID	United States Agency for International Development

CHAPTER I. INTRODUCTION

1.1 Research Background

As demand for education has been increasing in many developing countries, Information and Communication Technology (ICT) was introduced as an alternative approach providing more opportunities for education to various groups of people and improve education quality. ICT is defined as “a diverse set of technological tools and resources used to communicate, create, disseminate, store, and manage information.” Thus, ICT in education refers to adopting technological tools in the teaching and learning process (Blurton, 1999; Shamim & Raihan, 2017). Since the Education For All (EFA) movements in 2000, a plethora of research argues that ICT will enrich teaching and learning environments and has the potential power to improve the quality of education, by facilitating educational reforms that change students into productive knowledge workers (Kumar Bairagi, Rajon, & Roy, 2011; Robinson, 2008; Trucano, 2005; Yusuf, 2005). Accordingly, many developing countries have continued to introduce ICT into their education systems, and the amount of Official Development Aid (ODA) for ICT4D (ICT for Development) programs have been gradually increasing with the belief that the diffusion of ICT will bring educational development¹ (Heejin Lee, Jang, & Ko, 2007). Just as the introduction of ICTs has industrialized countries into the information age, many developing countries are now anticipating that they can leapfrog several stages of development and bring wealth and improved social benefits through ICTs (Arias & Clark, 2004).

According to Hepp et al. (2004), ICT could play various roles in education,

¹ Development can be defined as a special case of change in things which may be considered to be systems: when change has occurred, development may be said to have occurred if one or more characteristic of the system has changed in a positive direction in terms of some valued criterion (Sanders, 1969, p.277). Thus, this research defines “educational development” as a positive change that occurred in educational systems.

such as pedagogical, cultural, social, professional, and administrative roles (Hepp, Hinostroza, Laval, & Rehbein, 2004). To be more specific, the integration of ICT into education will have a positive effect by increasing students' motivation and responsibility toward learning (Igna & Trif, 2017; Passey, Rogers, Machell, & Mchugh, 2004), providing equal access to education (Tinio, 2003), and through teachers' utilization in class preparation and administrative works (Hansson et al., 2018; Smeets, 2005).

Moreover, these expectations of the positive effects of ICT in education in developing countries have been widespread, especially in international agendas such as the Sustainable Development Goals (SDG) era since 2015. For example, the International Conference on ICT and Post-2015 Education was held in Qingdao, China, to create an interface between the education and ICT sectors, and discussed how ICT could be leveraged at scale to support the achievement of the post-2015 education targets (UNESCO, 2015a). During this conference, the international community agreed that ICT must be harnessed to strengthen education systems, knowledge dissemination, information access, quality and effective learning, and more efficient service provision at the global level (UNESCO, 2015a).

Conversely, some researchers have been skeptical about the role of ICT in education, as the factors affecting the impact of ICT on education could vary depending on the context and available resources. Some argue that the available evidence has not established a direct link between ICT in schools and learning outcomes, and the data supporting the actual impact of ICT on education is still limited (Trucano, 2005; UNESCO, 2006). Gulati (2008) also pointed out that ICT would rather bring the more significant disparity between advantaged and disadvantaged groups in society. Although ICT has the potential to lead to educational development, for developing countries, ICT in education is not always taken as an essential tool for educational development. Rather the impact of ICT

could vary depending on various factors.

Among the many factors influencing the effects of ICT integration on education, teachers' pedagogical use of ICT in the classroom, has been raised as one of the most critical factors (Dong & Newman, 2018; Frederick K. Sarfo & Elen, 2007; Watson, 2001; Webb & Cox, 2004). Of course, in educational reform with ICT, technological support, and accessible Internet should be the prerequisite factors. However, the teachers' appropriate pedagogical use of ICT could also be a vital aspect infusing technology into the classroom, because new models of instruction and different teaching styles need to be created when technologies are integrated (Snoeyink & Ertmer, 2001), particularly where the basic technology has already been set up.

Nevertheless, it has been criticized that current ICT in education policies do not focus on enhancing teachers' pedagogical knowledge. Rather, teacher education programs often offer a basic technology course or a one-size-fits-all approach resulting in teachers learning more about technology that is irrelevant to the development of their subject-matter knowledge and teaching knowledge (Jang & Chen, 2010; Kalogiannakis, 2010; Koehler, Mishra, & Cain, 2013). Combining new technologies with effective pedagogy has become a daunting task for teachers' professional development (Jung, 2005). Many teachers still have difficulty in deciding when to and when not to use ICT, while others are reluctant to use them at all, as most of the ICT training has been limited to the transfer of technological ICT skills, such as the usage of Word, Excel, and other functions related with the Internet (Watson, 2001). This limitation in teachers' professional development in ICT usage has resulted in the way classes are taught with ICT not having changed when compared to the traditional way of teaching (Suárez-Rodríguez, Almerich, Orellana, & Díaz-García, 2018).

One of the reasons teachers cannot appropriately utilize the ICT in their classroom is partly due to the lack of practical discussion on "how" to integrate

ICT in the classroom, and there have not been specific guidelines or instructional design principles for teachers. Concerning this, the specific instructional design principles need to be discussed, together with technological supports, when integrating ICT in education. The Instructional Design (ID) generally refers to the systematic development of instructional specifications using learning and instructional theory to ensure the quality of instruction (Alzand, 2010, p.4075). Since ICT is perceived as a catalyst for change and change in teaching style and learning approaches, teachers should be aware of the specific instructional design process using ICT. While international society has agreed on the critical role of ICT and its potential for educational development, the pedagogy that teachers should adopt with the integration of ICT remains unchanged because the specific instructional design principles are not provided. Particularly in the case of developing countries, where their educational reforms with the use of ICT have been an active process, discussion on the instructional design in the context of the educational environment of developing countries should go hand in hand with providing ICT infrastructures and teachers training.

In short, the discussions on ICT in education have so far been more focused on either “progressive transformation” or “disruptive transformation” (Avgerou, 2010) to the educational development. However, the instructional design process that helps teachers utilize ICT in their classroom has not been sufficient provided. In order to fully utilize the potential of ICT as a tool for educational development in many developing countries, the focus should also be on instructional specifications for more successful use of ICT in education.

1.2 Research Purpose and Questions

This research selected Bangladesh as the case country, where educational reform is currently forcing secondary school teachers to utilize ICT materials in their classrooms. Although many schools in Bangladesh are still experiencing a

lack of electricity and Internet, this research targets secondary school teachers, who are appropriately trained in using ICT, to explore the possibility of developing and applying the instructional design principles in the case of least developed countries.

In this regard, this research aims (1) to develop optimal instructional design principles for using ICT in secondary school in Bangladesh and (2) to investigate its usability in a secondary school classroom in Bangladesh. To achieve the primary purpose of this research, this research attempted to answer the following research questions.

1) What are the optimal instructional design principles for using ICT in secondary education in Bangladesh?

- 1-1) How usable are the instructional design principles in an actual secondary school classroom in Bangladesh?
- 1-2) What are the requirements for applying the instructional design principles in Bangladesh?

2) What factors should be considered when developing instructional design principles for ICT integration in the context of developing countries?

- 2-1) What are the roles of teachers to be considered when developing the instructional design principles in Bangladesh?
- 2-2) How does the instructional design principles facilitate students' participation in education with ICT?

1.3 Significance of the Study

Teachers' pedagogical skills are important to determine the effective use of ICT in educational settings, especially in the countries where educational development with ICT has just embarked. Educators agree that ICT has the potential to improve student learning outcomes and effectiveness if used properly

(Bork, 2002; Jhurree, 2005). In other words, effective ICT integration should focus on pedagogy design by justifying how the technology is used in such ways and why (Kang & Kim, 2012; B.-K. Kim, 2003; Wang & Woo, 2007). However, many teachers in developing countries, including Bangladesh, do not integrate ICT into their pedagogy in a meaningful way (Mou, 2016).

As suggested by Mishra & Koehler (2008), teachers need three types of knowledge to effectively adopt ICT into the teaching and learning process: Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK). This indicates that ICT in education is not only about using computers or having Internet connections but also about using the technology appropriately in pedagogy (Mou, 2016). However, still many international agendas or ODA programs for ICT in education do not consider teachers' pedagogical knowledge much, although ICT has been continuously discussed as a critical resource for educational development.

In the case of Bangladesh, most of the teacher training programs do not focus on the pedagogical principles, which is an essential part of facilitating the use of ICT in teaching and learning (Khan, 2014). Although teachers' pedagogical capacity is well-recognized in promoting ICT in education, teacher training is still limited to providing technological knowledge such as developing a visual presentation or basic software skills. The Government of Bangladesh (GOB) recognized the importance of providing appropriately trained teachers for the use of ICT in school and has made an effort to integrate ICT in school education as a national strategy for educational development (Ministry of Education, 2013). However, most teachers are currently using conventional teaching methods where students have minimal chance to explore their thoughts and ideas about a topic (Imon, 2017). Moreover, the prime task of the learners in the multimedia classrooms is only watching and listening to teachers' PPT presentations and not actively participating in asking questions or contributing to collaborative learning

tasks like group and pair work (Babu & Nath, 2017).

In this context, discussion on the instructional design principles for integrating ICT in education in developing countries is a timely and highly necessary topic in the field of international education development. The “instructional design principle” is a popular research area in educational technology that can provide teachers with the appropriate pedagogical knowledge based on educational theories. This “instructional design” provides knowledge regarding designing lesson plans or an optimal blueprint of class activity, and developing the instructional strategies for effective teaching and learning for teachers (C. Lim, 1996). Hence, the instructional design principle should be integrated into the discussion of ICT in education for education development in developing countries for the successful utilization of technology, as well as support for hardware or teacher training for technological knowledge only. In order to integrate instructional design principles into the discussion of ICT in education in developing countries, this research employed the “development research methodology” because it can produce context-specific knowledge that serves a problem-solving function and establishes new procedures, techniques, and tools based upon a methodical analysis of specific cases (Richey & Klein, 2005). It is a pragmatic type of research that offers a way to test “theory” that has only been hypothesized and to validate practice that has been perpetuated essentially through unchallenged tradition (Richey & Klein, 2005).

However, in educational development with ICT, research about instructional design is not at the forefront of the discussion. In order to ensure improvement in the quality of education through ICT in developing countries, concrete discussion toward “how to integrate ICT in the context of developing countries” should be consistently studied, together with increasing access to ICT. Still, practical instructional strategies, models, and programs that can be applied in real educational settings are scarce, even though a plethora of experimental research

has been done (C. Lim, 2015). Also, a majority of research about pedagogical consideration in the area of technology integration in education has been conducted in technologically advanced countries (Jhurree, 2005). Therefore, the research in exploring the possible instructional design principles for using ICT in the context of developing countries should be more actively debated by asking the question “how should teachers design the class with the ICT tools?” to provide prescriptive instructional strategies for successful integration of ICT in education in developing countries.

1.4 Terminology

ICT in Education/ ICT integration in Education

ICTs cover Internet service provision, telecommunications equipment and services, information technology equipment and services, media and broadcasting, libraries and documentation center, commercial information providers, network-based information services, and other related information and communication activities (Adeya, 2002). Hence, ICT in education/ICT integration in education is generally translated into the integration of ICT materials such as computers, online learning resources, Internet, multimedia projects into the classroom with the purpose of helping to improve the quality of the lecture.

Digital Content

Digital Content refer to the educational content in the form of digital data. Digital content can also be an ICT tool, but in this research, "digital content" mainly refers to "PPT presentation" or other visual and auditory materials used by Bangladeshi teachers. Therefore, in this research, "digital content" and "ICT materials" were interchangeably used because the primary ICT tool in Bangladeshi education is "PPT presentation," which is normally understood as "digital content" among Bangladeshi educators. Also, the "digital content development" course in

the teacher's professional development program is one of the important initiatives by the Government of Bangladesh to enhance teachers' capacity to present their subject using PPT presentation in the class.

Multimedia Classroom (MMC)

Multimedia classroom (MMC) refers to the classrooms equipped with one laptop, one multimedia projector, an internet connection, and a sound system. As a part of the vision 2021 agenda of the GOB, the "access to information (a2i)" project was initiated to reform the traditional education system by introducing ICT-based education. The MMC is one of the a2i projects for improving the quality of education in primary, secondary, and madrasah of Bangladesh (Khanam, Monem, Howlader, & Ahmed, 2013).

Instructional Design/ Instructional Design Principle

The Instructional Design theory and model deal with the knowledge of "how to plan the class," which is necessary for solving problems in the classroom within a given educational context (C. Lim, 2015). Instructional Design, therefore, aims to ensure the quality of education by applying learning and instructional theory. This research attempted to develop the "instructional design principles," which are composed of three layers: "component," "principle," and "specific guideline." The component is the upper category that constitutes a set of interrelated instructional design principles. Instructional Design Principle is an accepted rule of action for teachers to follow when preparing lessons. The specific guideline is a more detailed statement for action under the principles.

CHAPTER II. LITERATURE REVIEW

As this research analyses the case of secondary school in Bangladesh, this part will firstly review the current status of ICT integration in education in the context of Bangladesh. Secondly, a theoretical background regarding the instructional design theory and model will be reviewed. Thirdly, the application of instructional design in the context of developing countries will be addressed to show how the existing instructional design theory and models could be applied or modified in the Bangladeshi context. As a summary of the literature review, lastly, it will explain the necessity of providing the instructional design principles in Bangladesh.

2.1 Contextual Background: ICT in Education in Bangladesh



[Figure 1] Map of Bangladesh

Bangladesh is one of the Least Developed Countries (LDC) located in South-

Central Asia bordered by India, Myanmar, and the Bay of Bengal (see figure 1). Bangladesh is known as a densely populated country with a population of 168.1 million people as of 2019, among which 24.3% still live-in poverty as of 2016². According to the 2019 UNDP Human Development Index (HDI) statistical update, Bangladesh ranks 133rd among 189 countries with an HDI score of 0.632, having achieved medium human development. Between 1990 and 2019, Bangladesh has been achieving dramatic improvement in terms of life expectancy (increased by 14.4 years), mean years of schooling (increased by 3.4 years), and expected years of schooling (increased by 6.0 years) (see table 1). Also, indicators of extreme poverty demonstrate that poverty had fallen from around 50 percent of the population in 2000 to around 24 percent in 2016, and broad improvements in social welfare have been secured, and social safety net coverage has improved drastically³. Further, Asian Development Bank (ADB) reports that Bangladesh's economic progress has been substantial over the past decade, with a gradual increase in Gross Domestic Product (GDP) expected to reach 7.2% in 2019 (Aziz, 2020).

Although there are still many challenges, Bangladesh prepared its own goals and targets, led by the General Economics Division (GED) of the Planning Commission, to achieve the post-2015 development agenda (Ahmed & Rahaman, 2016). The Government of Bangladesh (GOB) has continued to implement policies and programs to increase access to education and training, improve the quality and relevance of education, reduce inequality in education, and leverage knowledge and skills in science, technology, and innovation (GED, 2018). Under these circumstances, this section will address the overall explanation about policies and initiatives for ICT integration in education and some challenges that

2 Cited from UNDP Bangladesh website accessed on Jan 19th, 2021 (<https://www.bd.undp.org/content/bangladesh/en/home/countryinfo/>)

3 Cited from UNDP Bangladesh website accessed on 19th Jan 2021 (<https://www.bd.undp.org/content/bangladesh/en/home/countryinfo.html>)

have remained in Bangladesh.

[Table 1] Bangladesh's HDI Trends

	Life expectancy at birth	Expected years of schooling	Mean years of schooling	GNI per capita (2017 PPP\$)	HDI value
1990	58.2	5.6	2.8	1,554	0.394
1995	62.0	6.6	3.3	1,752	0.434
2000	65.4	7.5	4.1	2,002	0.478
2005	67.8	8.4	4.5	2,383	0.514
2010	69.9	9.2	5.3	3,117	0.557
2015	71.5	10.3	5.8	3,936	0.595
2016	71.8	10.8	5.9	4,143	0.606
2017	72.1	11.2	6.1	4,340	0.616
2018	72.3	11.6	6.1	4,643	0.625
2019	72.6	11.6	6.2	4,976	0.632

Source: UNDP (2020)

2.1.1 Policies and Initiatives for ICT Integration in Education in Bangladesh

The GOB continues to put great effort in modernizing and revolutionizing the education system through ICT, promoting technology-based teaching and learning as a strategic lever to achieve Bangladesh's Vision 2021 (Ministry of Education, 2019). Table 2 summarizes policies and initiatives of ICT integration in education by the GOB from 2002 to 2013. In 2002, the GOB provided a policy guideline emphasizing that ICT use has to be accelerated as the key-driving element for socio-economic development (Bangladesh Computer Council, 2002). This "National ICT Policy (NIP)" aimed at developing a countrywide ICT infrastructure to ensure access to information for every citizen and put emphasis on producing a large number of ICT professionals, in order to overcome the shortage of trained and qualified teachers/trainers for ICT training (Bangladesh Computer Council, 2002).

Later in 2007, the "Bangladesh Vision 2021" emerged projecting an image of Bangladesh in the year 2021 that meets the hopes and aspirations of the citizens

of the countries and identified a set of measures to achieve the eight goals⁴ by 2021 (Nagorik Committee, 2007). The concept of Digital Bangladesh is based on the perspective that Human Resource Development (HRD) bring more people into the ICT industry to raise skill levels so that they can enhance competency in the globalized 21st era (Mazumdar & Alharahsheh, 2020). It has become the buzzword used by the present governing party for expansion of any innovative decisions in relation to ICTs (Mazumdar & Alharahsheh, 2020). Although ICT integration in education was not directly mentioned in the Bangladesh Vision 2021, the role of ICT was well-recognized throughout the entire document in various sectors such as governance, finance, and education.

[Table 2] Policies and Initiatives of ICT Integration in Education

Year	Policy/initiatives	Organization
2002	National ICT Policy	Bangladesh Computer Council, Ministry of Science and Information & Communication Technology
2007	Bangladesh Vision 2021	Nagorik Committee
2009	Digital Bangladesh	Prime Minister
2009	National ICT Policy 2009 (revised from 2002)	Ministry of Science and Information & Communication Technology
2010	National Education Policy (NEP) 2010	Ministry of Education
2013	Master Plan for ICT in Education (2012-2021)	Ministry of Education

Source: Author

The importance of ICT for national development was specifically described in the “National ICT Policy 2009,” which is a revised version of the National ICT Policy from 2002. Since “Digital Bangladesh” was announced in 2009, the GOB

4 The eight goals include (1) to become a participatory democracy, (2) to have an efficient, accountable, transparent, and decentralized system of governance, (3) to become a poverty-free middle-income country, (4) to have a nation of healthy citizens, (5) to have a skilled and creative human resource, (6) to become a globally integrated regional economic and commercial hub, (7) to be environmentally sustainable, and (8) to be a more inclusive and equitable society.

has come up with the National ICT Policy (2009), National Education Policy (2010), and Master Plan for ICT in Education (2013) to implement Digital Bangladesh by 2021 (Imon, 2017). Based on the “Digital Bangladesh” agenda, the updated “National ICT Policy 2009” in line with the national goals, objectives, and capabilities were published to maximize the use of ICTs for national development with ten broad objectives⁵, 56 strategic themes, and 306 action items (Ministry of Science and Information & Communication Technology, 2009). As one of the objectives in the NIP 2009, “Education and Research” was included emphasizing that “expand the reach and quality of education to all parts of the country using ICTs, ensure computer literacy at all levels of education and public service and facilitate innovation, creation of intellectual property and adoption of ICTs through appropriate research and development” (Ministry of Science and Information & Communication Technology, 2009, p.4).

In the following year, the National Education Policy 2010 was also prepared for the education sector indicating that the “proper use of information technology can lead to the achievement of expected skills, and technology can play a vital role in the eradication of corruption by bringing in transparency in the state machinery” (Ministry of Education, 2010). In this National Education Policy 2010, computer and ICT are included as compulsory courses in every stream of education curriculum such as, vocational, technical, or madrasah education (Morshed, 2016). Also, the National Education Policy 2010 identifies five ICT in education strategic priorities as follows: (1) promotion of ICT-enabled teaching and learning, (2) promotion of professional development of teachers using ICT, (3) promotion of ICT literacy for students, (4) promotion of ICT-enabled education-related citizen services, and (5) use of ICT in education administration (C. P. Lim, Ra, Chin, & Wang, 2020).

⁵ Ten objectives include 1) Social Equity, 2) Productivity, 3) Integrity, 4) Education and Research, 5) Employment Generation, 6) Strengthening Exports, 7) Healthcare, 8) Universal Access, 9) Environment, Climate and Disaster Management, and 10) Supports to ICTs

In order to implement a more detailed plan for accelerating the use of ICT in education policy under the National ICT Policy 2009 and National Education Policy 2010, the “ICT in Education Master Plan” was undertaken in cooperation with the UNESCO, Dhaka Office in 2013. This “ICT in Education Master Plan” is the representative policies for the use of ICT in education in Bangladesh, which is expected to facilitate and create the following opportunities: education for all, improvement of the standard of education, skilled manpower, eradication of the digital divide/discrimination (Ministry of Education, 2013). Especially for the secondary level of education, this plan aims to improve the quality of education by creating an ICT-enabled teaching-learning environment and building up the learners at the secondary levels as skilled human resources for a knowledge-oriented society that is responsive to the needs of the 21st century. In order to improve teaching and learning activities using ICT in the classroom, this plan set four objectives with specific activities under each objective: (1) educating the learners at secondary & higher secondary levels in modern and appropriate ICT education, (2) development of professional skills of teachers through ICT, (3) developing teaching-learning materials through ICT, (4) creating an education-friendly environment through infrastructural development of ICT. Moreover, the “multimedia classrooms,” “teacher-led content development,” “e-learning module,” “interactive digital text” in primary, secondary, and madrasahs levels across the country were planned according to the Master Plan for ICT in Education (Farhana & Chowdhury, 2019).

Based on those policies and the master plan for leveraging ICT in education, Bangladesh has consistently taken steps by actively developing and engaging in several ICT in education initiatives by government/non-government agencies and local/international organizations (C. P. Lim et al., 2020). The leading organization to implement the “Digital Bangladesh” agenda is “Access to Information (a2i)” under the Prime Minister's office with financial support from UNDP and USAID

which started from 2007. With the ambition of making teaching-learning more effective and enjoyable to the learners and teachers using ICT, a2i programs as a GOB's flagship ICT for Development program have taken a significant number of ICT initiatives in education for capacity development of the teachers and education quality improvement. A2i has followed a 3-pronged approach in its efforts to remodel education: (1) establishing Multimedia Classrooms (MMCs) in secondary schools, (2) training teachers on making ICT aided educational content, and (3) making an electronic version of textbooks available in primary and secondary levels including technical, vocational and madrasah institutions (Khanam et al., 2013). For teacher development, a2i developed a teachers' portal named "Shikkhok Batayon (Teacher's Window)" in order for teachers to upload countrywide prepared e-materials, and enabled teachers to use digital content in the multimedia classroom with images, animations, video, and audios to explain complex concepts in the textbook (Morshed, 2016). Hansson et al. (2018) pointed out that the teachers' portal is crucial for changing Bangladeshi education and preparing the young generation with quality education.

2.1.2 Teacher Training for ICT in Education in Bangladesh

As ICT is recognized to have a greater impact on education, teachers' professional development has become an essential part of achieving "Digital Bangladesh." Currently, the Ministry of Education (MOE) with the help of the a2i program and the Bangladesh Computer Council, is providing ICT teacher training to at least one teacher from each school that has a multimedia classroom (ADB, 2017a). The ICT teacher training courses in Bangladesh are implemented by several educational institutes such as the Institute of Education and Research (IER) from the University of Dhaka, and the Bangladesh Open University (BOU), National Academy for Educational Management (NAEM), and Teacher Training Colleges (TTC). These institutes provide Bachelor of Education (B.Ed.) and

Master of Education (M.Ed.) degree programs for both pre-service and in-service teacher training (see tables 3 & 4). According to the data from BANBEIS, the total percentage of the trained teacher at secondary school level in Bangladesh is 67.0%, among which 65.7 % are female teacher as of 2019 (see table 5).

[Table 3] Number of Teachers Training Institute, Teacher Enrolment by Management & Gender (2018)

Year	Management	No. of Institutes	No. of Teachers			Enrolment		
			Total	Female	% Of Female	Total	Female	% Of Female
2018	Public	84	1,345	342	25.43	18,580	10,803	58.14
	Private	132	914	330	36.11	6,166	2,728	44.24
	Total	216	2,259	672	29.75	24,746	13,531	54.68

Source: BANBEIS-Educational Database

[Table 4] Types of Secondary Teacher Training Institutes

Type of Institute	Number of Institute
Government Teacher Training College (TTC)	14
Private Teacher Training College	104
Higher Secondary Teacher Training Institutes (HSTTI)	5
Bangladesh Madrasah Teacher Training Institute (BMTTI)	1
National Academy for Educational Management (NAEM)	1
Bangladesh Open University (BOU)	1
Institutes of Education and Research (IER), Dhaka University	1

Source: Akhter and Alam (2016)

[Table 5] Number and Percentage of Trained Teachers by Management and Gender (2019)

Type of School	Management	No of Teachers	No of Trained Teachers			% Of Trained Teachers		
			Total	Male	Female	Total	Male	Female
Junior Secondary School	Private	20,418	5,408	4,030	1,378	26.5	26.4	26.9
	Total	20,418	5,408	4,030	1,378	26.5	26.4	26.9
Secondary School	Private	190,683	133,512	101,766	31,746	70.0	70.8	67.5
	Public	12,172	9,343	6,736	2,607	76.8	77.3	75.4
	Total	202,855	142,855	108,502	34,353	70.4	71.2	68.1
School and College (School Section)	Private	22,250	16,208	10,720	5,488	72.8	71.2	76.4
	Public	1,322	927	636	291	70.1	69.9	70.6
	Total	23,572	17,135	11,356	5,779	72.7	71.1	76.1
Total	Private	233,351	155,128	116,516	38,612	66.5	66.9	65.1

	Public	13,494	10,270	7,372	2,898	76.1	76.6	74.9
	Total	246,845	165,398	123,888	41,510	67.0	67.5	65.7

Source: BANBEIS (2019)

Among the many teacher training courses provided by various institutions for secondary level education in Bangladesh, TTC plays a central role in training teachers by offering two types of courses: full-time academic courses such as B. Ed, M. Ed under National University, and in-service training such as digital content development by Teaching Quality Improvement in Secondary Education Project (TQI-SEP) and subject-based Continuing Professional Development (CPD) training etc. TQI-SEP is the major intervention by the GOB with assistance from various development partners such as ADB, DFID, JICA, and the World Bank in order to improve access and quality of education in general by incorporating technology in education (ADB, 2017b; Morshed, 2016). Under this project, TTC and other training institutes offer 12 day-long training to learn how to develop digital content to use for their teaching and assessment in the class (Ahsan, 2018). In the “digital content development” session, teachers learn to develop their own digital content mainly using PowerPoint presentation and demonstrate their PPT slides at the end of the class (in the individual interview with teacher trainer at TTC on Oct 1st, 2019). Some other ICT teacher training content include the basic computer skills such as saving, retrieving, printing a document, producing word processed documents, sending and receiving email with attachments, and downloading resources for educational use (Chowdhury, 2011). Moreover, TTC provides an “introductory course to understand ICT for educational development”⁶ in support of teachers to develop the instructional design using ICT.

Besides TTC, Bangladesh Bureau of Educational Information and Statistics (BANBEIS) and Upazila ICT Training and Resource Center for Education

⁶ Course instruction of TTC provided via email through personal communication

(UITRCE) are also organizing the teacher training especially for the “Basic ICT training” for secondary teachers since 2003. As an attached department of the Ministry of Education, which is responsible for the collection, compiling, and dissemination of all kinds of information and statistics relating to post primary stages of education in Bangladesh, BANBEIS offers various ICT training programs such as basic skills in using computers for official work, computer training course on hardware, maintenance & troubleshooting, E-governance project management. Most of the ICT training in BANBEIS is conducted through two weeks of intensive course, where teachers need to take leave from their institution while participation in the training session. Table 6 shows the example of the ICT training programs conducted by BANBEIS.

[Table 6] ICT Training Program by BANBEIS

Day	Topic	Method
1st day	- Registration, Evaluation of Pre-test - Tea Break - ICT Basics and its Components	L & D ⁷
2nd day	-Operating System & File System - Tea Break - Introduction to MS Word, Formatting Document, Select, copy, move, delete, cut and paste, save	L & D Practical
3rd day	- Formatting Paragraph (Line spacing & Indenting) and Formatting Doc.by using Line Draw Box, Practical - Tea Break - Avro Bangla Typing, Spell Checking, Grammar, Thesaurus.	L & D Practical
4th day	- Insert Table, Picture, Word Art, Page Formatting (Create Header/Footer, Page Numbering, Footnote) and Printing - Tea Break - Introduction of MS Excel (Workbook Creating, Editing & Saving)	L & D Practical
5th day	- Formatting values in MS-Excel - Using of Functions SUM, AVG, MAX, MIN, COUNT - Tea Break - Data Filtering, Conditional Formula (Sum if, count if etc.) Creating Result Sheet, salary sheet & Practical Test	L & D Practical
6th day	- Formatting Worksheet and Chart & Practical - Tea Break - Internet, Web browser, Search engine and Download Image	L & D Practical

⁷ Lecture & Discussion

7th day	- Introduction to MS PowerPoint, PowerPoint templates & Practical - Tea Break - Changing the slide design, insert an image, text box, rotation, animation slides& Slide transition.	L & D Practical
8th day	- Digital Content, Use of Free maker Video Converter for cutting, joining and converting video - Tea Break - Project on Digital Content	L & D Practical
9th day	- Network, Internet & creation of email id - Tea Break - email, Internet browsing, download, visit important sites	Project L & D Practical
10th day	- Use of drop box, google drive and social media - Tea Break - Digital Bangladesh and Values and Ethics	L & D Practical
11th day	- Examination (Theory) - Tea Break - Examination (Practical), Post Test	Evaluation
12th day	- Trouble shooting, Evaluation of Resource Person - Tea Break - Review the Course& Closing Session	L & D Practical Evaluation

Nevertheless, many challenges are still hindering Bangladesh from achieving SDG 4 by 2030 with the use of ICT in education. Even though there have been a number of initiatives and plans for teachers' professional development for integrating ICT at the secondary level, it is argued that schools still lack teachers with professional training, adequate knowledge in their subjects, and pedagogical skills (GED, 2018). Also, many teachers tend not to use ICT in their class when they go back to schools after receiving the training due to the limited ICT resources at the school level, or a majority of the classroom practices remained teacher-centered, with limited use of ICT to enhance teaching and learning (C. P. Lim et al., 2020). There are complex reasons why teachers in Bangladesh have a lack of Technological Pedagogical and Content Knowledge (TPACK) despite numerous teacher development programs. It is partly because of a lack of training institutes and infrastructures, and partly because the current ICT teacher training is relatively short but trying to teach many topics within a short time. There are too many issues to enumerate the constraints for teachers' limited use of ICT in their classroom, but teachers' weakness in pedagogical skill, especially for the integration of ICT

at the secondary school level, need to be critically discussed if the GOB is aiming for educational reform with ICT.

2.1.3 Challenges and Opportunity of ICT in Education in Bangladesh

One of the most discussed topics for ICT in education in the context of developing countries is the limitation and challenges for integrating technology-rich learning environments into education systems. Such challenges include (1) lack of motivation of teachers to use ICT, (2) lack of teacher training, (3) lack of practical example of ICT integration in education (such as successful case, network system for sharing the experience of using ICT in education), (4) lack of educational resources (multimedia contents, curriculum that makes ICT use mandatory, guideline for using ICT), (5) lack of infrastructure, (6) absence of administrative support, and (7) lack of policies (HyunAh Lee, Kim, Shon, & Lee, 2011). Ertmer (1999) divides these barriers to ICT use in developing countries into two types: internal and external barriers. The internal barriers include those obstacles related to teachers' belief about teaching and learning, motivation, and competency for the new teaching methods. On the other hand, the external barriers indicate extrinsic obstacles to teachers, such as lack of ICT equipment, training programs, and other related support (Ertmer, 1999).

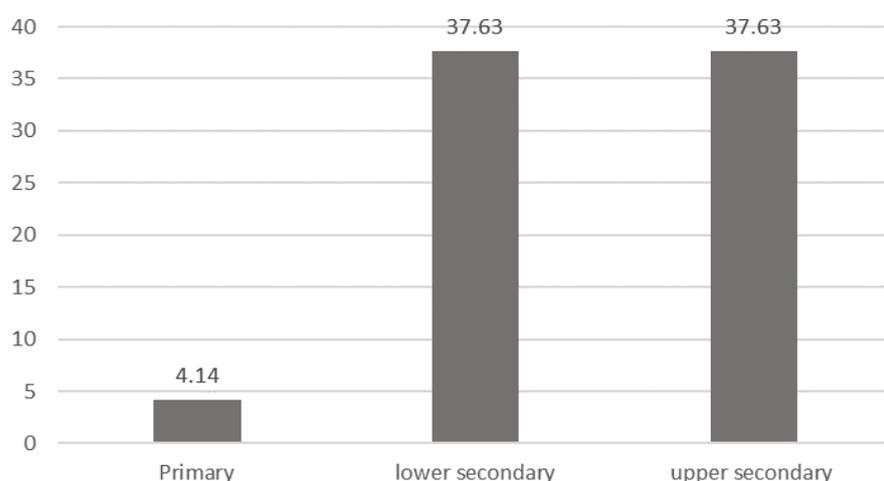
Ertmer (1999) explains that the internal barriers are more personal and deeply ingrained, making them harder to observe, and therefore less tangible than external barriers. Hence, many scholars have consistently mentioned the internal barriers as one of the significant factors influencing the successful integration of ICT in education. Particularly, when the infrastructure, internet and electricity have been gradually improved like Bangladesh has experienced, the internal barriers more critically affect to use of ICT by teachers.

Existing studies pointed out that teachers' low motivation and capacity to use ICT for their instructional purpose is mainly attributed to the inadequate teacher

training system. The ICT training system in many developing countries should provide in order for teachers to apply and integrate the technology into their teaching practice properly (Eom, Shin, & Han, 2011), yet, it is often criticized that the current ICT training for teachers tends to focus on merely instrumental aspects (Cabero & Barroso, 2016). Moreover, the way classes are taught with ICT has not been changed by using such resources compared to the traditional way of teaching in many developing countries (Suárez-Rodríguez et al., 2018). In most cases, teaching practices still follow a rigid chalk-and-talk, teacher-dominated, lecture-driven, and rote-learning pedagogy (UNESCO, 2015a).

In the case of Bangladesh as well, it is criticized that the current professional development programs for teachers exclusively focus on teachers' skills and competencies and overlooks other factors that significantly influence teacher professional learning and growth (Anwaruddin, 2016). The existing training courses, such as the "digital content development," merely focus on one basic technology course, and therefore the current multimedia classrooms do not provide a smooth picture as initially claimed by the government. It seems like these materials could not bring about the desired changes in the classroom without adequate training on how to blend technology with pedagogy (Babu & Nath, 2017). Currently, most Bangladeshi teachers are using ICT with their own PPT presentations after taking the "digital content development" course. However, the prime task of the learners is only watching and listening to the teachers' PPT presentation but not actively participating in the collaborative learning task (Babu & Nath, 2017). This is the opposite result of the government's expectation to make a "student-centered learning" using ICT in education. Moreover, a lack of teachers' confidence in using the multimedia content, the slow decision-making process at the government level, and limited access to use the materials outside the classrooms for students have also been raised as reasons hindering teachers from using ICT in their pedagogy (Babu & Nath, 2017).

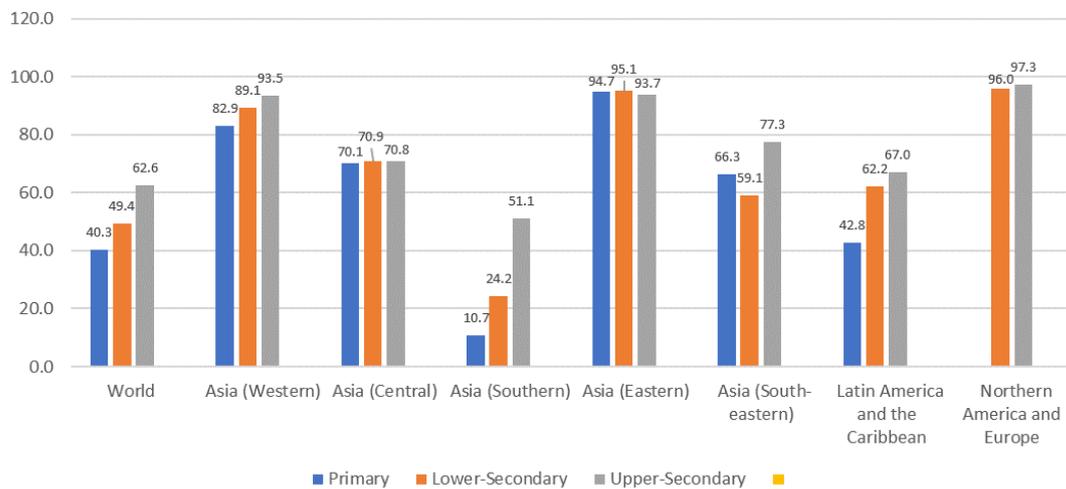
On the other hand, the external barriers are closely related to the lack of electrical supply and poor internet connection, which are the most critical part of using various ICTs in schools in developing countries. According to the latest available data from the UIS, the proportion of schools with access to the Internet for pedagogical purposes in Bangladesh is very low with only 4.14% at primary level and 37.63% at secondary level education (see figure 2). Considering that the world average is 40.3%, 49.4% and 62.6% at primary, lower-secondary, and upper-secondary level respectively (see figure 3), the current status of Internet access for pedagogical purpose at school level in Bangladesh is still challenging. Moreover, this data is a national average, and there is a large difference in internet access depending on the school location and head teachers' authority.



[Figure 2] Proportion of Schools with Access to Internet for Pedagogical Purposes in Bangladesh (2019, %)

Source: UIS database⁸

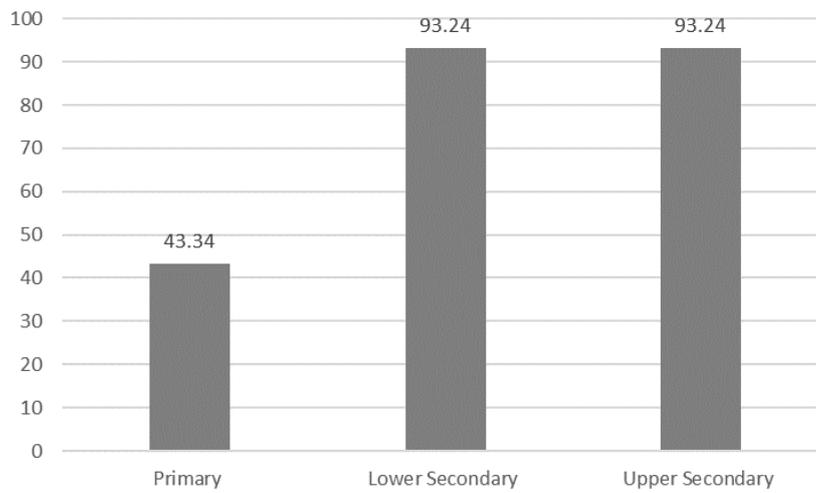
⁸ Data of primary level is from 2016



[Figure 3] Proportion of Schools with Access to the Internet for Pedagogical Purposes (2019, %)

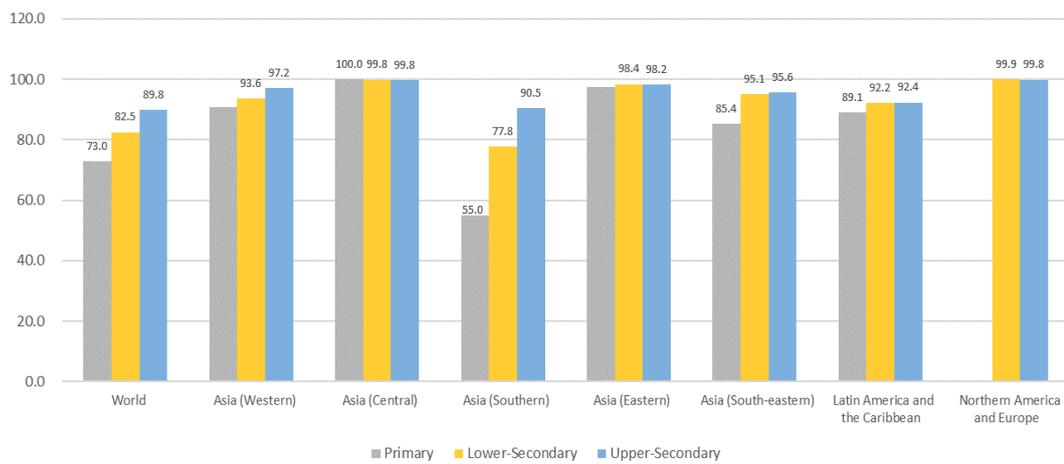
Source: UIS database

Meanwhile, the proportion of schools with access to electricity in Bangladesh is relatively high compared to the percentage of with Internet access (see figure 4). Specifically, access to electricity at the secondary level is slightly higher than the world average. Considering that 77.8% of lower secondary level in Southern Asia has accessible electricity (see figure 5), Bangladesh has improved in terms of electricity access at the school level, which is an essential step for using ICT in education. Although, it is still reported that the electricity is sometimes cut off, and particularly many rural areas do not have electricity (Mou, 2016), the GOB has made a great effort to overcome the external barriers at school level.



[Figure 4] Proportion of Schools with Access to Electricity in Bangladesh (2019, %)

Source: UIS database⁹



[Figure 5] Proportion of Schools with Access to Electricity (2019, %)

Source: UIS database

One instances where the GOB has struggled to overcome external barriers is the “establishing the Multimedia Classroom (MMC) project” implemented by a2i.

⁹ Data of primary level is from 2016

Through this project, the GOB is providing one laptop, and one multimedia projector to every secondary school, and developing of teacher-led multimedia contents and internet connectivity, so that teachers and students are using the MMC to discuss difficult-to-teach and difficult-to-learn contents (Khanam et al., 2013). As of 2019, the number of secondary schools having multimedia facility is 15,792 in total, among which 15,044 are private, accounting for 77.73% of the total number of private schools, and 659 schools are public, accounting for 78.84% of the total number of public schools (see Table 7).

[Table 7] Number of Institutions Having Multimedia (2018 & 2019)

Type of School	Management	2018			2019		
		Number of Institution	Institutions Having Multimedia		Number of Institution	Institutions Having Multimedia	
			Number	%		Number	%
Junior Secondary School	Private	2,385	462	19.37	2,380	471	19.79
	Total	2,385	462	19.37	2,380	471	19.79
Secondary School	Private	15,587	13,330	85.52	15,775	13,424	85.10
	Public	599	588	98.16	610	595	97.54
	Total	16,186	13,918	85.99	16,385	14,019	85.56
School and College (School Section)	Private	1,204	1,156	96.01	1,200	1,149	95.75
	Public	64	64	100.00	65	64	98.46
	Total	1,268	1,220	96.21	1,265	1,213	95.89
ALL	Private	19,176	14,948	77.95	19,355	15,133	78.19
	Public	663	652	98.34	675	659	97.63
	Total	19,839	15,600	78.63	20,030	15,792	78.84

Source: BANBEIS (2019)

In many developing countries including Bangladesh, it is very hard for teachers to actively integrate ICT into their classroom due to many reasons such as lack of infrastructure (external factors) and lack of teachers' motivation and capacity (internal factors). Especially, teachers' pedagogical weakness has been pointed out as critical obstacles for utilizing ICT in educational development. According to the progress review report for the master plan for ICT in education

of Bangladesh (Ministry of Education, 2019), there has been both positive and negative progress identified. It reported that the establishment of ultra-modern ICT labs in teachers' training institutes is ongoing, and a high-speed Internet connection has been installed in many teachers' training institutes. In contrast, there is still a lack of necessary learning materials required for the professional development of teachers, and no policies have been formulated that specify the planning of ICT supply, the use and maintenance of ICT materials.

It is no longer a question of if technology should be integrated into the school setting or not. Rather the question should be focusing on when and how to integrate technology to benefit all the parties concerned – students, teachers, administrators, parents, and the community (Jhurree, 2005). Notably, there have been continuous support for integrating ICT into the educational setting in many developing countries as a form of Official Development Aid (ODA) program, and international organizations, including UNESCO, have conducted a variety of ICT4ED projects to promote the transformation of education in developing countries (Cha, Park, & Seo, 2020). However, still many ODA programs focus only on providing ICT hardware and technological teacher training, which are not sustainable in the long run.

Under this circumstance, many theoretical discussions and practical projects should consider further "promoting a pedagogical practice of ICT in education." It is not easy to conduct teacher development programs that enhance all teachers' pedagogical skills for integration of ICT within a short time in Bangladesh. Therefore, this research attempts to explore instructional design principles considering the context of Bangladesh in order to discuss teachers' pedagogical use of ICT for educational development in Bangladesh. Based on existing studies, regarding the challenges of ICT in education, the following part will explain the "instructional design principles," which could be a theoretical base for practical use of ICT in education, especially considering the context of developing countries

where the teaching and learning resources are limited.

2.2 Instructional Design Theory and Model

ICT per se does not lead to better learning outcomes, and inappropriate pedagogical methods when ICT is integrated into the classroom will result in superficial learning (UNESCO, 2015b). Thus, ICTs in education should use or apply pedagogical and instructional design principles as well as technological design principles to create a range of ICT programs and tools in a relevant educational context (Richards, 2006). Especially developing countries, where the educational reforms with ICT are in the early stage, need a more careful approach with sophisticated pedagogy tailored to the environment in each country's context. Concerning this, Instructional Design (ID) theory and model, which is the methods and strategies for effective learning, need to be reviewed to discuss the appropriate pedagogy using ICT in developing countries.

2.2.1 Instructional Design (ID) Theory

As a cornerstone of educational technology, Instructional Design (ID) is a “prescriptive science” (Sanchez-Lugo, 1998) that develops the methods and strategies helping learners to utilize technology (Yang, 2016). The ID theory and model deal with knowledge about "how to plan the class," which is necessary for solving problems in the classroom considering the given educational context (C. Lim, 2015). Reigeluth (1983), a distinguished educational researcher in the field of educational technology and instructional design, defined the Instructional Design (ID) as followings.

"Instructional Design (ID) is the process of prescribing what a specific instructional system should be like. It entails selecting the instructional strategies, including strategies for sequencing the instructional content

and strategies for presenting the individual skills and knowledge that make up that content (Reigeluth, 1983, p.24).”

In other words, ID is the systematic development of instructional specifications using learning and instructional theory to ensure the quality of education and to bring about changes in learners in a given educational content (Alzand, 2010; Chung, 1997). The theory of ID has been advanced by many renowned scholars in the field of education, such as Dewey, Gagné, Merrill, Reigeluth, and Jonassen.

To begin, John Dewey was the first educationist who contended the necessity of the linkage between learning theory and actual practice in the classroom. He called this “linking science” as early as 1899, and it became the starting point for further research in educational technology that investigates instructional strategies to apply the learning theory into the actual classroom environment. Later, Robert M. Gagné elaborates Dewey's perspective by providing a more explicit theory on "prescriptive knowledge" about "how to design the class" by organizing the "Nine Events of Instruction," which shows "how to plan and design the class” according to each stage of nine of instructional event. The most widely applied ID theory is based largely on the work of the nine events of instruction. Gagné's principal assumption is that there are different kinds of learning outcomes and that different internal and external conditions are necessary to promote each type (David Merrill, Li, & Jones, 1990). Table 8 shows the internal process of learning, instructional event, and action example to suggest "how the class (instructional events) might be specifically carried out” (Gagné, 1985). His work on the conditions of learning clearly indicates the prescriptive knowledge (action examples) for each instructional event, and this prescriptive knowledge of instructional design based on comprehensive learning theory has contributed a lot to advance the theory of instructional design thereafter (C. Lim, 2015).

[Table 8] Gagne's Events of Instruction

	Instructional Event	Internal Process	Action Example
1	Gaining attention	Reception	Use abrupt stimulus change
2	Informing learners of objectives	Expectancy	Tell learners what they will be able to do after learning
3	Stimulating recall of prior learning	Retrieval to Working Memory	Ask for recall of previously learned knowledge or skills
4	Presenting the stimulus	Selective Perception	Display the content with distinctive features
5	Providing "learning guidance"	Semantic Encoding	Suggest a meaningful organization
6	Eliciting the performance	Responding	Ask learner to perform
7	Providing feedback	Reinforcement	Give informative feedback
8	Assessing performance	Retrieval and Reinforcement	Require additional learner performance, with feedback
9	Enhancing retention and transfer	Retrieval and Generalization	Provide varied practice and spaced reviews

Source: Gagné (1985)

Merrill is another well-known instructional design theorist who developed the Component Display Theory (CDT) based on Gagné's work. Merrill and his colleagues extended the outcome classification system by separating content type from a performance level and suggested a more specific taxonomy of presentation types (David Merrill et al., 1990). The CDT is a set of prescriptive relationships that can guide the design and development of learning activities (Merrill, 1994, p.108). The CDT assumes that there are different categories of outcomes requiring a different procedure for assessing achievement and for promoting the capability represented by the category (Merrill, 1994, p.109). While Gagné's event of instruction was limited to one-dimensional classification, CDT proposed the two-dimensional classification system: performance and content type and argued that each performance-content category has a combination of primary and secondary presentation forms that will result in more effective learning outcome. This performance-content matrix resulted in important differences in conditions for promoting the acquisition of learning objectives, which were often overlooked by previous classification schemes (Merrill, 1994). As such, the initial ID theories by Gagné and Merrill's work emphasized the prescriptive instructional strategy

according to each different condition and objective of learning.

However, the initial ID theories, which are called the “First Generation Instructional Design Theory (ID₁),” were criticized for being firmly rooted in behavioral psychology, which considers learners as a passive human being (S. I. Park & Choi, 1992). Those theories expect that the prescriptive instructional strategy according to each stage of the learning process will result in effective learning when learners were put in passive learning environment controlled by instructors. Thus, the ID₁ that emerged from the behaviorism were hard to apply in the actual classroom and struggled to provide a clear guideline and direction considering the dynamic learning environment, especially for higher-order thinking skills, cognitive strategy, and learning behavior (Chung, 1997; S. I. Park & Choi, 1992). Merrill et al. (1990) also identified the nine limitations of ID₁: (1) ID₁ content analysis does not use integrated wholes which are essential for understanding complex and dynamic phenomena, (2) ID₁ has limited prescriptions for knowledge acquisition, (3) ID₁ has limited prescriptions for course organization, (4) ID₁ theories are essentially closed systems, (5) ID₁ fails to integrate the phases of instructional development, (6) ID₁ teaches pieces but not integrated wholes, (7) ID₁ instruction is often passive rather than interactive, (8) every ID₁ presentation must be constructed from small components, and (9) ID₁ is labor-intensive. Although behaviorism has worked to advance ID principles such as reification of class objective, a subdivision of learning assignment, systematization of learning, provoking an active reaction, instant feedback, goal-oriented evaluation (Yang, 2016), more recent ID need to consider more various learning environment with using ICT and even Artificial Intelligent.

In order to overcome the limitation of ID₁, the “Second Generation Instructional Design Theory (ID₂)” were raised based on constructivism which emphasizes the active learner (S. I. Park & Choi, 1992). As the educational paradigm has changed from teacher-centered to learner-centered instruction, there

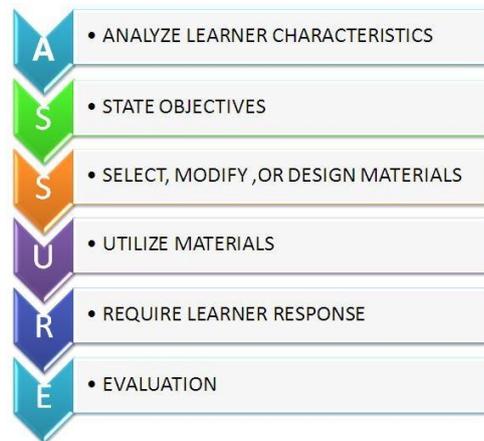
has been a need for sequencing of class content because learner-centered approach such as simulation, Problem Based Learning (PBL), and Goal-Based Scenario (GBS) are more complicated than previous learning system and need more holistic approach. Rather than a micro-level ID theory that divides the learning process into small pieces and teaching one by one, the ID₂ assumes that ID should recognize the knowledge and functions as “integrated wholes” and provide an interactive prescription that needs to teach integrated knowledge (Chung, 1997).

In this regard, Elaboration Theory (ET) by Merrill and Reigeluth is representative of macro-level ID theory, trying to sequence many ideas into one instructional design and prescribe that class should start from an “overview” of the class which enables teachers to teach general and simple but not abstract ideas (Reigeluth, 1983b). Reigeluth also contributed a lot to establish the “field of instructional design” into an academic discipline (C. Lim, 2015). While CDT is a representative theory of micro-level ID because it deals with class objectives, the ET is presenting more macro-level ID such as the optimal prescription for learning in the four areas: selection, sequencing, synthesizing, summarizing. For example, sequencing the class from the simple contents to the complicated ones helps learners construct the stable cognition structure and enables teachers to adjust the level of a unit or course according to students' learning process (Reigeluth, 1983b). Similarly, D. Jonassen provoked the research of ID from the perspective of constructivism. He contends that the constructivists believe that if knowledge is constructed individually, then there is no objective reality and that our own experiences determine our reality (Jonassen, 1990, p.34). Compared to the previous ID, constructivism makes a different set of assumptions about learning, and constructivist designers avoid breaking down context into component parts, rather in favor of environments in which knowledge, skills, and complexity exist naturally (Karagiorgi & Symeou, 2005). Specifically, Jonassen considered various forms of Information and Communication Technology (ICT) as one of the

cognitive tools and contributed to developing ID theories and models using ICT materials in education (C. Lim, 2015). In this sense, constructivism, although not originally described with ICT in mind, has developed the technological advances and their applications to learning and teaching (Adams, 2011).

2.2.2 Instructional Design (ID) Model for Using ICT: The ASSURE Model

When considering ICT integration in education, it is also important to understand an ID model that can be applied in the actual classroom, which could be a roadmap that helps teachers provide a systematic way or approach for effective utilization and implementation of educational media and technology in teaching (Ibrahim, 2015). The process of ID usually consists of five key components: Analysis, Design, Development, Implementation, and Evaluation, which is referred to as the “ADDIE model” (Arias & Clark, 2004). Previously, this ID model has been continuously used to design staff training programs in the military, but over time, the ID model shifted to educational settings as a useful methodology for classroom instruction (Bajracharya, 2019). ID model is a critical field of studies in educational technology as it has been figured out that applying ID in the classroom design process would bring more positive effects than just transferring knowledge. Among many ID models, the ASSURE model is often used for providing a linear process for integrating technology in the classroom (see figure 6). As classroom-oriented models, the ASSURE model is considered a potential model for designing technology-enhanced learning instruction (Bajracharya, 2019). Since this research explores the “instructional design principles for integrating ICT in secondary school in Bangladeshi context,” it will briefly review the representative ID model for using ICT materials.



[Figure 6] ASSURE model by Heinich et al. (1999)

The ASSURE model is the systematic procedural guide for designing teaching and instruction that incorporate media (Sarfo & Elen, 2014). Heinich et al. (1996) introduced the ASSURE model to guide teachers in how to plan and deliver lessons that effectively integrate technology, media, and materials into classroom teaching (D. Kim & Downey, 2016). This model consists of a six-step instructional system design process: (1) analyze learner, (2) state objectives, (3) select, modify, or design materials, (4) utilize materials, (5) require learner response, and (6) evaluation. This ID model demonstrates how to select, use, and evaluate technology and instructional resources as essential parts of a systematic design process. Based on this ID model, the instructor should decide which method is more appropriate for the learning objectives and what technology, media, and materials should be used for the lesson (Ibrahim, 2015). While the other instructional design models are only considering technology as one of the options to choose in the classroom, the ASSURE model focuses more on the role of technology/media in the classroom based on the conventional structure of the "ADDIE" model.

Much previous research investigated the effects of using the ASSURE model in the designing of the teaching process with technology and figured out its positive effects, compared to using technology in the classroom without

systematically following the instructional design model. For example, Kim and Downey (2016) demonstrated the ASSURE model's adaptability to a variety of school settings and subject areas in the U.S and concluded that the teachers successfully developed instructional strategies with technology to support learner differences and special needs. Also, Cho and Lee's work investigated the features of pre-service teachers for early childhood education and figured out that teachers easily understood the flow of the class and young children's perspective and actualize reflective thinking on the process of class when they adopt the ASSURE model (Cho & Lee, 2012). Moreover, comparative research between applying the ASSURE model and the general classroom showed that more satisfaction, understanding, and intimacy was found in the classroom applying the ASSURE model (W. Kim, 2009).

This session has explored the ID theories and model, which provide fundamental understanding about “how to design the class” and “how to integrate ICT in the class.” The ASSURE model could be a theoretical basis when examining the organization of the class with the use of technology. However, it needs to consider the peculiar factors in each educational environment and modify the model, which is more suitable in each different educational setting. To be more specific, the next session will explore the “instructional design principle” in the context of developing countries for more successful integration of ICT in education.

2.3 Application of Instructional Design Principles in Developing Countries

The integration of ICT in education has become a critical mechanisms that can improve access to education and address issues relating to inclusion, equity, and quality in the context of many developing countries (Frederick Kwaku Sarfo & Elen, 2014; UNESCO, 2018). However, the effects of ICT integration in

education are debatable depending on various social, cultural, and economic factors, particularly in developing countries. Most importantly, ICT should be appropriately utilized as a pedagogical tool by teachers, as well as to establish state-of-the-art technology in schools. However, specific instructional design models or principles have not been provided, and still, many teachers face difficulties using ICT materials as a pedagogical tool in the class. With the acknowledgment of the significance of pedagogical usage of ICT in education in the context of developing countries, this chapter explores (1) changing pedagogy with ICT in education and (2) previous research regarding instructional design principles in the context of developing countries.

2.3.1 Changing Pedagogy with ICT in Education in Developing Countries

First of all, it is important to understand how teachers' pedagogy should be changed when ICT is integrated into the traditional classroom before arguing that instructional design model and principles should be provided for teachers in developing countries. In order to leverage the positive roles of ICT in education, teachers are required to change their pedagogy in a way that ICT can be fully utilized in the classroom. The term "pedagogy" has been defined in various ways, including the art of teaching, the science of teaching, the craft of teaching, the profession of teaching, or just as another word for the practice of teaching (Webb & Cox, 2004). Certainly, teachers should understand that pedagogy needs to be changed in order to utilize the new technology which is different from that used in the conventional classroom settings. Regarding this, UNESCO (2011) suggested the four different levels of pedagogy and ICT integration in education through the knowledge ladder (see table 9). According to Table 9, the pedagogy and ICT use in the classroom are differently applied at each stage, depending on how students accumulate knowledge.

According to the four stages of the knowledge ladder, the *basic education level* requires a lecture-based pedagogy with minimum use of technology. Most of

the Least Developed Countries (LDC) are situated in this stage due to the lack of ICT resources and infrastructures. Therefore, teachers in this stage use “lecturing” as a dominant pedagogy with limited use of ICT. In the *knowledge acquisition stage*, information may be presented in various forms, and teachers are required to use ICT when delivering the information in the class. In this stage, education is expected to improve the economy by preparing a more knowledgeable and skilled workforce and capable of taking up new technologies (UNESCO, 2011). The pedagogical change in this stage may involve the use of various computer-based tools and online content as a supplemental tool. Also, this stage includes adding ICT as a subject in the curriculum (UNESCO, 2011).

[Table 9] Pedagogy and ICT Use at the Four Stage of Knowledge Ladder

Four stages of knowledge ladder	Pedagogy	ICT use
Basic Education	Class sizes with large student-to-teacher ratios, teaching relies on lectures	Minimum use of technology; some standalone computing for administrative purposes. Potential of minimum networked technology to provide access to remote resources for administration and teacher professional development.
Knowledge Acquisition	Teaching is focused on information delivery. Lectures are common but information may be presented in a variety of forms. Alternatively, instruction can be individualized and self-paced.	Technology is used primarily to deliver instruction and management. The ratio of students to computer may be low, if used by teachers for delivery, or high, if used by students for individualized instruction. Networking is used to support management and accountability.
Knowledge Deepening	Teaching is conducted in the context of complex, open-ended questions and problems and it is anchored in real world contexts. Classroom activities involve the application of key concepts and principles to analyze systems and solve problems across subjects. Internships and apprenticeships can be an important way to connect school learning to the real world.	Networks are used to support collaborative projects and connect students and teachers to outside contexts. Simulations and multimedia are used to support deep understanding of interrelated concepts, address misconceptions, explore systems, and solve problems.

Knowledge Creation	Teaching consists of challenging students to build on their knowledge and explore new topics. Collaborative projects and investigations involve searching for information, collecting and analyzing data, generating knowledge products, and communicating with outside experts and audiences to share results.	Pervasive technology and social networks are used to support knowledge production, collaboration, and knowledge sharing by students and teachers. Networks are used to help teachers and students build knowledge communities.
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Source: UNESCO (2011)

The *knowledge deepening stage* involves more complex classroom activities such as the application of key concepts and principles to analyze a topic, and ICT could be a pedagogical tool to support collaborative projects and connect students and teachers in this stage. Instructional technology in this stage can be used by students for visualizations and simulations to explore, understand, and apply complex knowledge, and therefore ICT becomes a daily classroom practice. Also, ICT equipment must be available in each classroom for regular use (UNESCO, 2011). Lastly, the *knowledge creation stage* consists of challenging students to build on their knowledge and explore new topics. Therefore, teachers use ICT in a way to help students to produce new knowledge and share ideas with each other in this stage. Particularly in the knowledge creation stage, learners must play an active part in their learning process and be autonomous learners who are actively engaged in constructing new meaning within the context of their current knowledge, experiences, and social environments (T.-K. K. Neo, 2003).

In the case of Bangladesh, the current status of ICT in education can be found somewhere between the basic education and knowledge acquisition stage. In terms of the pedagogy at the secondary school level in Bangladesh, teachers largely rely on lecturing with a high student-to-teacher ratio, which is closely related to the “basic education level.” However, in terms of ICT infrastructures, the GOB is now trying to construct multimedia classrooms with one laptop and one projector in all secondary schools, and ICT has become a compulsory subject at the secondary

level, since 2010, in line with the education policy 2010. Therefore, teachers are now able to present information on PPT slides with visual and auditory materials focusing on information delivery, which is related to the “knowledge acquisition level.”

At the policy level, ICT integration at the secondary level is expected to be a beyond the basic education and knowledge acquisition level that is only used for presenting the information through ICT equipment. The GOB stated the aim of using ICT in secondary and higher secondary education in "Master Plan for ICT in education" as *“the improvement of the quality of education with creation of ICT-enabled teaching-learning environment and building up the learners at the secondary and higher secondary levels as skilled human resource for the knowledge-oriented society that is responsive to the needs of the 21st century.”* (Ministry of Education, 2013, p.9). Although it is not specifically mentioned about the learners’ capacity, using ICT only with a purpose of presenting information would not bring the expected results that GOB is aiming for. The purpose of ICT integration by the GOB is to move forward to a more complex and sophisticated learning level with an ICT-enabled teaching and learning environment.

Thus, in order to successfully achieve the ultimate purpose to integrate ICT in education, teachers need to understand the changing pedagogy at the different stages of the knowledge ladder when using ICT in their class. However, in the context of educational development with ICT in developing countries, research regarding teachers’ capacity development and pedagogy is not at the forefront of the discussion. Still, too much attention is focused on new technology, lower-order skills, and information itself rather than ICT as a tool for educational development (Watson, 2001). In order to ensure improvement in the quality of education through ICT in developing countries, concrete discussion toward teachers’ ability to properly integrate ICT in their class must be consistently studied together with providing infrastructure and technological training for teachers.

Considering that adopting the new technology requires a different pedagogy, teachers should be not only learning TK (Technological Knowledge), but also improving the Pedagogical and Content Knowledge (PCK) for the effective use of ICT in education. Although ICT integration offers a well-equipped environment, successful integration of ICT would not be possible without careful consideration of the changing pedagogy by teachers, including the subject matters, classroom activities, type of teaching, learning organization, classroom environment, and instructional design process (S. B. Lee, Park, Kim, & Kang, 2010).

2.3.2 Instructional Design Principles in Developing Countries

Instructional Design Principle can be understood in two ways; the first being designing the “Instructional System Design,” which is a systematic process of analysis, design, development, implementation, and evaluation in order to develop effective instructional programs. Another being related to the knowledge regarding the methods of instruction or instructional strategies, which means designing lesson plans or instructional blueprint by choosing the optimal instructional strategies in a given educational context (C. Lim, 1996). It is imperative that effective and meaningful Instructional Systems Design (ISD) principles continue to be included in the design of new technology-based learning environments (Arias & Clark, 2004). Sarfo and Elen (2014) also argued that what makes teaching and learning effective is not ICT (computer, internet, wireless connection, and related software) but effective design of instructional methods or strategies based on effective principles of learning and instruction. Moreover, the availability of technological resources in the classroom does not necessarily equate to improved academic achievement (Albugami, 2016). In other words, in order to utilize technological resources in a way that improves academic achievement, some other intervention is necessary, and it could be systematic planning and designing of the class by a teacher (Kang & Kim, 2012; B.-K. Kim, 2003). When ICT materials are

integrated into the classroom, therefore, teachers should take different systematic planning and designing of the class from the traditional one in order to fully utilize ICT and improve the quality of education.

However, many discussions and research regarding the ICT integration have been focusing more on the successful cases rather than “how to utilize the ICT in the class” (B.-K. Kim, 2003). Also, K. Park (2007) criticized that instructional design principles and models are rarely applied in the actual classroom by a teacher due to the limitation of time and cost. It will be even harder to apply in the context of developing countries for many reasons, such as lack of resources or teachers who have been appropriately trained to use ICT. Although there has been little research regarding instructional design principles in the context of developing countries, some of the research emphasized several components to be considered when ICT materials are integrated into the resource-constrained environment.

For example, most recently, Cha, Park, & Seo (2020) explored the factors to be considered when developing ICT-integrated classroom models and suggested six categories of factors for designing ICT-integrated K-12 classrooms in a developing country: (1) status and policies in ICT education, (2) ODA goals and priority setting, (3) selection of schools, (4) infrastructure and technical challenges, (5) pedagogical methods, and (6) educational resources. Among these six categories, understanding ODA goals and priority setting is a particularly important factor because most of the policies and practices regarding ICT integration in schools in developing countries are conducted as a form of ODA. In addition, Cha et al. (2020) emphasized that understanding the present situation and requirements of the teaching and learning aspects of the country may determine the success or failure of ICT-integrated learning because each developing country has a different condition in terms of ICT infrastructures and readiness of teachers. Similarly, Arias & Clark (2004) stressed the importance of understanding the highly volatile socio-economic, cultural, and political context in developing

countries when applying instructional system design. By deeply understanding the current status of the educational environment in a certain country, the instructional designing process can be changed. In order to accurately analyze the current status of developing countries prior to the instructional design, Arias & Clark developed the “context-based analysis model” for providing the criteria of context-analysis in developing countries based on Tessmer and Richey (1997)’s work. The “context-based analysis model” is divided into three aspects of learning: orienting, instructional, and transfer. Each aspect has the learner, the environment, and the organization factor to be considered in learning situations in developing countries (see table10).

[Table 10] Context-based Analysis Model

	Orienting	Instructional	Transfer
Learner Factors	<ul style="list-style-type: none"> - Learner profile - Goal Setting - Perceived utility - Perceived accountability 	<ul style="list-style-type: none"> - Learner role perception - Learner task perception 	<ul style="list-style-type: none"> - Utility perception - Perceived resource - Transfer coping strategy - Experiential background
Immediate Environment Factors	<ul style="list-style-type: none"> - Social Support - <i>Motivation</i> - <i>Release time</i> - <i>Compensation</i> - <i>Participation culture</i> - <i>Availability of electricity</i> - <i>Appropriate facilities</i> 	<ul style="list-style-type: none"> - Sensory conditions - Seating - Instructor role perception - Learning schedule - Content Culture 	<ul style="list-style-type: none"> - Transfer opportunity - Social support - Situational cues
Organizational Factors	<ul style="list-style-type: none"> - Incentives - Learning culture - <i>Centralized decision making</i> - <i>Budget planning capacity</i> - <i>Human capacity building</i> 	<ul style="list-style-type: none"> - Rewards & values - Learning supports - Teaching supports 	<ul style="list-style-type: none"> - Transfer culture - Incentives

Source: Arias & Clark (2004)

Another possible instructional design principle that could be adopted in the

context of developing countries is “Universal Design for Learning (UDL),” which emphasizes the need for a complex and diverse approach to meet the needs of various groups of learners (Jang, 2010). The concept of UDL first originated in the field of architecture in which buildings were universally designed to be accessible by people with disabilities, and now it has been used in education sector as UDL encompasses an effective approach to classroom procedures, ensuring that instruction is designed to be accessible to all potential learners (Almumen, 2020). UDL principles has a solid basis in neuroscience and research and often utilize digital tools to ensure curriculum and learning environments are designed with options for all in mind (Chambers and Coffey, 2019). Although the current usage of ICT tools in education in developing countries is focused on simple technology such as PowerPoint presentation with auditory and visual materials, teachers should consider a wide variety of student needs in their teaching with adopting the UDL guidelines for more effective utilization of digital tools (see Table 11).

[Table 11] The Universal Design for Learning Guidelines

Multiple Means of...	To develop...	Provide option for...
Engagement	Purposeful, motivated learners	Recruiting Interest <ul style="list-style-type: none"> - Optimize individual choice and autonomy - Optimize relevance, value, and authenticity - Minimize threats and distractions
		Sustaining Effort & Persistence <ul style="list-style-type: none"> - Heighten salience of goals and objectives - Vary demands and resources to optimize challenge - Foster collaboration and community - Increase mastery-oriented feedback
		Self-Regulation <ul style="list-style-type: none"> - Promote expectations and beliefs that optimize motivation - Facilitate personal coping skills and strategies - Develop self-assessment and reflection
Representation	Resourceful, knowledgeable learners	Perception <ul style="list-style-type: none"> - Offer ways of customizing the display of information - Offer alternatives for auditory information - Offer alternatives for visual information
		Language & Symbol <ul style="list-style-type: none"> - Clarify vocabulary and symbols - Clarify syntax and structure - Support decoding of text, mathematical notation, and

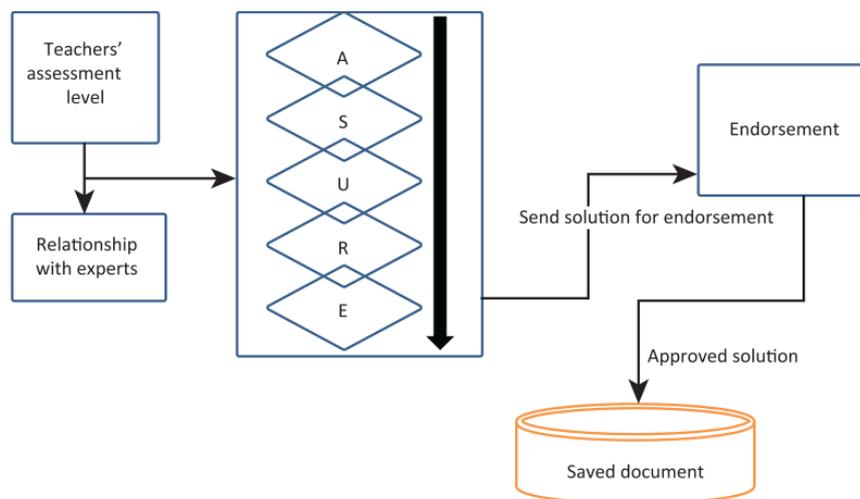
		<ul style="list-style-type: none"> symbols - Promote understanding across languages - Illustrate through multiple media
		<p>Comprehension</p> <ul style="list-style-type: none"> - Activate or supply background knowledge - Highlight patterns, critical features, big ideas, and relationships - Guide information processing and visualization - Maximize transfer and generalization
Action & Expression	Strategic, goal-directed learners	<p>Physical Action</p> <ul style="list-style-type: none"> - Vary the methods for response and navigation - Optimize access to tools and assistive technologies
		<p>Expression & Communication</p> <ul style="list-style-type: none"> - Use multiple media for communication - Use multiple tools for construction and composition - Build fluencies with graduated levels of support for practice and performance
		<p>Executive Functions</p> <ul style="list-style-type: none"> - Guide appropriate goal setting - Support planning and strategy development - Facilitate managing information and resources - Enhance capacity for monitoring progress

Source: Chambers and Coffey, 2019

Other studies that investigated the instructional design in the context of developing countries are emphasizing the “teacher” factor. Obviously, teachers are the most influential factor that can lead to the successful integration of ICT in their classroom, but teachers' capacity to fully utilize ICT in the conventional classroom is always facing many challenges. Teachers should be trained and well-prepared to properly utilize ICT material in their classroom, or any attempts to implement the use of ICT without critically addressing the issue of instructional design by the teachers will be a failure (Sarfo, 2007). Jhurree (2005), who developed the guidelines aimed at policymakers for technology integration in education in developing countries, also mentioned the necessity of involving teachers as well as school administrators and parents in making decisions on ICT integration in education in the context of developing countries. Many teachers are apprehensive about using computers for instructional purposes due to the lack of experiences or supports from school communities. Therefore, teachers’ attitudes are another

factor that needs to be changed first so that their commitment is secured for the successful integration of technology in education (Jhurree, 2005). Especially for teachers in developing countries, it is believed that teachers' self-efficacy is a precursor to deep learning with ICT and the strongest predictor of teachers' instructional strategies with ICT. Otherwise, teachers just use ICTs for simple tasks such as word-processing and information retrieval for delivery of passive learning materials (Sangkawetai, Neanchaleay, Koul, & Murphy, 2020). Thus, the teachers themselves (including level of ICT knowledge, self-efficacy, attitude, belief toward the effects of ICT) could be one of the most important factors that should be considered when developing the instructional design principles in developing countries.

Furthermore, some research has transformed the existing ASSURE model in order to apply it to the context of a developing country. Olayinka et al. (2018) suggested the TREASURES model in order to curb the problems encountered in the adoption of ASSURE model in Nigerian institutions, because developing countries face different problems to those in developed countries in educational settings. The TREASURES model is a combination of a series of steps that yield solutions to problems identified internally (see figure 7). In the TREASURES model, it is notable that it includes teachers' personal assessment level: a stage where the tutor personally assesses the teaching skills and technical know-how of the available resources and building relationships with other experienced teachers on the principle of identifying the right media and technology. This indicates the significance of teachers' preparation prior to applying technology in the classroom and knowledge sharing among teachers in the case of developing countries.



[Figure 7] The TREASURES model

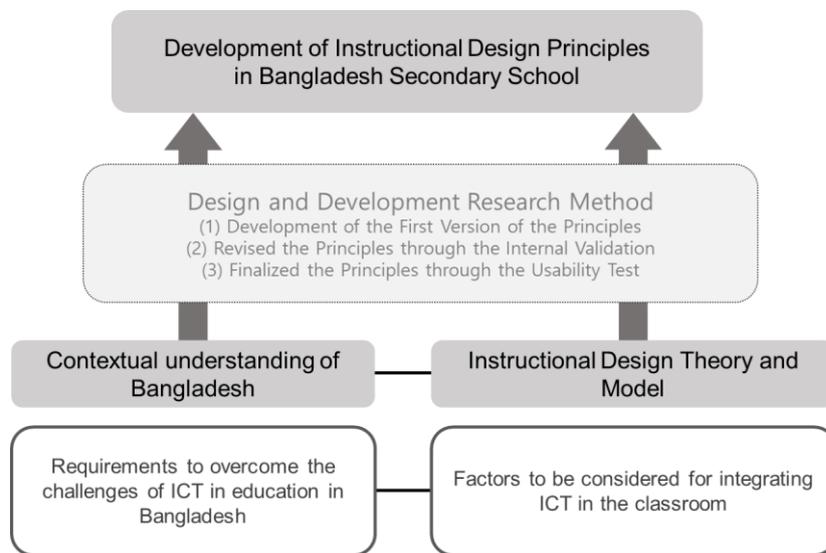
It is hard to recognize if education is being timely implemented to respond to the needs of learners without an instructional design process, and learning objectives, contents, methods, media, and evaluation are not organizationally linked to each other (Nam, 2012). In developing countries as well, there have been fewer efforts to systematically design the class based on the instructional design models or principles, while there are thousands of “ICT in education” projects undergoing by international organizations under the name of international development and cooperation program. In order to assess the outcome of ICT in education projects, the instructional design process needed to be included, and teachers should be appropriately trained with curriculum-specification guidelines for using ICT. Most importantly, in the field of international education development, teachers need to be considered as curriculum designers rather than passive receivers of ICT materials given by international partners.

2.4 Summary of the Literature Review

The mere adoption of the new or innovative technology can not sufficiently bring about desired changes (Khan, 2014). However, in many developing

countries, including Bangladesh, sometimes teachers are quick to adopt the new technologies without focusing on how that technology may affect instructional practices and student learning. While many professional development programs have been introduced to train teachers for using ICT in education, many studies have still argued for the lack of teachers' pedagogical skills for integration in education. In this regard, this chapter explored previous research regarding the contextual background of Bangladesh, instructional design theory and model, and issues regarding the application of instructional design principles in the context of developing countries.

As shown in Figure 8, the synthesis of analysis from the contextual understanding of Bangladesh and instructional design theory and model will be the theoretical foundation for developing the initial instructional design principles for using ICT in secondary school in Bangladesh. The contextual understanding of Bangladesh was examined in order to understand the challenges of integrating ICT in education, and the instructional design theory and model were reviewed to understand the factors to be considered for integrating ICT in the classroom. Particularly, the current challenges of using ICT in Bangladesh were investigated to figure out the requirements to overcome those challenges, which became the initial instructional design principles and specific guidelines.



[Figure 8] Research Framework

Source: Composed by author

Instructional design principles, as a prescriptive instructional theory, could be considered in the whole process of the class design for teachers to utilize the ICT in their teaching and learning activities. Therefore, in addition to the existing discussion on ICT in education in developing countries, this research attempted to draw out more practical discussion for more effective utilization of ICT in developing countries by providing prescriptive instructional design principles with the “design and development research” method. The next session presents the details of the methodology for developing the instructional design principle for using ICT in the context of secondary schools in Bangladesh.

CHAPTER III. METHODOLOGY

In order to develop the instructional design principles for using ICT in the context of secondary schools in Bangladesh, this research composed three phases of the research process based on the design and development research method: (1) development of the first version of the instructional design principles based on field research and literature review, (2) internal validation with experts' review, and lastly (3) usability test with secondary school teachers (see table 12).

[Table 12] Procedure of Development of Instructional Design Principles

Research Process	Development of the First Version of Principles	Internal Validation	Usability Test
Expected Outcome	Frist version of principle and specific guideline	Revised version of principle and specific guideline	Final principle and specific guideline
Method	<ul style="list-style-type: none"> - In-depth Interview - Class observation - Literature review 	<ul style="list-style-type: none"> - In-depth Interview - Validity Questionnaire 	<ul style="list-style-type: none"> - Development of lesson plan based on the revised principles with secondary school teachers - In-depth interview with secondary school teacher
Participants	<ol style="list-style-type: none"> 1) Teachers who regularly use digital content in his/her class 2) Teachers' trainers who are involved in ICT teacher training in Bangladesh 3) Experts in Bangladeshi education 	<ol style="list-style-type: none"> 1) Teachers who regularly use digital content in his/her class 2) Teachers' trainers who are involved in ICT teacher training in Bangladesh 3) Experts in Bangladeshi education 4) Experts in educational technology and instructional design 5) Experts in international educational development 	<ul style="list-style-type: none"> - One teacher who will develop the lesson plan with the revised version of principles - Four teachers who review the lesson plan in terms of its feasibility and applicability

3.1 Methodological Consideration

This research employed the “design and development research” method, which is also known as developmental or development research (Akker, Branch, Gustafson, Nieveen, & Plomp, 1999; Richey & Klein, 2005; Richey, Klein, & Nelson, 2004; Seels & Richey, 1994). Richey & Klein (2007) defined this type of research as the following.

“The systematic study of design, development and evaluation processes to establish an empirical basis for the creation of instructional and non-instructional products and tools and new or enhanced models that govern their development.”

Akker et al. (1999) criticized that traditional research such as experiments, surveys, and correlational analysis hardly provide prescriptions with useful solutions for various design and development problems in education (p.2). Currently, a great deal of effort is being put into the provision of ICT infrastructures and teacher training in Bangladesh under international education development. Thus, “development research” will provide a better understanding of how specifically Bangladesh should develop educational reform with the use of ICT by enforcing teachers’ instructional strategies. As a relatively new and upcoming approach, most of the design and development approach assumes that instruction should vary depending upon the type of learning task being addressed and among various sub-domain, such as curriculum, media & technology, learning & instruction, teacher education & didactics (Akker et al., 1999; Richey & Klein, 2007). Therefore, it is significant to investigate the various factors influencing teachers' use of ICT, such as learning environment, instructional culture, and teacher education in Bangladesh to explore the most optimal instructional design principles by employing the development research method.

The most important knowledge to be gained from development research is in the form of "design principles" to support teachers. Although these principles cannot guarantee success, they are intended to select and apply the most appropriate knowledge for specific design and development tasks (Akker, 1999). The Association for Educational Communications and Technology (AECT) in 1994 defined instructional design as the theory and practice of design, development, utilization, management, evaluation of processes, and resources for learning (Seels & Richey, 1994). Even though "instructional design" is considered the youngest discipline in the behavioral sciences, its impact on the learning activities of the military, business organizations, and other non-governmental organizations has been very remarkable.

Thus, this research attempted to develop "instructional design principles" for secondary school teachers in Bangladesh to effectively utilize the ICT materials in their classrooms. While there have been lots of Official Development Aid (ODA) projects for improving teaching and learning environment utilizing ICT, such as supplying of ICT facilities, development of ICT training centers, development of teacher capacity in Bangladesh, there has not been much discussion on how specifically ICT can be integrated into the classroom in the context of Bangladesh. Moreover, considering that the level of pedagogy and ICT use in Bangladesh is between the "basic education" and "knowledge acquisition" level¹⁰, providing the most optimal instructional design principles could be an important step to upgrade the teachers' pedagogical skills for using ICT to go forward to the "knowledge deepening" and even the "knowledge creation" level within the resource-constraint environment.

Before the interview and class observation, the research ethics of this research was approved by the Institutional Review Board (IRB) of Seoul National University: IRB No. 1909/003-012 (see appendix 10).

10 see the four-stage of knowledge ladder in table 9

3.2 Development of the First Version of the Principles

In order to develop the first version of the instructional design principles, this research firstly investigated the opinions of secondary school teachers and teachers' trainers in Bangladesh and conducted classroom observation where ICT is currently used. Also, previous research was reviewed to examine the issues regarding ICT integration in education in developing countries as well as Bangladesh, in order to develop optimal principles that cover the current challenges that Bangladesh is facing with using ICT in the classroom. The following is a specific description of the field research and literature review process used for developing the first version of the instructional design principles.

3.2.1 Field Research at Dhaka

This research was conducted as a case study of secondary schools in Bangladesh, a developing country in the South Asia region. It should be remembered that the instructional design process often occurs within a highly volatile socio-economic, cultural, and political context when applying instructional system design in a developing country (Arias & Clark, 2004). Thus, understanding the context was the first important step before developing instructional design principles in developing countries. In this research as well, careful context analysis should be preceded before developing the instructional design principles for Bangladesh, as the context of a developing country is entirely different from other countries. In many cases, most of the research in the field of instructional design principle develop the first version of the principles mainly by analyzing the previous research. However, considering the instructional design in the context of developing countries is hardly investigated before, field research for in-depth interviews with education stakeholders and class observation was conducted, as well as analyzing the previous literature at the same time.

During the eight weeks of field research from September 30th to November 20th in 2019, in-depth interviews were implemented with secondary school teachers who can utilize digital content in their classes, and teachers' educators in charge of digital content subject in teacher training institutes. Also, class observation was conducted in order to observe teachers' pedagogy with ICT materials and students' reactions toward the ICT-supported class. Merriam (2009, p.88) contends that interviews and observations are “the best techniques for intensive case studies,” and these methods give us a more nuanced view than a questionnaire could (Dong & Newman, 2018). Moreover, well-designed observations can allow researchers to explore the process of teaching in a naturalistic setting, provide information that precisely describes the status of classroom practices, and identify instructional problems (Hilberg, Waxman, & Tharp, 2004). Throughout the interviews and class observation during fieldwork in Dhaka, it was possible to obtain abundant information that could not be found in the previous literature by paying attention to the opinions of main stakeholders using the ICT in the classroom.

Table 13 and Table 14 show the list of schools and interviewees for this research during the fieldwork. The targeted schools for class observation were determined based on the recommendation of an officer from the Directorate of Secondary & Higher Education (DSHE), who oversaw one of the ODA projects by KOICA named “establishment of information technology (IT) labs in 100 secondary government schools of Dhaka.” The officer introduced the list of 100 secondary schools with IT labs and recommended selected schools where there are expert teachers who have been using ICT in their class for many years.

[Table 13] List of Visited Schools and Interviewees in Dhaka

	Name of the school	Teacher Interview	Class Subject	Date of Class Observation
1	School RM	Teacher Am	ICT	Oct 14th, 2019
2		Teacher R	English	-
3		Teacher N	Chemistry	Oct 14th, 15th, 2019
4	School MM	Teacher Za	English	Oct 15th, Nov 3rd, 2019
5	School MA	Teacher S	Agriculture, ICT	Oct 19th, 20th, 2019
6		Teacher H	Mathematic	Oct 19th, 20th, 2019
7	School VN	Teacher F	Biology	Oct 21st, 2019,
8		Teacher Af	Mathematic	Oct 21st, 2019
9	School MH	Teacher M	ICT	Oct 22nd, 2019,
10		Teacher Zz	Biology	Oct 22nd, 2019
11	School SG	Teacher L	English	Nov 5th, 2019,
	6 schools in total	11 teachers interview, 10 class observation in total		

[Table 14] List of the Visited Teacher Training Institutions and Interviewees

	Name of the institution	Teachers' Educator Interview	Interview date
1	Teachers' training college (TTC)	Teacher Educator A	Oct 1st, 2019
2	Teachers' training college (TTC)	Teacher Educator B	Oct 24th, 2019
3	Access to Information (a2i)	Teacher Educator K	Oct 30th, 2019
	2 teacher training institutes	3 teacher educators in total	

After making a reservation with the teacher on the list, a school visit was conducted for the interview with the teachers and class observations. Interviewee teachers kindly allowed observations of their multimedia class. Among the ten class observations, four of the classes were allowed to be observed twice, and the rest only allowed single observations. A class observation checklist was prepared

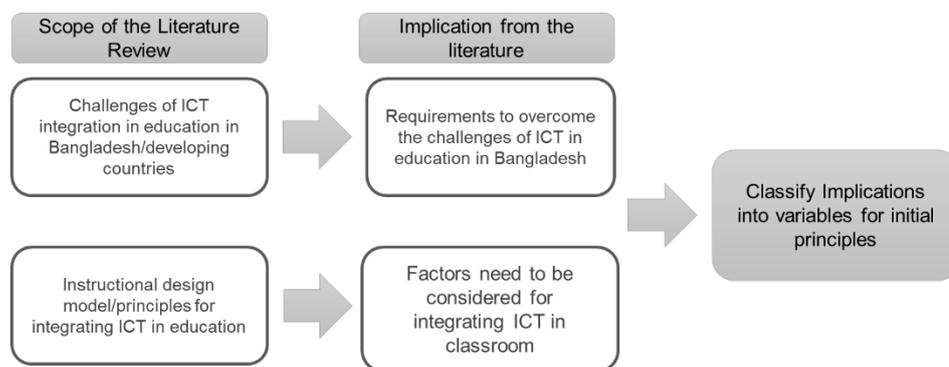
in advance in order to describe everything that was observed during the class, especially focused on facilities in the classroom, teachers' instructional strategies with the use of ICT, and students' reaction during the teaching and learning process with ICT (see appendix 8).

3.2.2 Review of the Previous Research

In order to develop the instructional principles fundamentally, the literature review is the first and foremost important step. Therefore, together with the field research, previous research was continuously investigated to draw implications for constructing the initial instructional design principles. However, there are only a few studies regarding "instructional design principles in the context of developing countries," and specifically "instructional design principles in the context of Bangladesh" were hardly found. Therefore, the scope of the literature review was limited to two categories: (1) challenges of ICT integration in education in developing countries/Bangladesh, and (2) instructional design model/principles for integrating ICT in education both in developed and developing countries. Also, the period of previous research was set from the early 2000s to the present because the discourse regarding ICT in education was radically changed since early 2000 in many developing countries. Previous research was searched through the appropriate research search engines such as Seoul National University Library and Google Scholars, which holds ERIC, PsycINFO, the Social Science Citation Index, and other wide ranging academic databases (J. Lee, 2012). Also, the research was selected based on its authority, seminal, and relevance (Hart, 2001).

As shown in Figure 9, the scope of the literature review was divided into two areas and drew out implication focusing on the "requirements to overcome the challenges of ICT integration in education" and "factors that need to be considered for integrating ICT in the classroom" in the context of Bangladesh. Those implications, together with the interview and class observation results from the

field research, were classified into variables to develop the first version of instructional design principles.



[Figure 9] Process for Literature Review

3.3 Internal Validation

After designing the first version of the instructional design principles by classifying the interview results, class observation, and previous literature review, internal validation was conducted three times. The first internal validation was conducted as a form of in-depth interviews with teachers' trainers and secondary school teachers during the field research, and two more internal validations were conducted with the experts in the field of educational technology and international development. The internal validation test aims to test the validity of the components, principles, and specific guidelines from the first version of instructional design principles and improve the principles by revising them based on feedback from experts. In particular, the internal validation test for those who are involved in ICT in secondary education in Bangladesh, such as teachers and teachers' educators, is an essential process to make the final principles more applicable in the actual classroom environment. Therefore, having opinions from main stakeholders in Bangladeshi education from the early phase of the development of instructional principles is the significant first step in this research in order to understand the context of the education environment in Bangladesh

more deeply.

3.3.1 Participants in the Internal Validation

The internal validation was conducted three times with 13 experts in total (see table 15). According to previous research, the number of experts for the internal validation test should be at least three and range up to ten (Rubio, Berg-Weger, Tebb, Lee, & Rauch, 2003). However, considering that this research is a case study of Bangladesh, where only a little research has been conducted so far, understanding the specific context of the educational environment and system should be the first step of developing instructional design principles. Thus, a higher number of experts than suggested in previous research participated, specifically in the field of Bangladeshi education.

The first internal validation was conducted during field research in Dhaka. The first version of instructional principles was reviewed by seven experts, among which six were currently working as either secondary school teachers or teachers' educators for ICT in education in Bangladesh. The other expert was a Korean professor in the field of Information Technology (IT) who has been involved in international education development project for many years. Among the seven experts, the six experts in Bangladeshi education underwent in-depth interviews with the prepared questionnaire for about one hour. During the interviews, the experts were briefed on the research at the beginning of the interview and asked to review its validity from the perspective of their expertise. Also, the experts suggested further improvement in the instructional principles. For the Korean professor, the validation was conducted by sending the questionnaire via email (see appendix 1). Based on the first internal validation, the second version of instructional design principles was developed, and the second internal validation was conducted with the second version of the principles (see appendix 2). The second internal validation was reviewed by seven experts, mainly in the field of

educational technology and international education development. Among them, one teachers' educator for ICT in education in Bangladesh was included for the second internal validation in order to have opinions from the perspective of the expert in Bangladeshi education. The teachers' educator in Bangladesh and those who could not meet in person reviewed the second version of principles via email. Similarly, the third internal validation was conducted with the third version of the principles, and all experts gave feedback via email (see appendix 3).

[Table 15] List of Experts participated in the Internal Validation

Validation Date	Expert	Expert Fields/ Position	Professional Experience (years)	Participation in Internal Validation		
				1st	2nd	3rd
10/30/2019	Expert A	Education of Bangladesh / Teachers' educator	14	○		
10/24/2019	Expert B	Education of Bangladesh / Teachers' educator	12	○		
11/8/2019 (1st) 2/5/2020 (2nd)	Expert C	Education of Bangladesh / Teachers' educator	6	○	○	
11/10/2019	Expert D	Education of Bangladesh / Secondary school teacher	7	○		
11/7/2019	Expert E	Education of Bangladesh/ Professor	12	○		
11/14/2019	Expert F	Education of Bangladesh/ Professor	6	○		
11/17/2019	Expert G	Information Technology/ Professor	20	○		
1/13/2020 (2nd) 3/6/2020 (3rd)	Expert H	Educational Technology & International Development / Professor	23		○	○
2/13/2020	Expert I	Educational Technology & International Development/ Professor	15		○	
2/1/2020 (2nd) 4/7/2020 (3rd)	Expert J	Educational Technology/ Professor	12		○	○
2/11/2020 (2nd)	Expert K	Educational	30		○	○

3/10/2020 (3rd)		Technology & International Development Researcher /				
2/12/2020 (2nd) 3/17/2020 (3rd)	Expert L	Educational Technology/ Professor	13		○	○
1/16/2020 (2nd) 3/24/2020 (3rd)	Expert M	Computer Engineering/ Researcher	23		○	○

3.3.2 Tools and Procedure for Internal Validation

The questionnaire for internal validation was designed by modifying previous developmental research (S. Kim, 2016; J. Lee, 2012). The questionnaires for internal validation mainly composed of two parts: (1) introduction of the research and (2) reviewing the validity for the draft principles. The introduction part explains the purpose and significance of the research, methodology, and overall process of developing the principles. The second part includes a questionnaire regarding the validity of each component, principle, and specific guideline (see appendix 1-3).

Before the interviews, the questionnaire was sent to the experts and then face-to-face meetings were had depending on the expert's availability or feedback was received via email. During the interview, the expert reviewed each item one by one by checking the four-point scale and orally explaining the principles' further improvement. Rubio et al. (2003) stated that this four-point scale provides additional information for the researcher to determine the extent to which the item needs to be modified or deleted. The interviews were permitted to be record by the interviewee, and the whole interview was transcribed in order to classify the expert's feedback for modifying the principles.

Table 16 shows the overall procedure, purpose, method, and evaluation items for three phases of the internal validation. For the first and second internal validation, the expert mainly reviewed the “appropriate reflection of the context of Bangladesh,” “logical linkage between components and principles,” “appropriate terminology,” “appropriate method for developing principles,” and

“overall validity, explicability, usability, generality, and comprehensibility of each component, principle and specific guideline." Based on the experts' feedback, the components, principles, and specific guidelines were continuously revised. The quantitative review was collected using the four-point scales, and an open-ended question for additional opinions was given at the end of the questionnaire. Similarly, the third internal validation was conducted with the four-point scale of the questionnaire and open-ended questions. It was focused more on the validity of each principle and specific guideline in terms of logical organization and appropriate terminology.

[Table 16] Internal Validity Procedure and Evaluation Item

Procedure	Purpose	Method	Evaluation items
First and second internal validation	<ul style="list-style-type: none"> - to test the validity of components, principles, and specific guideline - to test the validity of the developmental process of principles 	<ul style="list-style-type: none"> - Quantitative Questionnaire (four-point scale) - Face-to-face in-depth interview 	<ul style="list-style-type: none"> - Appropriate reflection of the context of Bangladesh - Logical organization between components and principles - Appropriate Terminology - Appropriate method for developing principles - Overall validity, explicability, usability, generality, and comprehensibility of each component, principle, and specific guideline
		Open-ended question	<ul style="list-style-type: none"> Additional opinion Further improvement
Third internal validation	<ul style="list-style-type: none"> - to test the validity of principles and specific guideline 	<ul style="list-style-type: none"> - Quantitative Questionnaire (four-point scale) - Face-to-face in-depth interview 	<ul style="list-style-type: none"> - Logical organization between principles and specific guideline - Appropriate Terminology - Overall validity, explicability, usability, generality, and comprehensibility of each component, principle, and specific guideline
		Open-ended question	<ul style="list-style-type: none"> Additional opinion Further improvement

Table 17 and Table 18 present more details of the evaluation items to validate the components, overall principles, and specific guidelines. In previous research,

the evaluation item for the components normally includes the appropriateness of the literature review to validate, if relevant literature was comprehensively reviewed in order to construct the initial principles. However, this research attempted to validate if the initial version of the principle is well reflected in Bangladesh's current educational environment because contextual understanding is the most important at the beginning stage of developing the instructional design principles. Moreover, there were very few literature reviews regarding "instructional design principles in the context of developing countries," thus, this research struggled to make sure of its contextual validity, especially in the first and second internal validation. For the third internal validation, the questionnaire includes only the validity of each principle and specific guideline in order to sophisticate and improve the principle rather than overall validity.

[Table 17] Evaluation Item for Components

Evaluation Items	Questions
Appropriate reflection of the context of Bangladesh	Are the components enough to consider when developing the principles for using digital content in the classroom in the context of secondary school in Bangladesh?
Logical organization between components and principles	Are the components clearly related to each principle?
Appropriate Terminology	Are the components using appropriate wording?
Appropriate method for developing principle	Is the interview with teachers appropriate to develop these components?
	Is the interview with teachers' trainers appropriate to develop these components?
	Are the classroom observations appropriate to develop these components?

[Table 18] Evaluation Item for Overall Principles and Specific Guidelines

Evaluation Item	Description
Validity	This principle is valid for teachers to consider when they design the classroom with digital content
Explicability	This principle is well explained for teachers what they should keep in

	mind when designing the classroom with digital content
Usability	This principle can be useful for teachers to design the classroom with digital content
Generality	This principle can be generalized in the whole context in Bangladesh
Comprehensibility	This principle is easily explained to understand what teachers should keep in mind when designing the classroom with digital content

As for the four-point scale validity questionnaire, quantitative data of the experts' rating was analyzed with the Content Validity Index (CVI) and Inter-Rater Agreement (IRA). The CVI is calculated based on the representativeness of the measure by calculating the number of experts who rated the item as three or four and dividing that number by the total number of experts, which will lead to the proportion of experts who deemed the item as content valid (Rubio et al., 2003). The CVI is recommended to be higher than 0.80 (Davis, 1992). Also, the IRA is assessed to determine the extent to which the experts are reliable in their ratings (Rubio et al., 2003). IRA shows how reliable the experts' ratings are. In other words, if IRA is higher than 0.80, the experts' opinion is overall in agreement, and therefore the experts' ratings are reliable (Lynn, 1986). The IRA for the scale can be calculated by the number of items that have IRA (=CVI in 4 point scale) over 0.80 and dividing it by the total number of items (J. Lee, 2012). Based on the in-depth interview transcription and the results of CVI and IRA, the principles were revised from the first to the third version.

3.4 Usability Test

Due to the corona pandemic, schools in Bangladesh closed from March 2020 to March 2021. Therefore, the usability test was conducted via ZOOM by interviewing secondary school teachers to gain feedback on the usability of the revised version of principles. The main purpose of the usability test is to determine if the revised principles and specific guidelines could work in a real-world situation (Jang, 2011). Also, the usability test can prove how the developed

principles can help secondary school teachers to conduct the actual classroom and figure out the improvement for finalizing the principles. This usability test can also be considered an external validation, as it includes critical voices from secondary school teachers who have much experience with using ICT in their classroom. Although opinions from students are critical, as the main purpose of instructional design is to help the learning process of learners, the opinions from the teachers or experts in the instructional design can also be very useful materials to finalize the instructional design principles (C. Lim, 1995). While the internal validation is for reviewing the theoretical and logical context of the instructional design principles and specific guidelines, the usability test is for confirming its practical applicability at the school level with teachers who will be the actual user of these principles (Jang, 2011).

A semi-structured interview method was employed for the usability test with secondary school teachers via ZOOM in order to give interviewees freedom to talk about the topics. In particular, the usability test focused on the "context of the education system in Bangladesh" because the research in instructional design principles has not been discussed much in the context of developing countries. Considering that the results from the internal validation also pointed out that the principles should reflect the specific context of Bangladesh more, the usability test attempted to figure out the applicability of each specific guideline and principle in the context of each teachers' classroom setting.

3.4.1 Participants in the Usability Test

Five secondary school teachers in total participated in the usability test. The criteria for selecting the secondary school teachers for the usability test were as followings: (1) ICT expert teachers who have been using ICT in their class for more than five years, (2) fluent English speaker in order to directly communicate with the researcher. The researcher sent the request for recruitment of the research

participant to the person in charge of ICT teacher training in a2i program¹¹, and received the recommendation list of ICT expert teachers. The teachers on the list are either currently playing a role as an ICT ambassador teacher designated by a2i in their community or highly regarded as an ICT expert by a2i. After sending the email to the all teachers on the recommendation list requesting research participation, four ICT expert teachers expressed their willingness to participate in the usability test. In addition, one teacher (teacher Z), who has participated in the internal validation process also participated in designing a lesson plan with the revised instructional design principles. The newly recruited four teachers (teacher A –D), therefore, participated as reviewers of the principles and the lesson plan in terms of its feasibility and applicability in their actual classroom (see table 19). Although the usability test was conducted only with English teachers for direct communication with the researcher, the usability test did not focus on the specific subject context because the principles and specific guidelines in this research were developed for all subject teachers in Bangladesh.

[Table 19] Profile of Teachers participated in the Usability Test

Research Participants	Designation	Subject	Location of the School	Teacher Experience Year	Date of the Interview	
					First	Second
Teacher Z	Teacher	English	Dhaka	10 years	Feb 5th	Feb 17th
Teacher A	Senior Teacher	English	Chattogram	17 years	Feb 26th, 2021	Mar 5th 2021
Teacher B	Senior Teacher	English	Chattogram	19 years	Feb 27th 2021	Mar 7th 2021
Teacher C	Assistant Teacher	English	Pabna	17 years	Feb 26th, 2021	Mar 7th 2021
Teacher D	Assistant Head Teacher	English	Gazipur	17 years	Feb 24th, 2021	Mar 1st 2021

¹¹ Access to Information (a2i) is a program of the government's Digital Bangladesh agenda supported by UNDP and USAID, under the Prime Minister of Bangladesh's Office.

3.4.2 Tools and Procedure for Usability Test

The revised instructional design principles can be divided into part I for “teachers’ preparation for using ICT” and part II for “teaching and learning activities using ICT.” Therefore, the usability test interviews were also conducted in two sections (see table 20). Previous research in the development of instructional design principles has employed the quantitative method with a four-point Likert scale so that research participants could answer with a score toward its usability. However, this research employed only a qualitative method using the in-depth interview because reflecting the critical voice from the teachers in Bangladesh is the most important part to finalize the principles.

The in-depth interviews were focused on the strength, weakness, and improvement of the revised principles, and tried to find the answer to the second research question of this research, "what factors should be considered when developing instructional design principles for ICT integration in the context of developing countries?" By asking about the usability of the principles in the actual classroom in secondary school in Bangladesh with why and how questions as much as possible, some distinctive factors were able to be identified, which should be significantly considered when developing the instructional design principles in the context of developing countries. The average time of each interview was one hour per individual interview, and each interview was recorded and transcribed for analysis.

[Table 20] Procedure and Interview Question of the Usability Test

Areas of principles	Procedure and Method	Interview Questions
<p>PART I (principle 1 – 5)</p> <p>Teachers' Preparation for using ICT</p>	<p>In-depth interview about feasibility and applicability of the principles and specific guidelines in the context of Bangladesh</p>	<p>1) Do you think the principles and specific guidelines are possible to use for your class?</p> <ul style="list-style-type: none"> - if you can, what is the strength of principles and specific guidelines? - if you cannot, what is the weakness of principles and specific guidelines? - how do you improve/modify them? - what should be added/edited in order to make it more applicable in the context of Bangladesh? <p>2) Are these principles helpful to improve your capacity and knowledge about ICT integration?</p>
<p>PART II (principle 6 – 10)</p> <p>Teaching and Learning Activity with using ICT</p>	<p>Development of lesson plan based on the principles</p> <hr/> <p>In-depth interview about feasibility and applicability of the principles and specific guidelines in the context of Bangladesh</p>	<p>1) Does this example of the lesson plan properly include the principles 6 – 10?</p> <p>2) Is the lesson plan usable/applicable in your classroom?</p> <ul style="list-style-type: none"> - if yes, what is the strength of the lesson plan? - if not, what is the weakness? - and what improvements need to be done to make your class more successful?

First, in order to determine the usability of part I “teachers’ preparation for using ICT,” a semi-structured interview was conducted with four secondary school teachers by asking about the feasibility and applicability of the principles in the context of the Bangladeshi classroom. The interview questions were designed to question the strengths, weaknesses, and improvement of the revised principles and identify how helpful the principles are when teachers prepare class using ICT materials. The usability test interviews were mainly conducted with open-ended questions to ask further questions based on the interviewee's answer.

Secondly, for the second interviews regarding the part II "teaching and learning activities using ICT," the “lesson plan" developed by applying the principle 6 - 10 was used to ask teachers about the applicability in their lessons.

Developing a lesson plan is an important step in order to check the usability of the instructional design principles. Therefore, the lesson plan was designed before the usability test with the help of one of the secondary school teachers (teacher Z) in Bangladesh. The first draft of the lesson plan was roughly developed based on the official English textbook called "English for Today" and the "lesson guideline," which are commonly used among English teachers in Bangladesh. Later, teacher Z reviewed the lesson plan draft, and gave some feedback to finalize the lesson plan (see appendix 7). Before the usability test with secondary school teachers, the lesson plan was sent to the teachers via email in advance, and the four teachers (A-D) were asked to review the lesson plan, assuming that they are going to use this lesson plan in their class. Like the first interview, the second interview aimed to determine the usability of principles 6 to 10 by reviewing the lesson plan. By asking about the usability of the lesson plan in their actual classroom, it confirmed its feasibility of the instructional design principles in the context of Bangladesh and improved to the final version of principles based on teachers' feedback.

CHAPTER IV. RESEARCH FINDINGS

This research aimed to develop instructional design principles for using ICT in secondary school in Bangladesh and confirm its validity when applied in the classroom. The findings of this research are expected to answer the two research questions. In order to answer the first research question, "what are the optimal instructional design principles for using ICT in secondary education in the context of Bangladesh?" this chapter shows the results of each development process of the instructional design principles from the first version of principles to the final version of principles. Also, in order to answer the second research question, "what factors should be considered when developing instructional design principles for ICT integration in the context of developing countries?" this research identified several distinctive factors to be considered for developing instructional design principles in developing countries throughout the whole research process.

4.1 The First Version of Instructional Design Principle

The first version of instructional design principles for using ICT in secondary school in Bangladesh was constructed via synthesis of the implications from the literature review of previous research, in-depth interview with stakeholders, and class observation during fieldwork. Considering that the main target of this research is secondary school teachers in Bangladesh, where ICT resources are minimal, the most concerning factor for the first version of the instructional design principle was to develop more precise and contextually valid principles from the beginning of the research.

4.1.1 Development of Initial Components through Fieldwork

First, to develop the first version of the instructional design principles, the components, which are the upper categories consisting of a few related principles,

needed to be constructed. As instructional design principles should be different in different situations, the main components should also differ depending on the context (Sarfo & Elen, 2014). Therefore, the current development of the Bangladeshi class using ICT was analyzed during fieldwork based on the ASSURE model and elicited the essential ingredients for conducting the ICT-supported class through in-depth interviews and class observation. As a result, six components that make up the current Bangladeshi class using ICT were identified: (1) selecting the digital content, (2) preparing the digital content, (3) designing the digital content, (4) preparing students for multimedia class, (5) interaction with students, and (6) setting up the proper environment for multimedia class (see table 21).

[Table 21] First Version of Components of Instructional Design Principles in Bangladesh

No	Components	Explanation
1	Selecting the digital content	Before delivering the class through digital content, teachers should first decide what kind of digital content will be used among the many types of ICT materials such as video, graphics, audio, text.
2	Preparing the digital content	Teachers should prepare the multimedia class by collecting resources from the internet or textbook such as relative video, pictures or texts, and exemplary PPT slides.
3	Designing the digital content	Teachers should appropriately design the PPT slides with some pictures or animation in order to attract the students' attention.
4	Preparing students for multimedia class	Teachers should provide a short guideline for students before the multimedia class in case where students are not familiar with digital content.
5	Interaction with students based on the digital content	Teachers should try different instructional strategies for interaction by using the digital content.
6	Setting up the proper environment for multimedia class	Before starting the multimedia class, teachers should check the class environment, such as internet, electricity, and computer availability.

First, "selecting the digital content" indicates that teachers decide what types of digital content will use for the class. If teachers decided to use digital content

for the class, then what types of content teachers will use needs to be considered. Although the available digital content in Bangladesh is quite limited, and many teachers often select to use PPT presentations, teachers should critically consider the necessity of digital content for their class objectives or learning outcomes.

Second, “preparing the digital content” is the most important ingredient for Bangladeshi teachers. Usually, Bangladeshi teachers use the PPT presentation as a primary ICT tool. Therefore, teachers need to find more educational resources from the internet to provide students with more relevant content and examples through their PPT presentations. Currently, expert teachers, who are used to using ICT materials in their classrooms, can prepare for the class by searching for more information through Google, YouTube, and other various OER, but some novice teachers just download the existing PPT slides made by other teachers through the teachers’ portal. Therefore, “preparing the digital content” could be an important component that teachers should consider in order to provide quality digital content to all students.

Third, “designing the digital content” is related to the technological factor for conducting class using ICT. Since many teachers are currently using PPT presentations, developing a well-designed PPT presentation has become one of the most important influencing teachers' capacity to use ICT in their classes. Also, many teacher training institutes provide "digital content development" courses, teaching the development of PPT presentations as one of the government’s core projects to enhance teachers' capacity for using ICT in education. Therefore, designing the PPT contents for more effective delivery of the contents should be considered when teachers prepare the class.

Fourth, "preparing students for multimedia class" emphasizes the readiness of students when teachers use ICT materials. Especially in Bangladesh, multimedia class is relatively new, and students do not always take classes with digital content. Therefore, class rules or culture in the multimedia classroom should be different

from the traditional class, and accordingly, teachers should consider that students should be well prepared for the multimedia class.

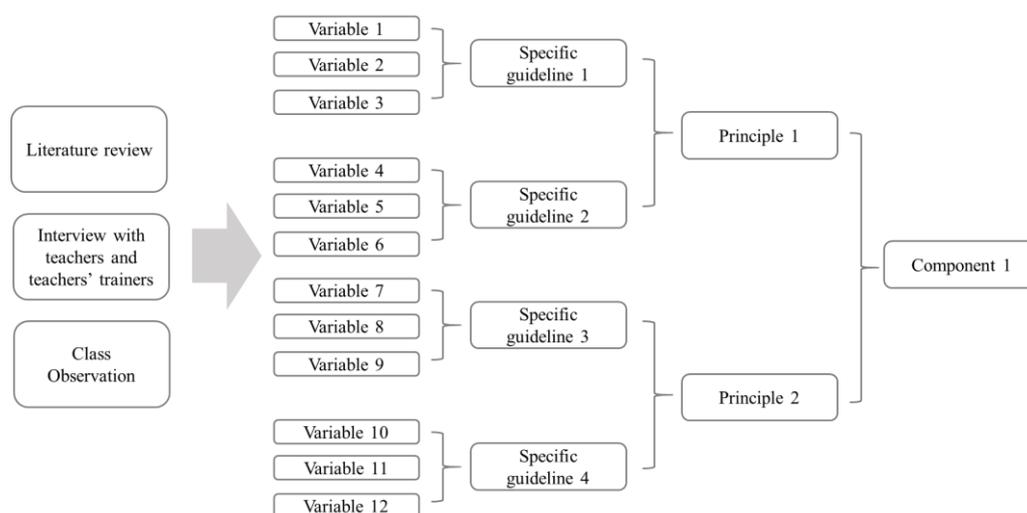
Fifth, “interaction with students based on the digital content” is the component that teachers should consider during the multimedia class. Currently, questioning and answering are typical interactions between teachers and students in the Bangladeshi multimedia classroom, making more "teacher-led learning" despite using digital content. However, the primary purpose of the GOB for integrating ICT into the education system is to make students more active participants in the class and make a student-centered learning environment. For a more effective use of ICT in education, teachers should attempt to apply more varied instructional strategies to elicit interaction with students through digital content.

Lastly, “setting up the proper environment for multimedia class” was included in one of the initial components because educational reform with ICT embarked with limited infrastructure in Bangladesh. Having the proper environment should be one of the prerequisites to use ICT in education. However, there are still many obstacles, such as unstable electricity supply and an Internet network at the school level. Therefore, Bangladeshi teachers should always check their class environment before conducting the multimedia classes and setting up a proper environment within the ICT constraint-environment should be considered by teachers in the instructional design principles in Bangladesh.

4.1.2 Development of Initial Principles and Specific Guidelines through the Literature Review and Field Research

Under each component, the initial instructional design principles and specific guidelines were developed based on the results of literature review, in-depth interviews, and class observations according to the following steps: (1) the variables that needed to be considered for ICT integration in the context of Bangladesh were derived under each component, and then similar variables were

integrated and re-stated to complete one specific guideline; (2) 2-3 specific guidelines were combined into the one principle based on its commonality, and developed the instructional principles covering the common contents of the specific guideline. Lastly (3) the wordings of principles and specific guidelines were elaborated on to make them more clearly understandable (See figure 10).



[Figure 10] Process of Development Initial Principles and Specific Guidelines

Throughout the process described above, the first version of the instructional design principle for using ICT in the context of Bangladesh was developed, including 25 specific guidelines, 12 principles, and six components in total. The first version of the instructional design principle was attached in appendix 1.

4.2 Results of the Internal Validation

The purpose of the internal validation is to test content validity of the components, principles and specific guidelines, and improve them for finalizing the instructional design principles. In order to secure the validity of the principles, this research conducted three times of internal validation. The results from each validation process are summarized below.

4.2.1 Results of the First Internal Validation

The first internal validation test was conducted to examine the validity for (1) components of the principles, (2) each principle and specific guideline, and (3) the entire principles. For the first internal validation, seven experts in the field of education in Bangladesh participated in a face-to-face interview during the field research in Dhaka to confirm the validity of the components, principles, and specific guidelines for using ICT in secondary school in Bangladesh. During the interview, the experts were asked to answer the validity of the first version of the principles with a four-point Likert scale (See internal validation package in appendix 1-3). From the results of the first internal validation, quantitative data of experts' ratings was analyzed and reported with the Content Validity Index (CVI)¹² and Inter-Rater Agreement (IRA)¹³. The questionnaires for all three internal validation tests and the specific results are included in appendix 1-3. Table 22 is a summary of the results of the first internal validation for the components, principles, and specific guidelines (see appendix 1 for the entire results of the first internal validation).

In addition to the quantitative analysis of the result from the internal validation, the experts gave feedback for further improvement on the principles and specific guidelines (see appendix 1.3.4 for the full comments). These feedbacks mainly include "changing the wordings," "making the guideline more detailed," "renaming the principles," and "reorganizing the principles." Particularly, most of the feedback was related to "considering the real context of Bangladesh" since

¹² CVI shows how valid the item is. It can be calculated by counting the number of positive ratings (i.e., 3 or 4) and dividing it by the number of experts. Higher than 0.80 is recommended (Davis, 1992).

¹³ IRA shows how reliable the experts' ratings are. In other words, if IRA is higher than 0.80, this experts' opinion is overall in agreement, and therefore the experts' ratings are reliable (Lynn, 1986). IRA for the scale can be calculated by the number of items that have IRA (CVI in 4-point scale) over 0.80 and dividing it by the total number of items. (Rubio et al., 2003).

most participants in the first internal validity test were experts in Bangladeshi education. Also, the experts from the first internal validation suggested alternatives, which are more suitable for the context of Bangladesh.

[Table 22] Summary of the First Internal Validation

Evaluation item	CVI (means)	IRA	Expert comments
Validity for the components	0.90	0.80	Modifying the wordings, reorganizing the principles, considering the context of Bangladesh, making the guidelines more detailed, and renaming the principles.
Validity for the principles and specific guidelines	0.97	0.92	
Validity for the overall principles	0.94	0.80	

4.2.2 Procedure to Develop the Revised Version of Principles

The second and third internal validation tests continued to further improve the principles and specific guidelines in the same manner as the first internal validation process. Based on the three internal validation tests, the components, principles, and specific guidelines were continuously revised and elaborated on in order to improve the instructional design principle for using ICT in secondary school in Bangladesh. The entire results of the second and third internal validation tests are included in appendix 2 and 3, and this session presents the summary of the whole process of the internal validation (see table 23).

As shown in Table 23, the results from the first internal validation were relatively high (CVI=0.97, IRA=0.92), which means the principles and specific guidelines are valid enough, and experts' ratings are also reliable. However, in the second internal validation, the score became slightly lower, especially in terms of IRA. It is assumed that the participants in the second internal validation were differently organized as it had opinions from the perspective of experts in educational technology. Mostly, principles and specific guidelines were renamed, reorganized, and modified to reflect the current context of the Bangladeshi education system. As a result, the score of the third internal validation achieved

the recommended score by previous research and developed the revised version of the instructional design principles based on the results from the third internal validation. The revised version of instructional design principles is listed in appendix 4 and it applied in the usability test to confirm its applicability in the actual classroom settings.

[Table 23] Summary of the Internal Validation Process

	First Internal Validation		Second Internal Validation		Third Internal Validation
CVI (mean) ¹⁴	0.97		0.80		0.91
IRA	0.92		0.5		0.92
Comments	Modifying the wordings	→	Modifying the Wording	→	Specifying the wording
	Reorganizing the principle		Restructure of principles and guideline		Reorganizing the components and principles
	Considering the context of Bangladesh		Considering the context of Bangladesh		Considering the context of Bangladesh
	Making the guidelines more detailed		-		Adding more specific guideline
	Renaming the principles		-		-

4.3 Result of the Usability Test

The revised instructional design principles from the three internal validation was evaluated on its operational validity through the in-depth interviews for the usability test. Four secondary school teachers participated in the usability test interview via ZOOM, and individual in-depth interviews were conducted to ask about applicability and usability in the context of the real secondary school classroom environment in Bangladesh. Each interview was conducted two parts;

¹⁴ The CVI here refers to the mean of the validity for the evaluation item of each principle and specific guideline (see the entire validity in appendix 2 - 2.3.2 and appendix 3 - 3.3.1)

the first part includes the principle 1 to 5, which are related to the “teachers’ preparation,” and the second part includes the principle 6 to 10, which are related to the “teaching and learning activity during the class.” During the usability test interview, teachers specifically described how the principles can work or cannot work in their classrooms, and some strengths and weaknesses of the principles and specific guidelines were identified by analyzing teachers' descriptions. Also, teachers suggested additional principles and specific guidelines that should be added when integrating the ICT into class Bangladesh classes.

In general, teachers commented that the principles and specific guidelines would guide teachers in planning their multimedia class and help teachers understand where they need to work when using ICT for their class. Currently, Bangladesh lacks specific guidelines for instructing teachers to utilize the ICT in the classroom, while the government has pushed teachers to integrate technology in education. Hence, the instructional design principles and specific guidelines are expected to provide a clear concept of “how” and “when” to use ICT in their lesson plan. The following are specific descriptions of strengths, weaknesses, and suggestions toward the revised version of principles. The final principles and specific guidelines were developed based on weaknesses and suggestions from the results of the usability test.

4.3.1 Strength of the Principles

The strengths of the principles resulting from the usability test were divided into four categories as shown in Table 24: teachers’ preparation, students’ participation, utilization of digital content as a supplementary tool, and consideration of Bangladeshi Context. The entire table of the strength of the principles is attached in appendix 5.1.

[Table 24] Strength of the Principles resulted from the Usability Test

Category	Instructional Design Principles
Teachers' preparation	Principle 2: Linking the ICT materials to your learning outcomes
	Principle 3: Use of various resources and activities that are relevant to the curriculum
Students' participation	Principle 7: Attracting students with digital content
	Principle 10: Sharing the class materials after class with the students
Utilization of digital content as a supplementary tool	Principle 9: Integration of the digital content with other materials
Consideration of Bangladeshi Context	Principle 1: Confirming the available resource
	Principle 4: Building a learning community with expert teacher
	Principle 5: Organizing an appropriate environment for multimedia class

4.3.1.1 Teachers' Preparation

Among the strength of the principles, first, the "teachers' preparation" was found to be an essential factor for preparing the class with ICT in Bangladesh. As Bangladesh currently lacks ICT-trained teachers, teachers' preparation needs to be precisely described in the instructional design principles to help teachers understand what they must focus on for the preparation of ICT-supported classes.

For example, the **principle 2 "Linking the ICT materials to the learning outcome of the class,"** is very important in order to prevent teachers from excessively using ICT materials. There have been some critics that class objectives or subject contents are not appropriately considered when ICT materials are integrated into an actual classroom (Kang & Kim, 2012). In Bangladesh as well, linking the digital content to learning outcomes has not been addressed yet because ICT in education policy is relatively new, and it has focused more on the expansion of using the multimedia classroom at the school level. Nevertheless, teachers during the usability test interview strongly mentioned that principle 2 must be applied when teachers prepare for the multimedia class. Especially the specific

guidelines 2.2 and 2.3 were identified as helping teachers link the ICT materials to the learning outcome because it facilitates teachers to think deeply about the “necessity of integration of ICT in education.” Digital content should not be used whenever teachers want. Rather it should be used depending on the “necessity” in order to facilitate the learning outcome. In the context of Bangladesh, PPT presentations have been placed as the main ICT resource at the school level, and the teacher still plays a role as the content deliverer with the use of PPT. Under this circumstance, the learning outcomes of the class will scarcely be achieved by presenting PowerPoint slides one way to students by a teacher (C. Lim, 2001). Teacher B explained her thoughts about using ICT to bring out the learning outcome of the class;

“That is the thing you need to think about using ICT. What is your educational goal to use that ICT materials, what is the (reason) for using that technology for your education. So, these are the things you need to know first and then you can use the component very comfortably and easily [...] if I find that using ICT materials will not bring the learning outcome, I will try to use other tools also. [...] It needs to be linked to my learning outcome from my students. It should be prepared first. So yes, I will use ICT as far as I need to bring out my learning outcomes.” (Teacher B at the usability test interview on Feb 27th, 2021)

Also, the **principle 3 “use of various resources and activities relevant to the curriculum,”** should also be considered when integrating the ICT into the class. During the usability test interviews, teachers agreed that they should use various resources such as Online Educational Resources (OER), which are accessible for all teachers through the internet. The OER is very important for teachers in Bangladesh, where there is a lack of digital learning resources, while

at the same time, more classrooms have access to ICT nowadays. Although the available OER is still limited for specific subjects, or many of OERs are using English as the medium of instruction and are global-north biased (C. P. Lim et al., 2020), currently Bangladeshi teachers are trying to utilize various online resources such as YouTube, 10 minutes school, khan academy, Hot potatoes¹⁵ when they conduct the multimedia classroom.

"I suggest to my colleague to use, of course teachers' portal, or YouTube or 10 minutes school, khan academy, any types of educational sites to make his class effective and fruitful for their students. Because our main moto is to improve our students' positions. So, to achieve our educational objective here, I always suggest my (colleague) teachers to use different website for the betterment of their presentation." (Teacher D at the usability test interview on Feb 24th, 2021)

"I always use YouTube and UNESCO toolkit. I use only hot potatoes. And I use YouTube and PPT. PPT is normally common. But I don't use khan academy. For YouTube and UNESCO toolkit I use for assessing students. We can set hot potatoes on our PPT. it is also popular." (Teacher A at the usability test interview on Feb 26th, 2021)

Moreover, teachers can try various activities such as gamification using "Kahoot." Although the class environment is very limited to utilize gamification with Kahoot in Bangladesh, Teacher A mentioned that she even tried the Kahoot game with students by asking them to bring their parents' mobile phone;

¹⁵ The Hot Potatoes suite includes six applications, enabling to creation of interactive multiple-choice, short-answer, jumbled-sentence, crossword, matching/ordering, and gap-fill exercises for the World Wide Web. Hot Potatoes is freeware and for any purpose or project.

“I always try to set more engagement. For that, I always try to set more exercise type of questions for students’ engagement, for participatory learning. That is my preparation. And sometimes I prepare the Kahoot game. I like the game. [...] whenever I decide to take the Kahoot game, then previously, I (announced) that parents will provide mobile phone only for this period.” (Teacher A at the usability test interview on Feb 26th, 2021)

4.3.1.2 Students’ Participation

The second strength of the principles is that it emphasizes the “students’ participation” when teachers integrate the ICT. Although students’ active participation with using digital content in the current multimedia classroom in Bangladesh is limited due to the lack of digital devices that students can access, teachers in the usability test interview mentioned that “ICT in education” should facilitate more students’ participation, rather than one-way lecturing by a teacher. In this respect, the instructional design principles in this research suggest two ways of facilitating the students' participation with the limited ICT materials so that students can also actively participate in learning with ICT materials.

The first one is “calling attention” by showing some content with ICT and asking many questions by the teacher at the beginning of the class. For example, the **principle 7 "attracting students with digital content"** suggests that teachers make more interesting classes with enjoyable examples and trigger animation in their PPT presentation. Since the most usable ICT material is PPT presentation in Bangladesh, principle 7 emphasizes "calling attention" by using auditory or visual materials for students' participation. Based on principle 7, teachers can introduce graphics or other forms of media, ask questions, incorporate relevant personal experiences, or even make a simple change in their volume or rate of speech in

order to attract students (Newby, Stepich, Lehman, & Russell, 2006).

“I always use attractive animation, I have some trigger in my PPT. [...] and some video clips, sometimes I use small songs also.” (Teacher A at the usability test interview on Mar 5th, 2021)

The second one is "students' use of ICT for their learning." The **principle 10 “sharing digital materials with students”** can facilitate students' participation in their learning by using ICT devices. By providing the opportunity for students to use ICT for their learning before and after the class, students can become an active user of digital tools as well as prepare for the class beforehand. Currently, Bangladeshi teachers are using various ways to connect to the students outside of the classroom via Facebook, school website, and WhatsApp, and some teachers utilize google classroom to share the class materials, although only a limited number of students can access the google classroom at their home. In this way, teachers can connect to the students even after the class, and students can also participate in the multimedia class more actively.

“(specific guideline) 10.1 is absolutely okay, because we also deliver our class after ending the session through our school website, our FB group.” (Teacher D at the usability test interview on Mar 1st, 2021)

“In my case, most of the time I use the google classroom, I just put the extra materials on there, so that when they come to the class, they have their own materials. [...] but not all the students have internet connection or facility, so for those students, I provide (the materials) them in the class. [...] I use all the device that for one class so that I can reach to everyone.” (Teacher C at the usability test interview on Mar 7th, 2021)

4.3.1.3 Utilization of Digital Content as a Supplementary Tool

The third strength of the principle is that it indicates the teachers' "utilization of digital content as a supplementary tool," not a main resource of the class. **The principle 9 "integration of the digital content with other materials"** points out that ICT should be organically combined with the advantages of traditional teaching, means and timely switch in the two teaching methods to make them supplement each other (Blurton, 1999; Xu, 2017). Digital content should not be only one teaching material during the class (C. Lim, 2001). Particularly the use of PPT during the class in many Bangladeshi classrooms has made students passive learners with teacher-centered teaching strategy and challenging to make constructivist learning. Sometimes teachers only focus on PPT presentations and do not integrate other instructional materials for more facilitated learning. This could increase the cognitive pressure of learners (C. Lim, 2001). In this respect, teachers in the usability test strongly agreed on the importance of applying principle 9 in their class, although many teachers are still merely focusing on PPT presentation throughout the whole class. Specifically, teachers emphasized the use of textbooks together with the digital content as a possible way to adopt principle 9 for more effective use of ICT in education.

"Definitely, going through the textbook is very important and my students know that. All the students know very well that in my class they need to bring the textbook. Because they need to repeat (the text) sometimes, they need to read silently sometimes, they need to make some activities from the textbook, so they need to bring the textbook always in my class. I prefer going through the textbook because English is subject for language learning, not for contents." (Teacher B at the usability test interview on Mar 7th, 2021)

“Teachers can show some PPT slides, and from that slides, students can have discussion among them, and then they will open the textbook and find the conversation [...], we can give them time to read by themselves. [...] so, they can use a textbook. So, in this way, we can integrate ICT and a textbook.” (Teacher C at the usability test interview on Mar 7th, 2021)

Not only textbooks, but teacher A also mentioned the use of whiteboard, marker, card, mobile phone, and speaker etc., as a way of combining traditional and ICT materials;

“We have whiteboard, marker, whenever we need to use whiteboard. Sometimes students have to write 'vocabulary' in warmup session, sometimes we use some card, or mobile phone. Sometimes we have some listening content, so for that, we have to use speaker, connecting to my mobile phone. [...]. After listening contents, they have to answer the question, set on the textbook.” (Teacher A at the usability test interview on Mar 5th, 2021)

4.3.1.4 Consideration of the Bangladeshi Context

The last strength of the principles is that it is well described from the perspective of the educational system in Bangladesh. Since this research starts from the necessity to develop the instructional design principles reflecting the context of developing countries, it was continuously committed to including the principles and specific guidelines based on the distinct features of the educational environment in Bangladesh. As a result, teachers from the usability test mentioned that some of the principles and specific guidelines were very well reflected in the current challenges of Bangladesh and clearly show how teachers can prepare and

conduct the class with ICT in this resource-limited environment.

For example, the **principle 1 “confirming the available resources”** was recognized by teachers as the most important and applicable principle in their classroom because of the lack of ICT infrastructure in many Bangladeshi schools. Especially, the specific guidelines 1.1 and 1.3 address the unstable electricity supply and the large number of students in one class, which are the distinct features of classrooms in many Bangladeshi schools. These two features are the significant challenges hindering teachers from using ICT in the classroom, but they are also important principles that teachers must consider when preparing multimedia classes. Therefore, teachers should always check the availability of electricity and internet connection before starting the class even though they have prepared the digital content well. Depending on the availability of network or electricity, teachers should change their lesson plans and teaching materials.

“Whenever I go to class, I confirm my contents, (and if) electricity is okay, internet is okay, I want to check. And other my devices are okay. I should check always” (Teacher A at the usability test interview on Feb 26th, 2021)

“So, these are the things that first you must come to your mind if you don’t know all these things you cannot even proceed. So, confirming the resource availability, confirming what resource you want to have in your lesson, what resource you want to pick actually for your students, it is also important.” (Teacher B at the usability test interview on Mar 7th, 2021)

Also, the classroom environment, such as many students, needs to be considered when confirming the available resources. Teacher A mentioned that teachers should find the most appropriate digital content “to handle the large number of students.”

"I arrange a clear sound system, and I always be careful about picture quality so that all the students can understand about the topic and can realize that what I want to teach them. [...] Picture quality and sound system are very much important here." (Teacher A at the usability test interview on Feb 26th, 2021)

"In our country, we have 60 – 70 students in one class (especially in) most of higher secondary school. So, with the large number of students, we should try all our best to set all kinds of things so that students can enjoy the class. So, principle no.1 is always perfect for preparing any kinds of class." (Teacher D at the usability test interview on Feb 24th, 2021)

Also, **the principle 4 “building a learning community with expert teachers”** could be the principle that reflects the context of Bangladesh. Having a teacher community is well understood as an inherent component of teacher development. In Bangladesh, there are many teachers who are taking on the role of a teachers' trainer to encourage their colleague to use ICT and train them on how to effectively integrate technology in their classroom activities. Those teachers are called “ICT ambassador” designated by a2i¹⁶ or “master trainers” depending on the teacher training institute and they try to share their knowledge of ICT by voluntarily organizing ICT forums for their colleagues in their community. While the teacher training programs are only focusing on basic computer training and technical knowledge within a limited time, learning communities led by expert teachers can provide more flexible teacher training even in the form of individual meetings. Teacher D, in the usability test interview, mentioned how she plays a role as an

¹⁶ Access to Information (a2i) is a program of the government's Digital Bangladesh agenda supported by UNDP and USAID, under the Prime Minister of Bangladesh's Office.

ICT ambassador;

“I taught (my colleagues) so many times. Sometimes I stand all the time with him or her to cooperate to run the (online) class, how to change the slide, how to start video, how to browse on that moment... (When I don’t have my class) [...] in my area, where my school is situated, it is really going on. Because in my neighboring schools, there are also 2 -3 teachers who are capable to run the technology, and they help other teachers.”
(Teacher D at the usability test interview on Feb 24th, 2021)

Lastly, the **specific guideline 5.4 “prepare a backup plan in case the technology does not work”** was also found to be applicable and more important than other guidelines under the principle 5. During the usability test interview, teachers shared their experiences when they could not continue the multimedia class due to blackouts and replaced their digital content with other materials such as textbooks. In Bangladesh, electricity is often cut off during the class, and therefore teachers should always keep in mind a “backup plan” for teaching whenever they prepare the digital content.

“The last one (5.4) is important because if you think that I will take a class or I will only use PPT for my class, but whenever you start your class, the electricity failure occurs, what will you do? You need to have the backup definitely. If you do not have the backup plan, what will you do for 45 mins? [...] I just decided not to use the digital tool. And decided to open the book... did different things... [...] I just continued for 45mins with my normal tools like book, whiteboard and other things. I didn't even bother for the digital tools. Because it was not working, I cannot spend the whole time to fix it up. This is how I plan for my class; yes, backup plan is very

important." (Teacher B at the usability test interview on Feb 27th, 2021)

"Bangladesh is a country where the electricity is really a problem. If we are ready with everything, but electricity can be stopped. It is happening a lot. Most of the schools do not have backup electricity and power generation system." (Teacher C at the usability test interview on Feb 26th, 2021)

4.3.2 Weakness of the Principles

On the other hand, teachers also pointed out some weaknesses of the principles, which are not applicable in the context of Bangladesh and required improvements to some extent. The weaknesses are mainly related to the mismatch between the principles and educational system or environment in Bangladesh, even though it is still an important factor for the successful implementation of ICT integration in education. They were divided into two categories as shown in Table 25: inapplicable principles due to the limited resource or budget in the current educational system of Bangladesh and replaceable principles with more appropriate guidelines in the context of Bangladesh. These principles have been modified based on teachers' comments in the final instructional design principles. The entire table of the weaknesses of the principles is presented in appendix 5.2.

[Table 25] Weakness of the Principles from the Usability Test

Category	Instructional Design Principles
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Inapplicable principles in the current educational system of Bangladesh	Principle 5: Organizing an appropriate environment for multimedia class
Replaceable principles with more appropriate guidelines	Principle 6: Provision of guideline to the learner before starting the class with digital content
	Principle 8: Facilitating participatory approach with digital content

4.3.2.1 Inapplicable Principles in the Current Educational System of Bangladesh

First, the **principle 5 “organizing an appropriate environment for multimedia class,”** was found to be not applicable to the Bangladeshi educational system and environment, although it is theoretically important when teachers use ICT materials in the class. For example, the **specific guideline 5.1, 5.2, and 5.3 under the principle 5** could not be for teachers’ consideration because teachers in Bangladesh cannot set up or move the projectors or screens whatever they want. Generally, in many secondary schools in Bangladesh, the minimum digital equipment such as one laptop and one multimedia projector have been provided by the government. Those multimedia classrooms are set up in one or two classrooms because schools cannot afford to have all ICT materials in each classroom. Thus, teachers normally use the multimedia class two or three times per week shared by other teachers, teachers cannot change or organize the multimedia classroom. Rather, teachers should consider the class environment, such as the electricity or internet network availability, when they use digital content.

“You cannot take or move all these things from here and there. So, this is the kind of thing we do not need to think about it. For example, the

guideline 5.1 (set up the screen is big enough...) you do not have scope or opportunity because schools just set up all these things. You do not need to think when to take the screen from here and there, or if it is a big class, you can take it in the middle or somewhere else, no. it is fixed. [...] But what you need to consider is that before going to the class 'is your laptop okay,' 'is your PPT working,' 'what video you want to show is working?' or just whenever you are in the classroom, you find everything is ready, cables are working, switches are okay, there is no interruption..." (Teacher B at the usability test interview on Feb 27th, 2021)

"(about the specific guideline 5.2 'prepare the separate and (if possible) movable screen) it is very difficult in my country, because of the economic condition. I cannot apply it to my classroom." (Teacher D at the usability test interview on Feb 24th, 2021)

4.3.2.2 Replaceable Principles with More Appropriate Guidelines

The principle 6 “**provision of guideline to the learner before starting the class with digital content**” and principle 8 “**facilitating participatory approach with digital content**” were also pointed out because they are difficult to apply in the current Bangladeshi education system but can be replaced with more appropriate guidelines. For example, the specific guideline 6.1 “give a short guideline to students **at the beginning of the class about how they participate with digital content throughout the class**” under the principle 6 can be replaced with “**at the beginning of the semester.**” Teacher B added that she needs to prepare the students at the beginning of the academic year, explaining how teachers are going to conduct the multimedia class throughout the semester, rather than doing it each and every class;

“I don’t find any deep relation with digital content and this principle 6 ‘preparation of the learners for the multimedia class’. [...] I don’t think when you are standing for any class, then you do not have any provision for preparing your students rather you can take preparation before going to the class especially when you are starting an academic year; when you are going to the class for the first time, you can talk to your student like intro class. ‘This year, these things will go on, and whenever we will do these things, you need to be with me like...’ I think normally I prepare my student like this.” (Teacher B at the usability test interview on Mar 7th, 2021)

Usually, a secondary school in Bangladesh allocates 45 minutes in one class and conducts the class in a separated multimedia classroom. Therefore, students need to move to the multimedia classroom during break time, and teachers also take some time to set up their ICT devices at the beginning of the class. Moreover, teacher A and D commonly mentioned that students are already ready to participate in multimedia classes because of the high level of digital literacy among the young generation in Bangladesh.

“We have only one digital classroom. Before going there, they (students) know they are taking preparation for multimedia class. Because they are shifting the class [...] so, one digital classroom is used one by one. Students come and leave, so they are mentally prepared for joining the multimedia classroom.” (Teacher A at the usability test interview on Mar 5th, 2021).

“Students are now used to attend the multimedia class. So, they are very much familiar with this method. I don’t think that you need to do anything

extra here because students know what they can do... so they are familiar and get used to do that.” (Teacher D at the usability test interview on Mar 1st, 2021)

Moreover, regarding **“the specific guideline 6.2,”** teachers cannot distribute the handout materials to all students due to the lack of budget or appropriate system at the institutional level. However, teacher C mentioned an alternative way to share the class materials with students using Facebook messenger or WhatsApp. Although this is not the common case to distribute the class materials for most teachers in Bangladesh, this guideline show that teachers can find more probable ways to use ICT to connect with students based on this principle 6.

“I have 60 – 70 students in one class. In general, in Bangladesh, there are lots of students in one class, for example 120 – 130 also. I don’t know if it is possible for them or not, but I think if teachers want, there are so many ways without supplying the hardcopy. There are softcopies nowadays they can use the Facebook messenger, WhatsApp to deliver the message.” (Teacher C at the usability test interview on Mar 7th, 2021)

Also, the **principle 8 “facilitating participatory approach with digital content”** is one of the weaknesses of the principles, which should be replaced with more feasible guidelines in Bangladesh's educational environment. However, many obstacles remained in the Bangladeshi classroom due to the lack of devices given to each student, although principle 8 is one of the important components to make student-centered learning with the use of ICT. In the Bangladeshi classroom, facilitating a participatory approach with digital content could be very limitedly implemented with ICT materials because most teachers are using PPT presentation as a main digital tool.

*“(principle 8) maybe not usable in our country, in the ongoing class during the group work, as students do not have access to the device, it is not possible to use ICT to make students engagement in the class.”
(Teacher C at the usability test interview on Mar 7th, 2021)*

*“Participatory approach is not possible with digital content always. Because digital content is just sort of ‘seeing participation.’ They will just watch it. They do not have any activities to be involved with that digital content in our country because they do not have the device in front of them, and they do not even have access to the device. So, I can’t involve them digitally in the digital content. Most specifically with the digital tools. I can show them, and they will watch it. That is not actual participation.”
(Teacher B at the usability test interview on Mar 7th, 2021)*

4.3.3 Suggestion by Teachers for Improving the Principles

Lastly, during the usability test interviews, teachers also shared more ideas to be added to the final instructional design principles. Three suggestions were made by teachers, which are (1) time management, (2) provision of opportunity for students to use the digital content, and (3) increase of teachers’ motivation to use the digital content.

4.3.3.1 Time Management in the Multimedia Class

Making a specific time distribution when teachers are using the digital content is an important component for organizing an appropriate environment for multimedia class (principle 5). In particular, when teachers are not familiar with the integration of ICT tools in their classroom, time management is inevitably considered.

"Time management is very much important. if I don't follow this time, then I cannot complete my target and work there. If I failed, then my students will be failed more. Because I always believe that by failing to prepare, you are preparing to fail. It is what I always believe." (Teacher D at the usability test interview on Mar 1st, 2021)

"Actually, what I do personally, while making the PPT class, I mention the time in my lesson plan. Which slide I should talk on how much time. [...] So, I think that this slide needs 15mins to talk about some activities, then I do that, and if the time doesn't permit me, then I finish that class on the next day. [...] So time management should be in mind or in the lesson plan." (Teacher C at the usability test interview on Feb 26th)

4.3.3.2 Provision of Opportunity for Students to Use the Digital Content

In order to achieve "Digital Bangladesh," which is the priority agenda for the current government of Bangladesh, students need to have the opportunity to use a digital device for their learning. Although most of the multimedia class is currently organized only using PPT presentation by teacher, teachers need to find various ways that students can engage in class with digital content.

One way of providing students with ICT material is to encourage students to utilize various educational resources from the internet. Teachers should consider not only using ICT tools in the classroom but also encouraging students to be more involved in online educational platforms after the class, such as "Kishor Batayon" or "10 minutes school," which is an online platform enabling students to participate in utilizing digital content by themselves. In Bangladesh, many online educational sites have been developed during the COVID-19 pandemic so that students can browse and find educational materials by themselves when schools

are closed. Teacher D described the online platform that the Bangladesh government is providing during the pandemic situation;

“The popular educational site now is ‘10 minutes school.’ Very popular. [...] It is an online platform. Students can just browse it, and they can find any kind of problem on a specific topic. They can just search it and find the solution. And this is really helpful for students, and sometimes for the teachers also [...] Besides this, in this pandemic situation, different online platform has been created here. For example, Chattogram online school, Gazipur online school... (they are) district-based platform. So, students can easily find any kind of information and any kind of topics there.”
(Teacher D at the usability test interview on Feb 24th, 2021)

4.3.3.3 Increase of Teachers’ Motivation

Teachers are at the forefront when it comes to influencing the teaching-learning process inside the classroom. Therefore, it is important to change their attitude toward ICT-based education. Teachers' motivation to use ICT in the class has been discussed in a plethora of research so far. Teachers from the usability test interview also emphasize the importance of increasing the teachers' motivation, especially when discussing principle 4 “building a learning community with expert teacher.” In Bangladesh, the teachers' community led by the ICT expert teachers is very active, and many expert teachers are working very hard to encourage their colleagues to integrate digital content into their education. Teacher D emphasized the “behavioral change” of the teacher for the betterment of education in Bangladesh;

“But things are not actually so easy. Why? Because we need to bring our behavioral change. If we do not accept this reality, we cannot actually

cope with the situation. In my country, the old-aged teachers, who are not so much interested in ICT in education. They didn't try to cope with the situation. It is not an important issue for them. They are not actually familiar with this ICT-based education. So, behavioral change is very much important here. [...] and all the stakeholders who are related to ICT inclusion, they should be positive-minded. Then there will be the possibility to deal with the community." (Teacher D at the usability test interview on Feb 24th, 2021)

4.3.4 Revision of the Final Principles

Based on the results of the usability test some principles and specific guidelines were modified as shown in Table 26. Overall, specific guidelines were revised based on the comments from the usability test interview. Major changes are (1) integration into one guideline due to the duplicated meaning, (2) modification of the sentence for more clear explanation, (3) addition of the new principles and guideline, and (4) elimination entire guidelines.

[Table 26] Summary of the Revision for Final Principles

Revision	Revised Principles or Specific guidelines	Final Principles
Integration into one guideline	Specific guideline 2.2 and 2.3	Specific guideline 2.2 ‘Justify that the rationale for using the technology is sound. See why this technology is needed for the topic, and how the technology can support the instructional process’
	Specific guideline 6.2 and 10.1	Specific guideline 10.1 ‘Share class materials with students before/after the class, so that students can access the resources anytime and anywhere. For example, teachers can distribute the softcopy of the class materials via google classroom, Facebook group or school website before the class’
Modification of the sentence for more clear explanation	Specific guideline 2.1	Specific guideline 2.1 ‘Make a pre-plan when and which specific areas during the class you are going to use ICT materials in order to achieve the learning outcome’

	Specific guideline 3.1	Specific guideline 3.1 ‘Utilize various open sources such as YouTube, UNESCO toolkit etc. for preparing the multimedia class’
	Component 5	Component 5 ‘Utilization of the digital content by students’
	Specific guideline 5.1	Specific guideline 5.1 ‘Set up the environment considering the large number of students. Font size and pictures should be clearly visible and understandable from every corner of the class.’
	Specific guideline 6.1	Specific guideline 6.1 Give a short guideline to students in the beginning of the academic year about how they should participate with digital content throughout the class.
	Principle 8	Principle 8 ‘Responsive pedagogy with digital content’
	Principle 10	Principle 10 ‘Provision of opportunity for students to use ICT materials’
	Specific guideline 10.1	Specific guideline 10.1 ‘Share the class materials with students before/after the class, so that students can access the resources anytime and anywhere. For example, teachers can distribute the softcopy of the class materials via google classroom, Facebook group or school website before the class’
Addition of the new principles and guidelines	-	Specific guideline 4.2 ‘Have a teacher community to give a motivation each other to use ICT in education’
	-	Specific guideline 5.2 ‘Make a plan for the specific time distribution to use the digital content’
	-	Specific guideline 10.2 ‘Encouraging students to use technology for an assignment or project’
Elimination	Specific guideline 8.1 and 8.4	-

4.4. Final Instructional Design Principles and Specific Guidelines

This research attempted to develop instructional design principles for using ICT in secondary schools in Bangladesh. The first draft of the instructional design principles and guidelines was developed based on the analysis of previous research and field research at Dhaka, and was continuously revised based on the results of internal validation and a usability test. As a result, the final instructional design principles and specific guidelines were developed, as shown in Table 27. The final principles are composed of five components, ten principles, and 22 specific guidelines in total. The complete version of the final principles and specific guidelines are included in appendix 6, and the following table shows the component, principles, and one specific guideline under each principle.

[Table 27] Final Principles and Specific Guidelines

Component		Principles		Specific Guidelines	
1	Selection of the digital content for the lesson	1	Confirming the available resource	1.1	Check the most possible digital content in your class environment. See if electricity, internet access and sound systems etc. are properly working in your class before deciding to use the digital content.
		2	Linking the ICT materials to the learning outcome	2.1	Plan when and which specific areas during the class you are going to use ICT materials in order to achieve the learning outcome
2	Preparation of the lesson plans with the digital content	3	Use of various resources and activities that are relevant to the curriculum	3.1	Utilize various open sources such as YouTube, UNESCO toolkit etc. for preparing the multimedia class
		4	Building a learning community with an expert teacher	4.1	Talk to other teachers, teachers' trainers, and other experts in ICT at the same grade level or in the same content area, to share ideas about how and when to use technology
		5	Organizing an appropriate environment for multimedia class	5.1	Set up the environment considering many students. Font size and pictures should be clearly visible and understandable from every corner of the class

3	Preparation of the learners for the multimedia class	6	Provision of guideline to the learner	6.1	Give a guideline to students at the beginning of the academic year about how they participate with digital content throughout the class. For example, class rules and culture during the multimedia class can be established by teacher
		7	Attracting students with digital content	7.1	Use the enjoyable examples and reflect the context of Bangladesh for attracting students
4	Utilization of the digital content for the class	8	Responsive pedagogy with digital content	8.1	Try various types of feedbacks and reactions for facilitating interaction through ICT. Teachers' actions can support children's learning and extend children's activities through 'offering ideas, know-how, and wisdom
		9	Integration of the digital content with other materials	9.1	Combine with other relevant educational technologies such as low-cost, high-impact, mass-delivery approach as well as printed text together with digital content challenges
5	Utilization of the digital content by students	10	Provision of opportunity for students to use ICT materials	10.1	Share the class materials with students before/after the class so that students can access the resources anytime and anywhere. For example, teachers can distribute the softcopy of the class materials via google classroom, Facebook group, or school website before the class

4.4.1 Conditions and Characteristic of the Final Principles

The general instructional design theory such as ADDIE or ASSURE model could not reflect the specific context of developing countries, therefore the instructional design principles in this research were developed based on the contextual analysis of ICT use in Bangladesh and needs analysis of secondary school teachers in Bangladesh. Also, the principles were developed with the purpose of helping secondary school teachers in Bangladesh more effectively plan and design the class using ICT. By using the instructional design principles and specific guidelines in this research, teachers should be able to select ICT tools for their pedagogical consideration. Not just use of any ICT tools for presenting

information through PPT, teachers should be able to systematically plan and conduct the class with ICT materials for going forward students' knowledge deepening and creation. Nevertheless, the availability to adopt those principles vary depending on each school and teacher' capacity, and it still has limitation to adopt the principles to all schools in Bangladesh. Therefore, this research assumes that the final principles and specific guidelines can be more effectively utilized under the following three conditions;

(1) first, having a proper infrastructure such as at least one multimedia classroom is a prerequisite to utilize the principles. This research was started with the purpose of making more effective use of ICTs in secondary school of Bangladesh where there are already in use. Therefore, ICT devices and other necessary school infrastructures should be to some extent prepared, so that teachers have opportunity to try the class with ICT materials following the principles and specific guidelines. (2) Second, this principle can be utilized when teacher training institutes want to provide more specific guidelines for teachers to use ICT in education. The principles in this research cover not only teaching and learning activities but also teachers' preparation process in order to effectively use ICT. Therefore, teachers can learn through this principle what to prepare, where to start and when to use ICT materials, as well as technological knowledge. (3) Third, these principles can be utilized at school level when teachers themselves want to improve pedagogical skills with using ICT. Especially ICT expert teachers, who are familiar with using ICT tools for their class, but struggle with finding more effective ways to use ICT, can refer to the principles and specific guidelines in order to get more ideas around using ICT in their classroom and share their knowledge with their colleagues.

The characteristic of the final principles are as follows; (1) these principles do not consider any specific subject. Although the usability test was conducted with English teachers, the principles can be used as umbrella principles for preparing

any subject with ICT materials. (2) The principles cover a wide range of teaching and learning processes, from the preparation of the class materials to providing opportunities for students to use the digital device even after the class. Considering that this research is based on the context of secondary school in Bangladesh, where the teachers' level, knowledge, and skills vary depending on the school or individual situation, some principles are available for some groups of teachers, while some are not. Therefore, it attempted to include every teaching and learning process so that every teacher can refer to the principle where and when they need it. (3) Finally, these principles reflect the current education environment of Bangladesh as much as possible by conducting in-depth interviews with teachers and teachers' trainers as well as class observation in secondary school in Bangladesh at the beginning of the development of instructional design principles.

4.4.2 Overview of the Final Principles and Specific Guidelines

The instructional design principles for using ICT in secondary school in Bangladesh assumes that it can help teachers use ICT within an ICT resource-constraint environment. Currently, teachers' pedagogy and ICT use in Bangladesh is only limited to "showing the contents" through PPT presentations. Thus, the final principles and specific guidelines are expected to instruct teachers "when" and "how" to use the digital content in their classrooms in various ways. The final principles can be presented divided into two important parts for teachers' use of ICT in education: part (1) teacher's preparation for using ICT in the classroom (principle 1 - 5) and part (2) teacher's use of ICT during the teaching and learning activities (principle 6 - 10). The followings are descriptions of the final instructional design principles and specific guidelines.

[Table 28] Division of the Final Instructional Design Principles

Division	Components		Instructional Design Principles	
PART I Teacher's Preparation for using ICT in the classroom	1	Selection of the digital content for the lesson	1	Confirming the available resources
			2	Linking the ICT materials to the learning outcome
	2	Preparation of the lesson plans with the digital content	3	Use of various resources and activities that are relevant to the curriculum
			4	Building a learning community with an expert teacher
			5	Organizing an appropriate environment for multimedia class
PART II Teacher's use of ICT during the teaching and learning activities	3	Preparation of the learners for the multimedia class	6	Provision of guideline to the learner
			7	Attracting students with digital content
	4	Utilization of the digital content for the class	8	Responsive pedagogy with digital content
			9	Integration of the digital content with other materials
	5	Utilization of the digital content by students	1	Provision of opportunity for students to use ICT materials

PART I: Teacher's preparation for using ICT in the classroom

For teachers in developing countries like Bangladesh, teachers' preparation for using ICT in the classroom needs to be considered the "selection of the digital content (component 1)" and "preparation of the lesson plans (component 2)." It can be often observed that Bangladeshi teachers are using PPT presentations to give a lecture in the classroom. This is one of the government's initiatives to integrate ICT into education by constructing multimedia classrooms in all secondary schools. Therefore, teachers should prepare the class by finding some images, videos, or any other charts related to the topic from the Internet and putting them on the PPT slides to present the topic. However, before using the visual or

auditory materials in the class, teachers must confirm the available resources (principle 1) in their class environments. In many developing countries, the available educational resource could vary depending on the teacher's capacity, school budget, and network environment. For example, sometimes, there is no appropriate sound system in the classroom, even though teachers prepared the auditory materials for listening to an English dialogue. Also, there are more than 60 - 70 students in one class, and electricity and the Internet network are often unstable. Therefore, teachers should carefully check the possible ICT resources suitable to their class environment when preparing the ICT-supported class.

Also, the selection of the digital content should be in a way that links the ICT materials to the learning outcome (principle 2) to improve the learning outcome of the students, not just a mandatory use of any instructional technology. In order to do that, teachers should be aware of which areas of the class specifically will need the ICT materials. For example, one picture or one minute of video could be the digital content as an additional educational resource that textbooks cannot include. There might be no questions about this principle in any educational environment, but it should be integrated into one of the instructional design principles that teachers need to consider in order to prevent the overuse of ICT materials. Teachers should always keep in mind why they use these ICT materials and for which purpose of the class when they prepare for the ICT-supported class.

After selecting the ICT resources, teachers should prepare the lesson plan. When teachers prepare the lesson plan, teachers should consider "using various resources and activities (principle 3)." Unlike the traditional class using textbooks only, ICT-supported class provides more opportunities to experience various teaching and learning activities. Teachers can try gamification using Kahoot and find more example videos or pictures through google search or YouTube. Also, teacher training institutes should provide more programs not only for the technological knowledge but also for the teachers' capacity to utilize the most

suitable resources for their class.

Moreover, “building a learning community with expert teachers (principle 4)” is essential for helping teachers prepare the lesson with the digital content. The current teacher training programs in Bangladesh do not offer subject-based training. Rather, it is more focused on the technological knowledge, and teachers participate in ICT training regardless of their subject knowledge. Thus, having a learning community with other expert teachers can be an opportunity to share more ideas about how and when to use technology among the same subject teachers and enhance the motivation to use ICT. The teacher community can be an online platform that teachers share their ICT materials, or an offline gathering led by expert teachers.

Lastly, when teachers prepare the lesson plan with the digital content, “organizing an appropriate environment for multimedia class (principle 5)” is a prerequisite. For example, considering that classes are crammed with many students, teachers should prepare ICT materials that can be understandable by all students. The font size and picture quality must be clear enough and provide enough time for students to actively participate in the class. Most importantly, a backup plan should be prepared in case that technology does not work.

PART II: Teacher’s use of ICT during the teaching and learning activities

When teachers are using ICT during the class, teachers' use of ICT could be divided into three components: "preparation of the learners (component 3)," "utilization of the digital content for the class (component 4)," and "utilization of the digital content by students (component 5)."

First, teachers preparing the learners for the multimedia class, “provision of guideline to the learner (principle 6)” is important. Since most secondary schools have only one or two separated multimedia classrooms, students are not always taking class with digital content. Therefore, it is recommended that teachers

provide a guideline to the students at the beginning of the academic year about how they are going to use the multimedia class throughout the semester. This will also help teachers planning the use of ICT materials in her or his class and help the student get prepared for any projects or assignments using ICT materials. Second, in order to have the learner prepared at the beginning of the class, “attracting students with the digital content (principle 7)” should be considered. For example, teachers can use some pictures or a short video to show an enjoyable example of the topic at the beginning of the class. This principle emphasizes that teachers can selectively use the ICT materials with a specific purpose and needs, not use the ICT throughout the whole class. Third, teachers can also use the ICT materials for “responsive pedagogy (principle 8).” Most Bangladeshi teachers are currently using ICT to deliver information, but ICT can be used to elicit the learners' participation in the class. For example, teachers can make a messenger group using Facebook, WhatsApp, or any other online communication tools to give students feedback and interact with each other even after the class. This principle can be applied to only a limited group of students who have access to the digital content at home but can be an alternative way to integrate ICT into education when schools cannot support enough digital devices during the class. Forth, when teachers use digital content during the class, it should be remembered that “the digital content should be integrated with other materials (principle 9).”

The importance of integration of ICT has become a central agenda of the present government of Bangladesh. So, it is often misunderstood that teachers should use digital content all the time during the class. Sometimes, teachers do not even use the textbook when they give a lecture with a PPT presentation. However, digital content should be a supplementary tool for other educational materials, and teachers should be capable of utilizing the digital content with other materials. Lastly, it is significant that teachers should “provide an opportunity for students to use ICT materials (principle 10).” This last principle is the most important but

most challenging. During the last few years, the digital literacy of the young generation has been dramatically improving. However, due to the lack of infrastructure at the school level, students do not have much opportunity to use the digital content for their learning. Therefore, the last principle suggests the utilization of the digital content by students so that the “ICT in education” initiative in Bangladesh could be scaled up to have a tangible effect on students, as well as teachers.

4.5. Factors to be Considered for Developing Instructional Design Principles in Developing Countries

Developing and suggesting optimal instructional design principles in the context of developing countries is not easy because there have been few relevant studies, and the educational contexts in developing countries are very volatile. Nevertheless, this research attempted to carefully analyze the specific context, distinguishing features, current issues, and challenges of Bangladesh for developing the instructional design principles to use ICT in secondary school in Bangladesh. Although the fundamental rationales for improving the effectiveness of ICT-supported classes are not so different from that of the developed world, it is paramount to analyze the most distinctive features of the country and reflect the instructional design principles for teachers to implement a successful ICT-supported class. Throughout the whole process, this research highlights the following two distinctive factors to be considered for developing the instructional design principles in Bangladesh: (1) the role of ICT expert teachers and (2) student participation in utilizing ICT for learning.

4.5.1 The Role of ICT Expert Teachers

The teacher-level factor is often addressed as one of the internal barriers hindering the effective use of ICT in education in developing countries (Snoeyink

& Ertmer, 2001). Particularly teachers' attitudes and beliefs play a vital role in using ICT in the classroom (Mou, 2016). To cope with the teachers' factor, the instructional design principles developed in this research included the principle 4, "building a learning community with expert teachers," to share pedagogical ideas about how and when to use technology, to motivate each other to use ICT in education and to provide support and feedback when teachers face difficulties with preparing digital content.

Regarding this, next part will explain the key role of ICT expert teachers in facilitating the ICT integration in education, especially in the context of developing countries from the following two aspects: (1) ICT expert teachers leading a teacher community and (2) ICT expert teachers facilitating to use ICT within the limited school environment. These two components need to be more considered in the field of international education development when implementing the teachers' professional development programs for improving teachers' capacity to facilitate the "ICT in education" in developing countries.

4.5.1.1 ICT Expert Teachers leading a Teacher Community

In Bangladesh, where teacher training cannot equally provide for all teachers, the teachers' community led by ICT expert teachers is an important resource for teachers' professional development. In this research, the ICT expert teachers refer to the teachers who have been well trained in ICT use in education and designated as expert teachers by the training institutes to disseminate their knowledge to other teachers in their communities. The expert teachers are called master trainers, teachers' educators, or ICT ambassadors, depending on the training institutes. For example, one of the groups of ICT expert teachers is called "ICT ambassadors" designated as an "ambassador of ICT for Education (ICT4E)" under the project of a2i. The ICT4E ambassador is a unique example of leaders in education who have been working in the 64 districts of Bangladesh in order to ensure the systematical

implementations of integrating ICT in education, sharing their technological and pedagogical knowledge for using ICT with other teachers. The ICT ambassador teachers are now working as a part of a2i project to promote multimedia classroom (MMC), digital content, model content, student portal, e-book, MMC monitoring application (Haque, 2018). Also, if one school needs a workshop for teachers about using ICT in education, the school can invite ICT ambassadors through a2i, or the individual teacher can also personally contact the ICT ambassador teacher to ask for their help. Currently, many different types of teacher communities led by the ICT expert teachers are being formed in various ways at the national, school and individual level in Bangladesh.

For example, at the national level, "Shikhhok Batayon," which is the biggest teachers' online community is very active. Through the "Shikhhok Batayon," teachers can share their digital content for each subject at both primary and secondary levels¹⁷. Many ICT expert teachers upload their multimedia content on this website so that teachers across the country can download the content when they need it. According to the research done by a2i, this teachers' portal is empowering teachers to become confident, efficient, ICT skilled, and teachers can generate innovative and creative ideas through collaborative networking (Hansson et al., 2018).

“We submitted (our PPT slides) in our Shikhhok Batayon page, we upload our class and contents there. There are a very good number of contents there, those novice teachers who don't have the content or facing difficulties, they can use from that.” (Teacher C at the usability test interview on Mar 7th, 2021)

¹⁷ <https://www.teachers.gov.bd/>

"I believe teachers' portal is very important here. Shikkhok Batayon. Very important. For example, for a newly appointed (teacher) in the school, maybe he or she cannot know how to prepare PPT or how to run PPT in the classes. So, he or she can easily enter the teachers' portal and download classes, and it can be helpful to run the class perfectly. So, he doesn't need to prepare PPT here. But gradually he can learn by seeing different courses" (Teacher D at the usability test interview on Feb 24th, 2021).

The content from the Shikkhok Batayon can be an exemplary model for when other teachers develop their own content and provide more educational resources that other teachers cannot access. One of the expert teachers even makes his own video content, which were well translated into Bangla from the original English languages. Considering that most of the available OER are using English as the medium of instruction (C. P. Lim et al., 2020), the expert teachers who translate the original educational content into Bangla can provide an opportunity for other teachers to access more varied educational resources.

At the school level, schools autonomously conduct "in-house training" in their school community to share ICT knowledge and skills among teachers. In-house training happens irregularly depending on the decision of headteachers of the school, but this could be an opportunity for teachers to learn from the expert fellow teachers in a homely environment and be encouraged to use ICT by each other. This in-house training can play an effective role in a country where there is a lack of ICT training for teachers and where ICT training provides merely a technical skill due to the limitation of resources and environment. Specifically, this in-house training can also be a place for the teacher to be motivated to use ICT, which is a new educational method for some teachers. During the interviews with teachers in Bangladesh, expert teachers shared how hard they are trying to persuade

colleagues to use ICT for their class even though some teachers refused to attend the in-house training. The expert teachers are always struggling to increase the motivation of their colleagues as well as teaching technological knowledge of ICT. Teacher D proudly explained how she led the in-house training in her school, and she strongly believes that this in-house training would increase teachers' motivation;

"I have 14 teachers (in my school), and I trained all the teachers nicely, and all my teachers are handling the class excellently (with ICT). And they also teach other teachers [...] I told them that if you don't have any knowledge on using ICT, then you are failed to be a teacher in 21 centuries. Actually, main thing is that if you don't give anyone any pressure, just a little, then no one actually changes their position. Behavioral changes. [...] we need to change ourselves for the betterment of education and the future of our country. So that our students can follow us, and they can also be changed." (Teacher D at the usability test interview on Mar 1st, 2021)

The literature regarding the impact of in-house training is still under-researched, and the form of in-house training varies from school to school, depending on the institutional support. However, this in-house training could be an exemplary case of how expert teachers in developing countries could share their technological and pedagogical knowledge to develop more ideas about "how to integrate the technology in their class" when they have limited opportunity to receive the ICT training.

Lastly, at the individual level, some ICT ambassador teachers voluntarily organize the "ICT forum" even in their home or somewhere else in their community to individually teach the use of ICT in the classroom. Teacher C is aware that many of teachers are not going to participate in this private forum

because of the busy schedule during the weekend, but she keeps trying to reach other teachers in her community in order to share her knowledge;

"I personally organize the forum. It is my motivational activity because I'm the ICT ambassador of a2i, so I feel that if I don't develop myself, and if I'm not able to develop my colleague, it will not work in my country. For this motivation, I make a forum in my area, and I invite them every once a week. I sit together with them, and we share our ideas and problems there. [...] now I'm arranging some seminar on Kahoot [...] and some google forum how to use google classroom during this COVID situation."
(Teacher C at the usability test interview on Feb 26th, 2021)

Teachers' community led by ICT expert teachers such as online platform, in-house training, and informal gathering can be an important resource for teachers' professional development for using ICT. Considering that most ICT teacher training focuses only on basic technical training, teachers' community can be a place for teachers to share their idea and rationale for using ICT in their classrooms. Especially with the limited resources and under the vulnerable environment in Bangladesh, teachers tend not to use ICT and do not want to change their teaching style even after receiving the ICT training. However, involvement in teachers' community continuously would encourage teachers to keep trying to use digital content in their pedagogy, and therefore gradually enhance their instructional strategies.

A plethora of existing research has identified the obstacles to using ICT in education in developing countries. Most of them focused on the insufficient training, lack of ICT knowledge and skills, lack of facilities, teaching overloads, and teachers' low motivation toward the use of ICT (Amuko, Miheso, & Ndeuthi, 2015; Bingimlas, 2009; Ertmer, 1999; Mirzajani, Mahmud, Fauzi Mohd Ayub, &

Su Luan, 2015; Mou, 2016; Samarakoon, Christiansen, & Munro, 2017). In this regard, this research particularly emphasizes that utilization of teacher community led by expert teachers as a factor to overcome the current challenges of teachers' professional development for using ICT in developing countries. Although more institutional supports and systematical organization of teachers' community are required, this research contends that the role of ICT expert teachers in their community can positively influence teachers' motivation and develop pedagogical knowledge for ICT integration even in the limited educational environment.

4.5.1.2 ICT Expert Teachers facilitating to Use ICT within the Limited School Environment

Another theoretical insight regarding the role of ICT experts found in this research is that the expert teachers are not only leading the teacher community as teachers' trainers but also struggling to find more ways to use ICT at their school. The efforts by the expert teacher are sometimes very drastic, innovative, and even trying to be ahead of the school authority despite the limited ICT infrastructure. During the usability test interview, teachers explained their attempts to integrate ICT in their class. For example, the teacher D, who is working in the secondary schools located in a slum area in Dhaka, described her efforts to conduct PPT presentation in her class by painting the wall in white color;

“I painted the wall in white color, and I just show my PPT on that wall [...]. Because we don't have any screen each class. Just use white color and show on the wall.” (Teacher D at the usability test interview on Mar 1st, 2021)

The effort by teacher D was not forced by anyone, but it came from her strong belief that she must use ICT for the better achievement of her students. Also,

teacher C mentioned that she often uses the “google classroom” for sharing class materials with students beforehand. She sometimes tries flipped learning by asking students to watch the video uploaded on google classroom and then discussing the video during the class;

“Sometimes I talk on 'liberation war,' and there is no video (during the class). So, I generally put the video (on google classroom), and tell students to watch the video, and tomorrow we will discuss on the video.”
(Teacher C at the usability test interview on Mar 7th, 2021)

In addition, teacher A and C even try to get students to use mobile devices by utilizing gamification during the class by borrowing parents’ or other teachers’ mobile phones. These expert teachers do not give up on using ICT materials, although their schools are not properly equipped with ICT materials. Instead, they consistently find the way that they can utilize digital tools within a recourse constraint environment.

“Whenever I decide to take the Kahoot game, then previously, I (announced) that parents will provide mobile phone only for this period”
(Teacher A at the usability test interview on Feb 26th, 2021)

“Sometimes for the group work, I take the help of my colleague, I take the mobile phone from my colleague (if needed) along with my one and give to students and browse it and find out the answer.” *(Teacher C at the usability test interview on Mar 7th, 2021)*

These efforts by ICT expert teachers can give several implications for

successfully implementing the multimedia class in the context of developing countries. First, these expert teachers are trying hard to utilize ICT for their classes even though they are in a limited environment. They are very much motivated and passionate about using ICT in education, and they strongly push ahead with using ICT in their education where the infrastructure is not yet fully equipped. In this respect, expert teachers can take a role to motivate and encourage other teachers by voluntarily organizing ICT forums for colleague teachers or helping novice teachers to conduct a multimedia class. Particularly, in such a limited environment where their educational reforms with technology have just embarked, the attitude of teachers toward the ICT can be an influential factor to the results of ICT integration in education (Cavas, Cavas, Karaoglan, & Kislal, 2009). Even though there are enough ICT facilities and technologies, if teachers are not motivated to integrate ICT in their traditional teaching methods or feel uncomfortable using technology, it would be difficult to see the actual effects of ICT integration in education. Thus, ICT in education projects or initiatives should involve more ICT expert teachers so that they could actively communicate with other teachers to encourage and motivate them. The ICT4E ambassador could be such an exemplary model for involving expert teachers in ICT in education projects.

Second, the expert teacher can take a role to evolve some new points regarding how teachers could organize their classes, how teachers could engage students in the class, or how teachers could make the lessons more attractive by using ICT through the "pair support" (Shohel & Banks, 2012). In other words, expert teachers can share their instructional strategies for using ICT to enhance pedagogical knowledge (PK). Since the current level of ICT in Bangladeshi schools is normally limited to one laptop, one multimedia projector with a screen, and a pair of speakers (ADB, 2017a), a lack of teachers' pedagogical use of ICT will possibly lead to merely "lecturing with PPT presentation." This is not the ultimate purpose of the GOB. Therefore, choosing a proper way to conduct their class with not only

Technological Knowledge (TK) but also PK should be more prioritized in the current teachers' training programs, and it could be more developed within teachers' communities led by expert teachers. Some of the previous research identified that school hardware and internet-connection infrastructure are less significant than teacher ICT training, collaboration among teachers, perceived self-efficacy, and teaching concepts (Gil-Flores et al., 2017). Of course, the infrastructures, internet connection, or large class size must be considered in the context of developing countries, but it is also crucial that the teachers should be well-trained to use ICT as pedagogical tools, rather than “knowing the technological knowledge.” This process could be more efficient when utilizing a role of the expert teachers.

4.5.2 Students’ Participation in Utilizing ICT for Learning

In the process of developing the instructional design principles, it was figured out that students’ participation in utilizing ICT for their learning should be highly considered, especially when it comes to “ICT integration in developing countries.” Teachers must provide opportunities for students to utilize the digital content for educational purposes. The “Digital Bangladesh” is anchored on the idea that “the vision for an inclusive society is that all citizens are able to participate in creation for wealth and its equitable distribution, where information and reliable and affordable communication technology channels are available for accessing information for making informed decisions and opportunities for common citizens to participate in governance.”¹⁸ Under this vision of the GOB, teachers must consider the students’ participation in learning with ICT for deepening their knowledge, not just delivering the information through ICT.

Although there are many restrictions in terms of students’ use of digital

¹⁸ A2I (2010), Strategic Priorities of Digital Bangladesh, Prime Minister Office, Government of Bangladesh 2010 (p. 16).

devices during the class, this research includes alternative approach to facilitate the students' participation in utilizing ICT for learning. (1) Utilizing online communication tools for facilitating students' participation and (2) encouraging students use of online learning platform. The next part will explain these two aspects of student participation in utilizing ICT for learning as the crucial factors to be considered when developing the instructional design principles for using ICT in secondary schools in Bangladesh.

4.5.2.1 Utilizing the Online Communication Tools for Facilitating Students' Participation

According to principle 8 in the final principles, it suggests teachers give feedback to the students by using online messenger or facilitates students to interact with each other via online platforms even after the classes. Also, the principle 10 emphasized the use of ICT materials by students themselves for their learning. Currently, many multimedia classes are led by teachers' lectures with PPT, despite the fact that ICT is supposed to provide more student-centered pedagogical approaches that empower students to learn at their own pace and support students in their own cognitive thinking (Underwood, 2009). Hence, developing the instructional design principles in the context of developing countries like Bangladesh should keep in mind that ICT materials should be used by students as well as teachers, and try to explore various ways that can facilitate the students' participation with the use of ICT in and outside of the classes.

However, it is not easy to create opportunities for the student to use ICT for their learning due to the lack of ICT infrastructures at the school level. Regarding this, teacher D explained that the online communication tools could be utilized to give each student feedback and facilitate interaction between individual learners via online messengers such as Facebook group or WhatsApp messenger;

"By using ICT, we can give our students feedback individually or together. And it works. [...] I give them a message in group or individual. In my class, there is a messenger group for 1-9 class, for class 10 WhatsApp group. [...] In this pandemic situation, I think all the students have a mobile phone, but before the pandemic, mobile phone is not allowed to use (in our school). But during this pandemic, there is no alternative way to use a mobile phone to connect teachers. So, every student has a mobile phone, and they use it. There are some bad sides, but the good thing is that they are connected to the teachers." (Teacher D at the usability test interview on Mar 1st, 2021)

Online communication between the teacher and students is especially important during the COVID-19 pandemic situation. The one-year school lockdown has facilitated teachers to use more online messengers to give feedback or interact with students. This is not only the case in Bangladesh. As a consequence of COVID-19, many developing countries are formally using social media, e.g., Facebook, WhatsApp to communicate between teachers and students for educational purposes (Sobaih, Hasanein, & Elnasr, 2020). Although there are many challenges remaining, such as a lack of stable internet connection, lack of proper devices, cost of data, family financial condition, and others (Ramij & Sultana, 2020), planning the class with ICT could not ignore the utilization of the online communication tools for teachers. By utilizing the online communication tools, it fosters quality and quantity of communication between learners, teachers, and classmates (Wei & Chou, 2020), and communication would become much easier, especially when there are 60-70 students in one class.

Now, most of secondary schools in Bangladesh conduct the class via ZOOM due to the COVID-19 pandemic, and therefore, students have more opportunities to use computers or lots of online educational resources. It also naturally makes

students use more ICT devices for their learning, and this should be continuously adapted in the face-to-face class even after the COVID-19 pandemic. Teacher A is now uploading the class materials to the school Facebook page or any other ways that she never thought about before the COVID pandemic;

"It is not possible (to distribute the hard copy) because it is not so cheap. But in the pandemic situation, we take the class with PPT, and after the zoom class, we upload the recorded class to our Facebook page. So, if they need something, they can get it from their school FB page. [...] before the pandemic, [...], we never think that we should upload (the class materials online). But in the pandemic, teachers (are trying to do) new things. [...] It is good. I can upload it to our school website, school FB page. It is very beneficial and helpful for students. It is not possible to provide hardcopy, but I can provide a soft copy in any other way in school website or students email, google classroom." (Teacher A at the usability test interview on Mar 5th, 2021)

4.5.2.2 Encouraging Student Use of Online Learning Platform

Another way of facilitating students' participation in utilizing ICT for learning is to encourage students to use various educational resources from the internet. As teachers mentioned in the usability test interviews, Bangladesh has developed many online learning platforms that students could access during the one-year school lockdown. For example, a district-based online learning platform such as Chattogram online school and Gazipur online school¹⁹ were developed to provide teacher's recorded lectures and other information for students' self-learning. Teachers could submit their classes to the district-based online learning platform,

¹⁹ <https://www.facebook.com/Gazipur-Online-School-110230884051310/>

and students can be benefited from having an online class. Although not all students can access the learning platform, this is one of the efforts of Bangladesh to overcome the gaps in educational opportunity during the COVID pandemic and encouraging students to utilize this online platform as a supplementary tool should be considered even after the pandemic.

In addition to the district-based platform, there are more e-learning platforms such as “10 minutes school²⁰” and “Kishor Batayon²¹.” The 10 minutes school is the largest online education platform in Bangladesh, with over 4,000 video lessons, providing more than 150,000 students with education every day (Karim, Shahed, Rahman, & Mohamed, 2019). This type of online learning platform plays a critical role in disseminating motivation among the young generation so that they can be conducive to national development and be instrumental to the national development agenda "Digital Bangladesh." (Karim et al., 2019). “Kishor Batayon,” which is translated into "teenage window," is also a unique online platform where students can empower themselves to share ideas and knowledge. Using “Kishor Batayon,” students can read books, comics, watch cinema, share their own writings, thinking, and plans. Teacher D also emphasized the importance of using an online platform such as the "Kishor Batayon" for students' learning.

“Sometimes, I advise my students to use ‘Kishor Batayon’ It is for students. This is the platform for the student. Each student has a potential and hidden quality. So, I suggest my student be a member of kishor batayon and submit their best performance (such as drawing and writing). In my country, our government encourages students to submit their best performance there and encouraging them by giving a gift. It is very important for the students.” (Teacher D at the usability test interview on

²⁰ <https://10minuteschool.com/>

²¹ Konnnect.gov.bd

Feb 24th, 2021)

It is argued that traditional education environments are not suitable for preparing learners to function or be productive in the workplaces of today's society, and schools that do not incorporate the use of technologies cannot prepare their students for the twenty-first century (Yelland, 2001). Considering that the GOB aimed to "improve the quality of education with the creation of ICT-enabled teaching-learning environment and build up the learners as skilled human resource that is responsive to the needs of the 21st century" by integrating ICT in education, it is an essential that teachers should consider not only using ICT tools in the classroom but also encouraging students to be more involved in the online educational platform outside of the class.

Moreover, teacher C explained that giving homework as group work is the best way to encourage students to use ICT for their learning because some of the students can use the digital content at home. The description by teacher C shows teachers' efforts to integrate ICT into students' assignments so that students also can be a part of the "digital Bangladesh."

"For example, ongoing activity (at the classroom) is really difficult for the participatory approach (using ICT), but homework like making a video or group work project (are possible). [...] But it should be group work, not individual work because not every student has the devices. So, if it is assigned for the group work, it will work." (Teacher C at the usability test interview on Mar 7th, 2021)

The current education system that facilitates the use of multimedia classroom in Bangladesh makes more teacher-led education, and students barely have an opportunity to use ICT during the class. In terms of physical infrastructure, it is

impossible to provide ICT devices to all the students in Bangladesh in a short period of time. However, students' participation in the ICT-supported class should be considered in more various alternative ways such as online communication tools or online learning platforms when teachers design the lesson using ICT.

CHAPTER V. DISCUSSION

Although many schools in Bangladesh are not equipped with appropriate ICT infrastructures, Bangladesh has already started to establish an internet-enabled classroom called Multimedia Classrooms (MMC), where teachers have been able to use digital content since 2012 (Hansson et al., 2018). However, the progress has not profoundly improved due to many constraints, even though there has been an increasing number of teachers who can integrate ICT for their classes (Shamim & Raihan, 2017). Further, many teachers still do not use ICT effectively, or even if they use ICT, it is not integrated into their pedagogy in a meaningful way (Mou, 2016).

Under this circumstance, analyzing the factors affecting the challenges of using ICT in Bangladeshi education and providing the instructional prescription are timely and necessary works because “ICT in education in a developing country” is now being placed as one of the important sectors in many ODA projects and research. Therefore, this research has attempted to seek the most optimal instructional design principles for using ICT in the context of Bangladesh and implemented the usability test in order to confirm its applicability in the actual classroom environment. Throughout the field research, literature review, internal validation, and usability test, a few implications have been raised for the discussion about the instructional design principles for using ICT in education in the context of developing countries.

5.1 Instructional Design Principles for Using ICT in Developing Countries

The mere adoption of new technology could not sufficiently bring about desired changes (Khan, 2014). However, in many developing countries, including Bangladesh, sometimes teachers are quick to adopt the new technologies without

focusing on how that technology may affect instructional practices and student learning. Particularly in developing countries, international organizations such as UNESCO have consistently supported the teachers' professional development in order to provide pedagogical suggestions for transforming teaching methodology with ICT (UNESCO, 2015b). However, still very few teachers are using technology as delivery tools for their classes, and many studies still argued for the lack of teachers' pedagogical skills for integration in education.

Under this circumstance, this session will discuss how the instructional design principles have been developed as a prescriptive instructional strategy that helps teachers prepare and conduct the ICT-supported class more effectively from the perspective of Bangladesh and how the principles can be applied in the resource-constraint environment in the context of developing countries.

5.1.1 Developing the Instructional Design Principles from the Perspective of Developing Countries

Instructional Design is the systematic development of instructional specifications using learning and instructional theory to ensure the quality of education and bring about learners' changes in a given educational content (Alzand, 2010; Chung, 1997). Particularly, in developing countries where ICT is considered an important tool for educational development, providing the instructional design principles for teachers is an essential process to successfully implement the ICT integration in education. The instructional design process is one of the activities that help teachers design with systematic planning and enable teachers to decide the most appropriate teaching strategies (K. Park, 2007). Theoretically, the principles and specific guidelines are supposed to work out in each educational setting when teachers apply them, resulting in better students' achievement. Therefore, this research has committed to analyzing the contextual background of ICT in education in Bangladesh and instructional design theory and models in

order to figure out the most optimal instructional design principles for using ICT in secondary schools in Bangladesh.

First and foremost, the contextual understanding of Bangladesh is the most essential part when developing the instructional design principle in the context of developing countries. Therefore, eight weeks of fieldwork was conducted for in-depth interview with secondary school teachers, teachers' trainers for ICT use, and class observation. Based on the literature review regarding the barriers hindering from using ICT in education in Bangladesh, and the results of field research could make the first version of the principles reflect more contextual understandings than analyzing the previous research only. From the field research and literature review, it was figured out that the most significant challenges of ICT use in the classroom were the teachers' unquestioned use of PowerPoint Presentations. It is probably because of the government policy that makes the mandatory use of ICT or teachers' strong belief that advanced technology can improve the students' achievement. Therefore, the final instructional design principles of this research included the "confirming the available resource (principle 1)" and "liking the ICT materials to the learning outcome (principle 2)" to suggest teachers use ICT selectively only when they need it for a specific purpose. Also, from the in-depth interview with secondary school teachers and teachers' trainers, it was figured out that teachers often use open Educational Resources (OER) to prepare their lesson, but many OERs are provided in English only or developed for a particular subject such as science or mathematics. Thus, the final principles also included the "use of various resources and activities relevant to the curriculum (principle 3)" to encourage teachers to find more educational resources. However, this principle also indicates that more various OERs need to be provided that more teachers can use as their supplementary educational tool.

Moreover, as a distinctive feature of ICT in education in Bangladesh, it was observed that ICT expert teachers play a critical role in encouraging the motivation

of other teachers and sharing pedagogical knowledge within their community. In Bangladesh, various types of teacher communities are led by expert teachers who are actively working with their colleagues to encourage the teachers to use ICT more effectively. This is one of the distinctive features that must be included in the instructional design principles for using digital content for teachers. In planning and designing the class using digital content, teachers should cooperate with other teachers to learn not only technological knowledge but also pedagogical knowledge to integrate ICT in education. In this way, instructional design principles for using ICT in developing countries should consider including the principles that can enhance the role of expert teachers. In order to reflect this circumstance, principle 4, "building a learning community with an expert teacher," was included in the final principles to facilitate communication and share knowledge among teachers when they prepare the class with ICT. Also, some of expert teachers' efforts to facilitate the students' participation in utilizing ICT for their learning have been reflected in the final principles as "responsive pedagogy with digital content (principle 8)" and "provision of opportunity for students to use ICT materials (principle 10)." These two principles show alternative ways of students' use of ICT for their learning within ICT resource-limited environment.

Employing the development research method in the developing countries' context has not been the main research area in the field of international education development. However, increasing concerns and alerts for the necessity of pedagogical improvement for integrating ICT in education in developing countries indicate that more practical discussion on "how" to integrate ICT in education in developing countries should be done. In this regard, this research explored the most optimal instructional design principles that possibly apply to the current Bangladeshi educational system based on the analysis of the current challenges and issues of ICT integration in Bangladesh and instructional design theory and models for using ICT. Technology by itself does not enhance the teaching-learning

process and environment. It is the effective and efficient use of technology along with effective instructional strategies by teachers that will bring about a positive change. In this way, instructional design principles can help teachers make more effective plans for their class preparation by presenting precisely what they need to focus on. Although more specific consideration of each subject needs to be explored, the instructional design principles in this research can produce a practical insight as an umbrella principle for those who are looking for pedagogical improvement for ICT integration in education in developing countries.

5.1.2 Implications for Applying the Instructional Design Principles in Developing Countries

Based on the results of the instructional design principles for using ICT in secondary schools in Bangladesh, this section will discuss the practical implication of applying the instructional design principles in the context of developing countries.

First of all, teachers' professional development for ICT integration in education should be transformed to be more flexible and collaborative teacher training programs. It should be noticed that half of the final instructional design principles, among ten principles, are related to the "teachers' preparation" for using ICT in their classes. This implies that the development and application of the instructional design principles in the context of developing countries are closely related to the teachers' readiness, which eventually requires a change of the teacher's professional development system. This research has consistently criticized that teacher training programs only focus on "acquiring basic ICT skills" and do not provide "how to develop the pedagogical aspects of ICT" in Bangladesh as many previous research pointed out (Bingimlas, 2009). There is no doubt that basic computing skills constitute the foundation of ICT literacy, but they are not enough for adequately preparing teachers for teaching with ICT, especially when

computing skills are taught in isolation from a pedagogical context (Valanides & Angeli, 2005).

It is believed that the interaction of the Technological, Pedagogical, and Content Knowledge (TPACK) produces the flexible knowledge required for teachers to successfully integrate technology use into teaching (Koehler et al., 2013). Therefore, teacher training should consider "what types of supports are needed for teachers to make a proper plan with ICT" as well as technological supports. As presented in the final instructional design principles, teachers' training should be able to provide a wider range of supports that enable teachers to "confirming the available resource," "linking the ICT materials to the learning outcome," "using various resources and activities relevant to the curriculum," "building a learning community with expert teachers," and "organizing an appropriate environment for the multimedia class."

Among the principles related to the teachers' preparation, particularly having a teacher community is very important for supporting teachers' preparation for using ICT in their classes in the context of Bangladesh. Vandeyar (2013) argued that teachers apparently desired ICT cluster groups as an effective form of mutual learning, sharing, and collaboration between schools when ICT in education policy neglects to inform schools on how ICT might be used in the classroom practice (Vandeyar, 2013). In order to address the importance of having a teacher community, this research suggested "building a learning community with expert teachers (principle 4)." This principle was identified as the most applicable and important principle in the current education system in Bangladesh. As continuously pointed out, the role of the ICT expert teacher plays a critical role in the Bangladeshi context by sharing pedagogical knowledge about how and when to use technology and increasing motivation to help other teachers who face difficulties with preparing the digital content. Although many teachers are left demotivated to use ICT in schools due to many barriers, teachers can be motivated

and enhance pedagogical knowledge through various forms of teacher communities.

Therefore, the supporting system for ICT teacher training should also need some changes so that teachers can align themselves as Communities of Practice sharing a concern for improved ICT pedagogy and ICT curriculum integration, learning how to do it better (Vandeyar, 2013). According to Wenger's Community of Practice framework, learning can be developed through three modes of belonging: (a) engagement or mutual participation in joint tasks, (b) imagination, which is the willingness to explore and try new things, then reflect on how these relate to other practices, and (c) alignment, which is the convergence of a common focus, cause, or interest (Baya'a, Daher, and Anabousy, 2019). Still the current ICT teacher training in Bangladesh is often conducted as a form of on-site programs that teachers should take leave from the school and conducted regardless of the teachers' subject knowledge. Considering that teachers' professional development is influenced by many personal, social, and professional factors (Morais et al., 2005), more flexible and collaborative teacher training programs need to be constructed and supported by utilizing the community of practice. Also, support to organize various types of teachers' community can be an essential task in order to overcome the barriers such as lack of ICT training and lack of ICT knowledge and skills. Especially the role of expert teachers in their community can provide a training opportunity for teachers who could not access to the ICT training, and increase teachers' motivation by discussing among themselves about their belief and value for the use of ICT.

Second, in order to apply the instructional design principles from this research, the concept of "ICT in education" should be extended by encouraging students' use of ICT for their learning. ICT in education policy should address much larger issues related to professional development and do so in a broader context of educational change (UNESCO, 2011). However, the current ICT in education

policy by the GOB is providing one laptop and one projector to each secondary school and implementing teacher training for digital content development, which makes a more teacher-centered approach. The expected educational impact will be difficult to achieve if the ICT in education policy still sets a limit to the use of technology by teachers only. Therefore, it needs to extend the concept of "the ICT in education" to provide more opportunities for students to utilize ICT for their learning.

One of the essential processes that need to move forward for more effective ICT in education initiatives is that students should be a part of ICT-supported classes. It is important that teachers, students, and administrative staff can access the ICT resources equally, but most developing countries, including Bangladesh, are not affordable for these costs (Parvin, 2013), and many cases still ignored the use of ICT by students for their learning. In order to address the opportunity to use ICT devices by students for their learning, the final principles included the “responsive pedagogy with digital content (principle 8)” and “provision of opportunity for students to use ICT materials (principle 10)” as an alternative way to use ICT by students for their learning. Although the ICT resources that students can access could not be provided at the school level, these two principles suggest alternative approach enabling teachers to design the lesson using ICT in a way to encourage students to use ICT for their learning.

Although not every student has the same access to digital content, teachers should give opportunities for those who have access, so that more students can experience the education with digital tools. In terms of students' opportunity to use the digital content in the case of Bangladesh, teacher C, during the usability test, critically commented that ***“those students who are available to access to the internet or any other digital tools, they have the right to go with the ICT.”*** She insisted on using "google classroom" only for those students who can access the digital device and internet at home. For teacher C, making the best use of available

ICT resources for her class is higher prioritized than providing equal access to the learning materials to all the students. Instead, she looks for alternative ways to distribute the class materials to those students who do not have access to google classroom. Even though the headteacher of the school was skeptical about using google classroom because not all students are ready for this, teacher C insisted that she could not wait until all students have access.

This approach might result in inequality in terms of educational opportunity with ICT in Bangladesh. Theoretically, when ICT-based teaching and learning resources are widely available for ample coverage, students have better access to good quality information and expanded opportunities in and outside school (Ra et al., 2016). However, educational equity with ICT in the context of Bangladesh should be also understood as “how teachers provide an educational opportunity with ICT for those who are and are not available equally.” As more students now have access to ICT devices with significant improvement of digital literacy during the last few years in many developing countries, including Bangladesh, successful integration of ICT in education depends on teachers’ effort to give an opportunity to use ICT for students’ learning and provide same educational materials to those who are not accessible to ICT is essential. The provision of opportunities for students to access ICT devices is a necessary part of transforming education into student-centered learning. However, it is more important to consider not only exploring the alternative ways that students can access the technology outside of the classrooms but also changing the related class rules and supports at the institutional level so that as many students as possible can experience the education with ICT.

It is quite impossible to ignore to use of ICT in education nowadays. Particularly in the developing world, ICT has been regarded as an important tool for educational reforms to respond to the increasing demand for education from various groups of people. With SDG4, the UN has committed to ensuring that by

2030, “all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes” (UNDP, 2015), and ICTs are widely viewed as a critical part of this education future (Samarakoon et al., 2017). However, it would be difficult to say that ICT will bring an effective learning outcome, excluding students from the process of ICT in education. Although schools cannot afford digital devices for every student, teachers should be able to look for more opportunities for students to use the ICT tools for their learning as much as possible as their teaching and learning strategies for using ICT.

5.2 Teachers’ Pedagogy before Technology

In developing countries, the policy-makers often have adopted ICT in education to accelerate the nation’s development efforts, but teachers’ skills and attitudes toward ICT would have often been ignored (Rastogi & Malhotra, 2013). Although the importance of teachers’ capacity for utilizing ICT in education is well-recognized among various stakeholders, still ICT policy and management have been on the provisioning of hardware and infrastructure, rather than on informing how ICT might be used in the classroom practice (Vandeyar, 2013). Thus, this session will explain why technology is still more prioritized than teachers’ pedagogy in the context of Bangladesh and contend the importance of providing practical instructional design principles and guidelines for successful implementation of ICT in education in developing countries.

5.2.1 Structural Contradiction of ICT in Education: A Gap between Policy and Implementation

There have been many studies regarding the challenges to using ICT in

education in developing countries, such as insufficient computers and a lack of teachers' knowledge/skills in ICT (Pelgrum, 2001). Among many factors hindering the use of ICT in education in developing countries, this research particularly paid attention to a gap between policy for ICT integration and implementation at the school level in the context of Bangladesh. This part will especially discuss a structural contradiction of the government policy for multimedia classroom establishment that has influence to prioritize more teachers' technology than pedagogy during the past few years.

5.2.1.1 The Mandatory Use of Multimedia Classroom

During the past few years, the GOB has strongly emphasized using ICT in secondary education, and the MOE of Bangladesh has committed to stimulating a participatory learning process with the use of ICT. Especially the use of multimedia content has been offered as a way of delivering instruction that benefits both students and teachers by providing an interacting learning process (Khanam et al., 2013). As one part of the government efforts to use multimedia content, the GOB introduced the concepts of “multimedia classrooms” and “teacher-led multimedia content development,” which were initiated by the a2i program of the Prime Minister's Office. Under this project, teachers have been trained to develop multimedia content for PPT presentation in their class, and secondary schools have been equipped with one laptop and one multimedia projector since 2009.

In order to accelerate the use of multimedia classroom, the GOB has made the use of multimedia class mandatory at the school level by asking teachers to upload their pictures of conducting the multimedia class on the class monitoring application. During the usability test, teachers commonly mentioned that it is mandatory to upload the pictures of their multimedia class on the multimedia monitoring system in order to prove that the school is implementing the

multimedia class every day. There are even GPS function on the Multimedia Classroom Monitoring application, so teachers should submit the photo at school.

However, the mandatory use of multimedia classrooms has influenced the teachers' use of ICT at the school level very limited. Throughout the class observation and interview with teachers' trainers during fieldwork, it was observed that teachers' use of PPT presentation is simply substituted for using a textbook. Sometimes, teachers put everything in the PPT slides, and students only listened to the teacher's presentation. Particularly preparing the PPT presentation is more time-consuming than a traditional class because teachers need to search for more extra visual and auditory materials to include in the PPT slides. It was found that most of the teachers in Bangladesh face insufficient time to prepare the multimedia class even though they have been adequately trained and are confident about using ICT. Teacher C during the usability test, who is preparing PPT presentation every night, addressed how much works teachers must manage in one day. According to teacher C, teachers have 6-7 classes in one day, and sometimes they are required to teach other subjects as well. Under this circumstance, preparing their own PPT slides to show in the multimedia classroom is a huge burden, and sometimes teachers use the "Shikkhok Batayon" as an online platform where they can easily download the PPT slides and just show them to students without considering instructional design for the class. Teacher B during the usability test also critically mentioned that "*multimedia classroom is used only for showing something to the students rather than drawing active participation.*"

In this way, a great number of multimedia classes has become "advanced in teaching methods, and poor in teaching effect" (Xu, 2017). Especially for those teachers who are not expert in developing teaching and learning materials with digital content, PPT slides downloaded from the "Shikkhok Batayon" are the easiest way to conduct the multimedia class, because teachers can easily show the slide in front of students. The current use of multimedia class for "showing

presentation," would not be able to bring the expected results that the Bangladeshi government intended. Xu (2017) explained this limited use of ICT in the multimedia class as a “deviation on cognition.” According to Xu (2017), many teachers have deviations on cognition to multimedia teaching, such as some teachers mistakenly think that they can give up the traditional teaching because of multimedia (p.189). In Bangladeshi secondary school as well, teachers often decided not to use the traditional teaching method and tend to consider that multimedia class can replaced everything from the textbook. The multimedia class in Bangladesh now has become the “showing PPT presentation by teachers.”

Aziz (2020) argued that the National ICT Policy 2010 in Bangladesh was framed without contextualizing socio-economic challenges, as well as the local aspects of technical, cultural, and human resources. The intention of the GOB might be to facilitate the use of multimedia classes at the secondary school level for more effective learning, but it has somehow become a burden for teachers. Because of the obligation that teachers should submit the photo of the multimedia class to the government, some teachers just download the PPT slides made by other expert teachers and show the presentation during the class without using a textbook or other material.

Here, the gap between the policy and implementation at the school level regarding the understanding the “ICT in education” is generated. The government focused on the positive aspects of “using a multimedia presentation" and pushed the school to use digital content every day without considering their current challenges and needs. Teacher C during the usability test described the reason of this gap as a “miscommunication” between government policy that pushed teachers to use ICT in the classroom and teachers’ understanding that they should use PPT presentation for a whole class. Moreover, the GOB followed the idea of setting up digital technologies, and internet connectivity appears as a solution for developing countries (Aziz, 2020). However, implementation of only this

approach cannot be a fundamental solution for educational development using ICT. Rather this approach could postpone the development of the education system with digital content if there are no additional supports for teachers to use ICT in a meaningful way.

5.2.1.2 Focusing on Technological Knowledge at the Teacher Training

Institutes

Another reason for the gap between the policy and teachers' implementation at the school level is the structural limit of ICT training for teachers. It is criticized that existing teacher training programs in developing countries often neglect to take into account the difference in individual teachers' ICT knowledge or subject specialism (Jeon & Song, 2018). Likewise, the ICT teacher training in Bangladesh focuses only on the standardized technological knowledge (TK) rather than pedagogical knowledge (PK) for each teacher.

It is partly because ICT training institutes in Bangladesh prioritize those teachers who never had ICT training, as there are still many teachers left behind who do not even have TK. Since the resource to train all the teachers in Bangladesh is quite limited, TK is prioritized to teach rather than the overall Technological Pedagogical and Content Knowledge (TPACK). Consequently, the training has been more focused on teaching basic computer operating systems or digital content development for making PPT presentations.

Moreover, it is partly because the priority of teacher training institutes in Bangladesh is to motivate teachers' mindset in order to utilize technology in their conventional class. Teachers' perspective, attitude, motivation are of course very important factors to conduct educational reform, especially in those countries where the ICT initiatives have just started. Therefore, teacher trainers strongly believe that teachers should be motivated first rather than learning pedagogical strategies for using ICT. However, this lack of pedagogical support at the teacher

training level results in the “teacher-centered multimedia class,” which is opposite to the government’s aim for “Digital Bangladesh.”

Throughout this research, it has continuously emphasized that a significant number of teachers are still left behind to use ICT in a meaningful way even though after receiving an on-going teacher training. In order to reduce such a gap between teacher training and teachers’ actual usage of ICT at their school context, practical instructional guidelines should also be prioritized at the training level. Especially, context-based instructional design model/principles are necessarily discussed at the teacher training because there are various types of schools in Bangladesh and each school’s context is different depending on the location of school, administration process and culture. Shohel and Banks (2012) also explained the importance of concentrating on “school-based technology” at the teacher training because the most successful teacher education programs to promote significant pedagogical change happen in the school context. Likewise, the ten instructional design principles suggested from this research might not be necessary for all teachers. Some teachers might need one or two principles, and some teachers need another principle depending on many factors such as their capacity, experiences, and institutional supports. Therefore, teacher training programs need to elaborate more on the instructional design principles and specific guidelines which are useful for various groups of teachers as well as providing technological knowledge and mindset training.

In summary, the government's ICT policy for education has facilitated "transforming the traditional class into multimedia class" that teachers can use visual and auditory materials through the PPT presentation. Although the multimedia class has many positive aspects compared to the traditional class, the implementation at the teacher training institute and school level is somewhat different from the government’s intention to make “student-centered and interactive class with the use of ICT.” Many teachers are now using PPT as a main

tool with the same teaching strategies as the traditional method. Teacher training is also more focusing on the TK rather than PK without considering each teacher's subject specialism. Moreover, at the school level, teachers easily download the PPT presentation made by other teachers through the teachers' portal in order to mandatorily conduct the multimedia class. Certainly, the multimedia class can make the lessons easy to present, and eased the teachers' workloads (Sarowardy & Halder, 2019). Especially with a large number of students in the class like Bangladesh, a multimedia classroom enables a teacher to become a facilitator and raises the possibility of reaching every student compared to the traditional class (Sarowardy & Halder, 2019). However, the government's emphasis on the mandatory use of the "multimedia class" and the "teacher training focusing on TK" could not lead to the students-centered class if teachers use the PPT presentation as the main tool for ICT integration. Although the teachers in Bangladesh are aware of the importance of ICT as an educational tool, currently the actual integration of ICT into teaching remains under discussion.

This gap between policy and implementation seems difficult to narrow down in a short period, but it also indicates that there is a need to concentrate more on the actual integration of ICT to promote pedagogical practices of ICTs in schools (Buabeng-Andoh & Yidana, 2015). More specific guidelines for teachers should be provided in order to clearly show how the integration of ICT in education should look like at each classroom. The government policy and teachers' practice at the school level must share the same purpose toward the multimedia class, and teachers need to be supported more specific and practical instructional guidelines as well as technological support in order to effectively implement the multimedia class at the school level. The following discussion will address more about the importance of providing the practical guidelines for teachers' capacity development for more effective ICT integration in education.

5.2.2 Provision of Practical Guidelines for Teachers' Capacity Development

One of the key failures for ICT integration in education in developing countries was that schools were provided with expensive equipment but with little or no support for teachers' professional development, national ICT-in-education policies, or community involvement (Hawkins, 2002). However, it should be remembered that technology integration in education should not be considered as a replacement for face-to-face instruction but rather as a support to attain objectives that have not been attained efficiently otherwise (Jhurree, 2005). In this regard, the teacher factor plays a critical role in ICT integration. Teachers are the main implementor of ICT in education initiatives at the school level. Hence, teachers should be well-trained in what to prepare, when and where to use ICT, and why they are using ICT in education. It is obvious that trained teachers will be able to perform their tasks more efficiently than untrained teachers (Akhter & Alam, 2016). However, in the case of Bangladesh, the opportunity of receiving ICT teacher training is not equally given to all teachers, and the gap between teachers who are motivated enough to utilize ICT in their classrooms and teachers who are not so very eager to use ICT in education is very large.

In order to cope with this limitation of ICT training for teachers in Bangladesh, this research contends that more practical and applicable guidelines for teachers to use ICT in their classroom are required. Thus, this research presented the ten instructional design principles and 22 specific guidelines. Those principles and guidelines are assumed to help teachers selectively use the ICT as educational tools, such as what kind of preparation and lesson activities specifically need to be considered when they use digital content. Although the discussion on the instructional design principle is an unfamiliar area in the field of international education development, it is a necessary process that teacher's professional development programs should take into consideration for successful integration of ICT in education.

Nevertheless, developing the optimal instructional design principles in the context of developing countries is very difficult due to many constraints. Furthermore, some might be skeptical about developing and implementing instructional design principles in developing countries, where still many challenges remained, such as lack of digital devices and unstable electricity. However, for the government of Bangladesh to realize "student-centered learning" by integrating multimedia classrooms at secondary level education, "how to effectively use the multimedia resources and improve the teaching effects" should become a topic, which is worth discussion for education development in Bangladesh. Hence, a systematic instructional design principle developed by analysis of requirements and needs for ICT-integrated classrooms in developing countries can help teachers integrate relevant technology into teaching in order to improve teaching effects. During the usability test, teachers also described the importance of using instructional design principle as it helps them to plan for the multimedia class. Teacher C mentioned that *"the most important strength of the principle is that 'giving the instruction on the lesson plan' for teachers. I have very clear concept of using ICT, and give proper instruction that when, how and what to do."* and Teacher D also emphasized that she believes *"these principles improve knowledge and capacity as a teacher"* because these principles specifically guide teachers in what they have to plan and do after one another. These results can also support many of previous research that arguing the proper instructional design model and principles should be used for teachers to effectively and systematically plan the class (Cho & Lee, 2012; Kim, 2003; Kim, 2009; Kim & Downey, 2016; Lee, 2013, Sarfo, Frederick Kwaku, & Elen, 2014). Although this research is one case from Bangladesh, it shows the possibility to adopt the instructional design principles in the context of developing countries.

Researchers increasingly argue for a change in the definition of "digital inclusion" to go beyond the idea of Internet access (Van Dijk, 2006). In developing

countries as well, ICT in education does not indicate the integration of computer, internet, or PPT presentation in the traditional classroom anymore. Rather the definition of "digital inclusion" in education should be a way to develop each teacher's capacity to systematically prepare the class using digital content. Instructional design using ICT means analyzing, designing, developing, implementing, and evaluating the ICT educational tools based on the general instructional design process (B.-K. Kim, 2003). Although the educational environment is too diverse to make one standard instructional design principle in the context of developing countries, specific guidelines and methods for integrating ICT in education should be discussed more based on the analysis of challenges and obstacles in a specific educational setting. This process will eventually provide more opportunities for teachers to learn the role of ICT as a tool for developing education quality, not a mandatory use of simple technology with teacher-led learning.

The advent of ICT in education in developing countries around a decade ago was expected to overcome the educational challenges that developing countries face and, therefore, decrease the gap between developing and developed countries. However, the current utilization of ICT by teachers in developing countries merely focus on its technological functions that make teacher's lecture more convenient. This could not lead to improving the education quality in developing countries, as it was expected. In order to enable teachers to effectively utilize ICT to improve the quality of education, teachers need to learn what to prepare, when and where to use ICT, and why they are using ICT throughout experiencing the instructional design process. Furthermore, this process needs to be further prioritized in the teacher's professional development programs and additionally supported by school authority so that teachers become capable of applying the systematic instructional design principle into their lesson planning for reaching quality education.

CHAPTER VI. CONCLUSION

6.1 Summary of the Research

The integration of ICT in education has been expected to improve the quality of education in many developing countries. Among many arguments on ICT integration, most importantly, teachers' pedagogical use of ICT in the classroom has been raised as one of the most influential factors to lead the successful integration of ICT in education. Since international agendas for educational development have also focused on ICT utilization since the early 2000s, the current phenomenon, that still very few teachers are using technology as a pedagogical tool is alarming, highlighting the necessity for further discussion of ICT in education.

In this regard, the primary purpose of this research was to develop the optimal instructional design principles for using digital content, and to identify the validity of the instructional design principles in secondary schools in the context of Bangladesh. In order to achieve the research purpose, this research employed the "development research" method from the field of educational technology and developed the most optimal instructional design principles and specific guidelines by investigating the learning environment, instructional culture, teachers' professional development, and more other factors affecting teachers' use of ICT. **Chapter 3** showed the details of the methodology. It presented the development process of the first version of the principles throughout the literature review, the procedure to develop the revised version of the principles throughout the internal validation, and the usability test for finalizing the principles.

In chapter 4, research findings were presented from the first, second, and third versions of the instructional principles, three rounds of internal validation and the usability test. The first version of the instructional design principle was developed through eight weeks of field research in Dhaka, Bangladesh, from

October 1st to November 21st in 2019, together with a literature review on the (1) challenges of ICT integration in education in developing countries/Bangladesh, (2) instructional design model/principles for integrating ICT in education both in developed and developing countries. The revised version of the principles was developed through internal validation to test the validity of the components, principles, and specific guidelines and improve the principles by modifying them based on feedback from experts. The internal validation was conducted three times with 13 experts in total in the field of education in Bangladesh, educational technology, and international education development.

The revised version of principles was again verified to determine if the revised principles could work in a real-world situation through usability test interviews with secondary school teachers. Due to the COVID-19 pandemic, all secondary schools in Bangladesh have been closed. Therefore, the usability test was conducted via ZOOM meetings by interviewing secondary school teachers to obtain feedback on the revised principles in terms of feasibility and applicability in their classrooms. As a result of the usability test, strengths, weaknesses, and improvement points were identified under each principle and specific guideline. While most of the principles and specific guidelines were applicable in the actual classroom in Bangladesh, some principles such as “organizing an appropriate environment for multimedia class,” “provision of guideline to the learner before starting the class with digital content,” and “facilitating participatory approach with digital content” were figured out to be not applicable in the context of Bangladesh and need improvement.

Based on the usability test results, the principles and specific guidelines were modified and elaborated on. The final instructional design principles include five components, 10 principles, and 22 specific guidelines in total. Principle 1 to 5 addressed the “teachers’ preparation for planning the class with ICT,” and principle 6 to 10 are related to the “teaching and learning activities with ICT.” Also,

throughout the whole development process, two factors that need to be considered for developing the instructional design principles in the context of developing countries were figured out: (1) the role of ICT expert teachers and (2) students' participation in utilizing ICT for learning.

In chapter 5, several implications have been raised for the discussion on developing and applying the instructional design principles in the context of developing countries from two aspects: “educational technology” and “educational development and cooperation.” First, from the perspective of educational technology, it was discussed how the instructional design principles of this research had been developed in order to enhance the ICT capacity for Bangladeshi teachers and how the principles can be applied in the resource-constraint environment of developing countries. In order to provide practical implications for applying the instructional design principles in the context of developing countries, this research stressed the two policy implications; (1) the system of teachers' professional development for ICT integration in education should be changed to more flexible and collaborative teacher training programs and (2) the concept of “ICT in education” should be extended by encouraging students' use of ICT for their learning. The second discussion from the perspective of educational development and cooperation, addressed an importance of teachers' pedagogy rather than technology. Thus, it criticized a structural contradiction of the government policy for multimedia classroom establishment that has influenced to prioritize more teachers' technology than pedagogy due to the lack of practical guidelines for “how to use ICT” in the classroom. Lastly, this research contends the importance of providing practical instructional design principles and guidelines for teachers' capacity development for the successful implementation of ICT in education in developing countries. Using ICT at school does not mean that teachers can replace their traditional teaching method with digital content, but still, many practices and discussions focus on the effects of ICT or the positive

results of using ICT in developing countries. Thus, pedagogical consideration needs to be addressed more by providing instructional design principles so that teachers are trained on what to prepare, when and where to use ICT, and why they are using ICT throughout the instructional design process.

6.2 Limitations and Suggestion for Further Studies

This research has attempted to develop instructional design principles for using digital content in the context of secondary school in Bangladesh by employing the developmental research method. However, due to the unexpected COVID-19 pandemic, an external validation test for applying the final principles at the secondary schools could not be conducted. The purpose of an external validation is to test the impact of the principles and specific guideline on learning, not to test the principles per se., therefore, this step is optional and a trial step to test the impact of the final principles through applying in the actual classroom (J. Lee, 2012). Instead of external validation, this research conducted a usability test via ZOOM by asking secondary school teachers about its applicability and usability in their classrooms in order to include the vivid description by Bangladeshi. For further studies related to the instructional design principles in developing countries, the final principles need to be applied in the actual classroom environment to confirm the effects on learning by interviewing students as well as teachers.

Another limitation of this research was that there was a lack of previous research regarding the instructional design principles in the context of Bangladesh. In this case, field research, interviews with stakeholders and class observations are strongly recommended for future research. This research also conducted fieldwork in Dhaka for two months in order to more precisely understand the issues and challenges of providing the instructional design principles for using ICT in secondary education in Bangladesh. By having done in-depth interviews with

experts in Bangladeshi education and conducting the class observation at the beginning of the research, it was able to reflect the current issues and problems that Bangladeshi education is facing when integrating ICT in education.

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APPENDIX

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1. The First Version of Instructional Design Principles and the First Internal Validation

1.1 The First Version of Instructional Design Principles

Specific guideline	Methods Employed	Instructional Design Principles	Components
1.1 Select the most appropriate digital content that is the most suitable for the objective of the class among various functions of digital content (Interview with teachers' trainer K, teacher R; Newby et al., 2000; Wang, 2008)	Literature Review, Interview	1. Linking the digital content to the objective of the class	Selection of the digital content
1.2 Check for what purpose teachers need to use digital content before the class (Interview with teachers' trainer R; Newby et al., 2000)	Literature Review, Interview		
2.1 Using other conventional materials such as whiteboard and textbook together with digital content (Lim, 2001; Interview with teachers' trainer A)	Literature Review, Interview	2. Using digital content together with other materials	
2.2 Transition between one to another material during the class should be smoothly going on throughout the class, when various materials are included in the one class (Lim, 2001).	Literature Review		
2.3 Give some amount of time for students to use textbook (Interview with teachers' trainer K, teacher Shafiq)	Interview		
3.1 Digital content should not be the main of the class. PPT should be less than 10-15mins, and video or pictures should be displayed only when necessary (Interview with teachers' trainer K, Mayer, 2002)	Literature Review, Interview	3. Using digital content as a supplementary resource for the class	
4.1 Try to reflect the students' needs and interests when collecting the resource from the internet (class observation)	Interview	4. Collecting the digital content from the various resource	Preparing the digital content
4.2 Utilize various open sources from the internet such as YouTube, Khan Academy, UNESCO toolkit etc. (Interviewed with teachers' trainers A, teacher Sh)	Interview		

5.1 Distribute the handout materials in advance for the practice questions or for explaining something that are not included in the textbook (Class observation; Wang & Woo, 2007)	Literature review, Class observation	5. Sharing the class materials before/after the class with the students	
5.2 Share the class materials through Face Book or school website before/after the class, so students can preview/review the class (Class observation, Interview with professor S; Gulbahar, 2007)	Class observation, Interview, Literature review		
6.1 Preparing the backup plan and (technical support) in case that technology does not work (Kim, 2003; Farhana and Chowdhury, 2019; Cha et al., 2018)	Literature review	6. Preparing the infrastructure	
7.1 Use high contrast, lots of movement so students don't get bored (Kim et al., 2016)	Literature review	7. Using appropriate visualization in Power point Presentation	Designing the digital content
7.2 Use less than two types of fonts on the one slide (Kim et al., 2016)	Literature review		
7.3 Consider the number of students in the class, when designing the PPT presentation. Sometimes font size is not appropriate for students who sit backside of the class (Class observation; Yildiz & Usluel, 2016)	Class observation		
8.1 Use the enjoyable examples and reflect the context of Bangladesh (UNESCO, 2015; interview with teacher S, teacher Z)	Literature review, Interview	8. Attracting students with visualization	
8.2 Use various visual contents and trigger animation in the beginning of the class (Lim, 1999; Interview with teacher Z)	Literature review, Interview		
9.1 Showing the summarizing slides for reviewing the previous class (Lim, 2001).	Literature review	9. Confirming the prior knowledge	Preparing students for multimedia class
9.2 Giving a small quiz with the digital content for reviewing the previous class (Lim, 2001).	Literature review		

10.1 Giving a short guideline to students in the beginning of the class about how they participate with digital content throughout the class. For example, class rules and culture during the multimedia class can be established by teacher (Mayer, 2002; Merrill, 2002; Sarfo, 2007; Ertmer, 1999)	Literature review	10. Giving a short guideline to students in the beginning of the class	
11.1 Give students group/individual/pair work based on the digital content (Interview with teachers' trainer K, teacher Z; Cha et al., 2018)	Literature review, Interview	11. Trying the participatory approach with digital content	Interaction with students based on the digital content
11.2 Specific work guideline in groupwork should be given to students before the group/individual/pair work (Class observation)	Class observation		
11.3 Make a space for student to ask a question to teachers based on the digital content for requiring participation in the class (Interview with teachers' trainer K)	Interview		
12.1 Screen should be clear and big enough for the big number of students (Class observation)	Class observation	12. Organizing of an appropriate environment for multimedia class	Setting up proper environment for multimedia class
12.2 Light should be off only the frontside to show the slide in order to show the digital content. It is not necessary to turn off all the light in the classroom. (Class observation)	Class observation		
12.3 Proper sound system is required considering the big number of students in the class (Class observation)	Class observation		

1.2 Questionnaires for the First Internal Validation

Dear 000 sir,

Hello, this is Yoonjung HWANG, a Ph.D. candidate from Global Education Cooperation major in the College of Education, Seoul National University. The purpose of this questionnaire is to confirm its validity regarding the components and principles for using digital content in the secondary level of education in Bangladesh.

This questionnaire is mainly composed of two parts, which are *1) Introduction of the research, and 2) Reviewing the validity for the first draft of principles*. The introduction of the research will explain the purpose and significance of the research, methodology and overall process of developing the principles and detailed guidelines that I have developed during the field research in Dhaka from the period of Oct 1st to Nov 5th. The second part for reviewing the validity includes questionnaire for asking the validity of the components, principles and detailed guidelines.

This validity test (Part II) will take around 30-45mins and can be conducted either by face-to-face interview or online communication according to your availability. The personal information you provide will be only accessed by the principal investigator (Yoonjung HWANG) and her academic advisor (Cheolil, Lim, Professor, College of Education, Seoul National University) for the purpose of identifying the data and will not be included in the dissertation.

If you have any questions, please do not hesitate to contact Yoonjung HWANG.

Thank you for your kind cooperation.

[Profile of the experts]

- ◆ Name:
- ◆ Major:
- ◆ Highest level of education:
- ◆ Affiliation/ position:
- ◆ Working experience (teaching with digital content as a secondary school teacher, as a teacher educator, or other professional experience regarding ICT in education):

1.2.1 Validity for the Components of Principles

The components of the principles for using digital content have been developed through mainly interview with teachers, teachers' trainers, and classroom observation in the period of Oct 1st to Nov 5th in Dhaka city, Bangladesh. Please carefully read the contents below and check the tick mark on the scale according to your opinion.

1. Strongly invalid, 2. Invalid, 3. Valid, 4. Strongly valid

Evaluation Items	1	2	3	4
1. Are the components enough to consider when developing the principles for using digital content in the classroom in the context of secondary school in Bangladesh?				
1.1 Selecting the method for using digital content				
1.2 Preparing the digital content				
1.3 Designing the digital content				
1.4 Preparing students for multimedia class				
1.5 Interaction based on the digital content				
1.6 Setting up proper environment for multimedia class				
2. Are the components clearly related to each principle?				
2.1 Selecting the method for using digital content				
2.2 Preparing the digital content				
2.3 Designing the digital content				
2.4 Preparing students for multimedia class				
2.5 Interaction based on the digital content				
2.6 Setting up proper environment for multimedia class				
3. Are the components using appropriate wording?				
3.1 Selecting the method for using digital content				
3.2 Preparing the digital content				
3.3 Designing the digital content				
3.4 Preparing students for multimedia class				

3.5 Interaction based on the digital content				
3.6 Setting up proper environment for multimedia class				
4. Are the interview with teachers appropriate to develop these components?				
5. Are the interview with teachers' trainers appropriate to develop these components?				
6. Are the classroom observations appropriate to develop these components?				

Please write down if you have additional opinion, especially for those you marked under 3 points

1.2.2 Validity for the Principles and Specific Guidelines

The questionnaires below are to examine the validity for the principles and specific guideline under each principle. Please carefully read the contents below and check the tick mark on the scale according to your opinion.

1. Strongly invalid, 2. Invalid, 3. Valid, 4. Strongly valid

Components	Principles and Specific guideline	Validity			
		1	2	3	4
Selecting the digital content for the lesson	1. Linking the digital content to the objective of the class				
	1.1 Select the appropriate digital content that is the most suitable for the objective of the class among various functions of digital content.				
	1.2 Check for what purpose teachers need to use digital content before the class				
	2. Using digital content together with other materials				
	2.1 Using other conventional materials such as whiteboard and textbook together with digital content				
	2.2 Transition between one to another material during the class should be smoothly going on throughout the class, when various materials are included in the one class				
	2.3 Give some amount of time for students to use textbook				
	3. Using digital content as a supplementary resource for the class				
3.1 Digital content should not be main of the class. PPT should be less than 10-15mins, and video or pictures should be displayed only when necessary					
Preparing the digital content	4. Collecting the digital content from the various source				
	4.1 Try to reflect the students' needs and interests when collecting the resource from the internet				
	4.2 Utilize various open sources from the internet such as YouTube, Khan Academy, UNESCO toolkit etc.				
	5. Sharing the class materials before/after class with the students				

	5.1 Distribute the handout materials in advance for the practice questions or for explaining something that are not included in the textbook				
	5.2 Share the class materials through FB or school website before/after the class, so students can preview/review the class				
	6. Preparing the backup plan in case that technology does not work				
Designing the digital content	7. Using appropriate visualization in PowerPoint Presentation				
	7.1 Use high contrast on the slide				
	7.2 Use less than 2 types of fonts on the one slide				
	7.3 Consider the number of students in the class, when they design the PPT presentation. Sometimes font size is not appropriate for students who sit backside of the class				
	8. Attracting students with visualization				
	8.1 Use the enjoyable examples and reflect the context of Bangladesh				
	8.2 Use various visual contents and trigger animation in the beginning of the class				
Preparing students for multimedia class	9. Confirming the prior knowledge of students				
	9.1 Showing the summarizing slides for reviewing the previous class				
	9.2 Give a small quiz with the digital content for reviewing the previous class				
	10. Giving a short guideline to students in the beginning of the class				
	10.1 Give a short guideline to students in the beginning of the class about how they participate with digital content throughout the class. For example, class rules and culture during the multimedia class can be established by teacher				
	11. Trying the participatory approach with digital content				
	11.1 Give students group/individual/pair work based on the digital content				
	11.2 Specific work guideline in groupwork should be given to students before the group/individual/pair work				
	11.3 Make a space for student to ask a question to teachers based on the digital content for requiring participation in the class				
Setting up	12. Organizing an appropriate environment for multimedia class				

proper environment for multimedia class	12.1 Screen should be clear and big enough for the big number of students				
	12.2 light should be off only the frontside to show the slide in order to show the digital content. It is not necessary to turn off all the light in the classroom				
	12.3 Proper sound system is required considering the big number of students in the class				

1.2.3 Validity for the Overall Principles

The questionnaire below is to examine the validity for the principles for using digital content in the secondary school in Bangladesh. Please carefully read the contents below and check the tick mark on the scale according to your opinion.

1. Strongly invalid, 2. Invalid, 3. Valid, 4. Strongly valid

Item	Question	1	2	3	4
Validity	This principle is valid for teachers to consider when they design the classroom with digital content				
Explanation	This principle is well explained for teachers what they should keep in mind when designing the classroom with digital content				
Usefulness	This principle can be useful for teachers to design the classroom with digital content				
Generality	This principle can be generalized in the whole context in Bangladesh				
Understandability	This principle is easily explained to understand what teachers should keep in mind when designing the classroom with digital content				

Please write down if you have additional opinion, especially for those you marked under 3 points

--

1.3 Results of the First Internal Validation

1.3.1 Result of the First Internal Validation for Components of the Principles

Questions	No	Experts							Mean	S. D	CVI	IRA
		A	B	C	D	E	F	G				
1. Are the components enough to consider when developing the principles for using digital content in the classroom in the context of secondary school in Bangladesh?	1.1	4	3	4	3	3	3	4	3.43	0.53	1.00	0.80
	1.2	4	3	4	3	2	3	4	3.29	0.76	0.86	
	1.3	4	3	4	4	3	3	3	3.43	0.53	1.00	
	1.4	4	3	3	4	4	3	3	3.43	0.53	1.00	
	1.5	4	4	4	4	4	3	3	3.71	0.49	1.00	
	1.6	4	4	4	4	3	3	4	3.71	0.49	1.00	
2. Are the components clearly related to each principle?	2.1	4	3	4	4	3	3	4	3.57	0.53	1.00	
	2.2	4	3	4	4	3	3	4	3.57	0.53	1.00	
	2.3	4	3	4	4	3	3	3	3.43	0.53	1.00	
	2.4	4	3	3	4	3	3	3	3.29	0.49	1.00	
	2.5	4	4	4	4	3	3	3	3.57	0.53	1.00	
	2.6	4	4	4	4	3	3	4	3.71	0.49	1.00	
3. Are the components using appropriate wording?	3.1	4	3	4	4	2	2	4	3.29	0.95	0.71	
	3.2	4	3	2	3	2	2	4	2.86	0.90	0.57	
	3.3	4	3	2	4	2	2	3	2.86	0.90	0.57	

	3.4	4	3	3	4	3	2	3	3.14	0.69	0.86	
	3.5	4	4	2	4	3	2	3	3.14	0.90	0.71	
	3.6	4	4	4	3	4	2	4	3.57	0.79	0.86	
4. Are the interview with teachers appropriate to develop these components?	4	3	3	4	4	2	4	4	3.43	0.79	0.86	
5. Are the interview with teachers' trainers appropriate to develop these components?	5	3	3	4	4	3	4	4	3.57	0.53	1.00	
6. Are the classroom observation appropriate to develop these components?	6	3	3	4	4	3	4	4	3.57	0.53	1.00	

1.3.2 Result of the First Internal Validation for Principles and Specific Guidelines

Principles and Specific guideline	Experts							Mean	S. D	CVI	IRA
	A	B	C	D	E	F	G				
1.1 Select the most appropriate digital content that is the most suitable for the objective of the class among various functions of digital content.	4	4	4	4	3	4	4	3.86	0.38	1.00	0.92
1.2 Check for what purpose teachers need to use digital content before the class	4	3	4	4	3	4	4	3.71	0.49	1.00	
2.1 Using other conventional materials such as whiteboard and textbook together with digital content	4	4	4	4	3	4	4	3.86	0.38	1.00	
2.2 Transition between one to another material during the class should be smoothly going on throughout the class, when various materials are included in the one class	4	3	4	4	3	4	4	3.71	0.49	1.00	
2.3 Give some amount of time for students to use textbook	3	2	2	4	3	3	4	3.00	0.82	0.71	

3.1 Digital content should not be the main of the class. PPT should be less than 10-15mins, and video or pictures should be displayed only when necessary	4	4	4	4	3	4	4	3.86	0.38	1.00
4.1 Try to reflect the students' needs and interests when collecting the resource from the internet	4	4	4	4	3	4	4	3.86	0.38	1.00
4.2 Utilize various open sources from the internet such as YouTube, Khan Academy, UNESCO toolkit etc.	4	4	3	4	3	4	4	3.71	0.49	1.00
5.1 Distribute the handout materials in advance for the practice questions or for explaining something that are not included in the textbook	3	3	3	4	3	4	3	3.29	0.49	1.00
5.2 Share the class materials through Face Book or school website before/after the class, so students can preview/review the class	3	2	2	3	3	4	3	2.86	0.69	0.71
6.1 Preparing the backup plan and (technical support) in case that technology does not work	3		4	4	3	4	4	3.67	0.52	1.00
7.1 Use high contrast, lots of movement so students don't get bored	4	4	3	4	3		3	3.50	0.55	1.00
7.2 Use less than two types of fonts on the one slide	4	4	4	4	3	4	3	3.71	0.49	1.00
7.3 Consider the number of students in the class, when designing the PPT presentation. Sometimes font size is not appropriate for students who sit backside of the class	4	4	4	4	3	4	4	3.86	0.38	1.00
8.1 Use the enjoyable examples and reflect the context of Bangladesh	4	4	3	4	4	4	4	3.86	0.38	1.00
8.2 Use various visual contents and trigger animation in the beginning of the class	3	4	3	3	4	4	3	3.43	0.53	1.00
9.1 Showing the summarizing slides for reviewing the previous class	3	4	4	4	4	3	3	3.57	0.53	1.00
9.2 Giving a small quiz with the digital content for reviewing the previous class	3	4	4	4	4	3	3	3.57	0.53	1.00
10.1 Giving a short guideline to students in the beginning of	3	4	3	4	4	4	3	3.57	0.53	1.00

the class about how they participate with digital content throughout the class. For example, class rules and culture during the multimedia class can be established by teacher											
11.1 Give students group/individual/pair work based on the digital content	4	4	4	4	4	4	4	4.00	0.00	1.00	
11.2 Specific work guideline in groupwork should be given to students before the group/individual/pair work	4	4	4	4	4	4	3	3.86	0.38	1.00	
11.3 Make a space for student to ask a question to teachers based on the digital content for requiring participation in the class	4	4	4	4	4	4	4	4.00	0.00	1.00	
12.1 Screen should be clear and big enough for the big number of students	3	4	4	4	4	4	4	3.86	0.38	1.00	
12.2 Light should be off only the frontside to show the slide in order to show the digital content. It is not necessary to turn off all the light in the classroom.	4	4	4	4	4	4	3	3.86	0.38	1.00	
12.3 Proper sound system is required considering the big number of students in the class	4	4	4	4	4	4	4	4.00	0.00	1.00	

1.3.3 Result of the Internal Validation for the Overall Principles

Questions	Experts							Mean	S. D	CVI	IRA
	A	B	C	D	E	F	G				
(Validity) This principle is valid for teachers to consider when they design the classroom with digital content	4	4	4	4	3	4	4	3.86	0.38	1.00	0.8
(Explanation) This principle is well explained for teachers what they should keep in mind when designing the classroom with digital content	4	4	4	4	3	3	4	3.71	0.49	1.00	
(Usefulness) This principle can be useful for teachers to design the classroom with digital content	4	4	4	4	3	4	4	3.86	0.38	1.00	
(Generality) This principle can be generalized in the whole context in Bangladesh	3	3	4	4	1	2	4	3.00	1.15	0.71	
(Understandability) This principle is easily explained to understand what teachers should keep in mind when designing the classroom with digital content	4	3	3	4	3	3	4	3.43	0.53	1.00	

1.3.4 Expert Comments from the First Internal Validation

Category	Feedback
Modifying the wording	When we say Internet, then it covers all sources (expert C)
	You can prefer using “Learning outcome of the content” instead of objective of the class. The teacher should link the digital content with the learning outcome (what the students will learn after the class), not the objective of the class. (Expert E)
	Instead of preparing students for multimedia class, you can say, motivating students for multimedia class. (Expert F)
	You need to change the wording because that doesn’t sound the quite right word that you are looking for. When you say, ‘interaction based on the digital content’ your digital content become the major focus. But it should be supported. So, there are problem with that. (Expert F)
Making the guideline more detailed	Sometimes we see all the topic of a subject is not applicable for digital presentation. It depends on availability of teaching aids. For example, we cannot use those topics which is suitable for hands on activity by showing the real time teaching aids. Naturally we try to prepare digital content on abstract and complex topics. (Expert A)
	Slides/PPT should be blank or off while other methods are applied. (Expert B)
	Consider the age of learners. The method or time for using digital content can make it more effective when it is used differently depending on learners' age or grade. For example, teachers can more use visually attractive contents for lower grades, while the higher grade require more knowledge-based lectures (Expert G)
Considering the context of Bangladesh	All teachers in Bangladesh still not receive the training on digital content, so all are not aware of enough about the principles. Even the trained teachers are not following the principles when developing Digital content. Online sharing will not possible as most of students have no access of internet. (Expert B)
	(Sharing class materials) However, in the context of Bangladesh, we cannot set this as principle. As you observed, this is not practiced by the teachers and there is no institutional support for teachers to do this. In the rural areas this is impossible for teachers to practice. Therefore, I will request you to think about this principle (Expert C)

	<p>In this component you should consider seeing how the teachers are benefitted from the ‘warm experts’ (Bakardjieva, 2005) as the teachers are not digital native users of Technology. They require support from other experts (colleagues, family members, even advanced students) (Expert E)</p> <p>“Check for what purpose teachers need to use digital content before the class” most of teachers, they don’t have idea why they are using it. They use because government tell them to use it (Expert F)</p> <p>Teachers must know they need training, and there are tons of issues related to that, but then again when you say that ‘check what purpose teachers need to’, they don’t bother to you don’t know. Because they think that I must do that anyway because government wants me to use this and that class... so either do in the way that suit them, or they just keep it outside of the classroom (Expert F)</p> <p>These will be applicable only for those schools who are completely ready. And again, about use, in terms of getting ready, no schools are ready. I know there are lots of school they have computer, and they are pretty much ready, but they have infrastructure ready, but connecting materials that sort of training, pedagogical training, they don’t have. (Expert F)</p>
Renaming the principles	<p>Consider renaming this principle as “Selecting and creating the digital content by their own/from various sources” (Expert E)</p> <p>Why you are limiting yourself in power point presentation. There are tons of other stuff nowadays. Instead of saying power point, why don’t you just make it open? So, if you keep it open it will also include power point. So, whether you use power point, or something would like to use other software (Expert F)</p>
Reorganizing the principles	<p>Preparing and designing, these are the same? You need to put preparing and designing or something like organizing your digital content... (Expert F)</p> <p>(Duplication of the principles and detailed guideline) This is already covered by 1.1 (Expert C)</p> <p>Initially teachers should “plan” at this stage (1.1). Please include another principle under the second component and there include a new guideline under principle 4 (Expert E)</p>

2. The Second Version of Instructional Design Principles and the Second Internal Validation

2.1 The Second Version of Instructional Design Principles

Component		Principles		Specific guideline	
1	Selecting the digital content for the lesson	1	Linking the digital content to the learning outcome of the lesson	1.1	Select the most appropriate digital content that is the most suitable for the objective of the class among various functions of digital content. Do your research to find out suitable ICT materials for your class (Interview with teachers' trainer K; teacher R; professor T; Newby et al. 2000; Wang,2008)
				1.2	Use checklist to narrow teachers' choices and to focus on what will work best to help your students learn your contents among many digital content (Interview with teachers' trainer R; Newby et al., 2000)
		2	Integrating digital content with other materials	2.1	Using other conventional materials such as whiteboard and textbook together with digital content. Depending on the teachers' pedagogy/object of the class, teachers should give some amount of time for students to use textbook (Lim, 2001; interview with teachers' trainer K)
				2.2	Using other relevant materials (e.g., model, instruments, blocks, map, globe, newspaper and other subject specific materials (Interview with teachers' trainer R)
				2.3	Ensure that different media are properly synchronized with one another (Newby et al., 2000) Transition between one to another material during the class should be smoothly going on throughout the class, when various materials are included in the one class (Lim, 2001)
		3	Using digital content as a supplementary resource for the class	3.1	Digital content should not be main component of the class, but supplementary. PPT should be less than 10-15mins, and video or pictures should be displayed only when necessary (interview with teachers' trainer K; Mayer, 2002; Norman, 1993)

2	Preparing the digital content	4	Attracting students with digital content	4.1	Use the enjoyable examples and reflect the context of Bangladesh (UNESCO, 2015; Lim, 1999; interview with teacher S and teacher Z)
				4.2	Use trigger animation by the change of color or arrow to show the clue for the contents (Lim, 1999)
				4.3	Give a small quiz for reviewing the previous class, and for motivating students for the contents; but it should not be always digital content (Lim, 2001).
		5	Selecting and creating the digital content by their own/from various source	5.1	Utilize various open sources from the internet such as YouTube, Khan Academy, UNESCO toolkit etc. (interviewed with teachers' trainers R)
				5.2	Try to require support from other experts (colleagues, family members, even advanced students) (Khan, 2014; Shohel & Power, 2010; Lee, 2012; Gulbahar, 2007; Jhurree, 2005; Ertmer, 1999)
				5.3	Try to reflect the students' needs and interests when collecting the resource from the internet (class observation)
		6	Preparing the PowerPoint presentation (when necessary) with appropriate design	6.1	Keep your point simple in digital content (e.g., Use less than 2 types of fonts on the one slide at a time, one idea on the one slide, put the title for summarizing the contents of the slide) (Voss, 2004; Kim et al., 2016; Interview with Professor T)
				6.2	Consider the number of students in the class, while preparing the PPT presentation. Font size should be visible and understandable from every corner of the class (Class observation)
				6.3	Design with visually comfortable (such as proximity, alignment, repetition and contrast on the PPT slide (Kim et al., 2016)
		7	Preparing the backup plan in case that technology does not work	7.1	Get prepared for any kind of technological disruption in the class (e.g., load shedding, technical trouble) (Kim, 2003; Chowdhury, 2019; Cha et al., 2018)
3	Preparing the learners	8	Preparing the learner before starting the class	8.1	Guide students with some complicated terms beforehand if your class has more information that does not include in the textbook especially for those subjects such as Biology and Mathematic (Mayer, 2002)

				8.2	Giving a short guideline to students in the beginning of the class - Instruct students how they should follow the digital content throughout the class (Class observation)
4	Pedagogical use of digital content	9	Trying the participatory approach with digital content	9.1	Give students group/individual/pair work relevant the digital content (interview with teachers' trainer K)
				9.2	Specific work guideline in groupwork should be given to the students before the work (Class observation)
		10	Interaction based on the digital content	10.1	Try various types of feedbacks (Park et al., 1997; Tse-Kian, 2003; Dong & Newman, 2018)
				10.2	Do not explain the contents first, rather instruct students to explain/discuss the topic in class/group (Interview with teachers' trainer R)
				10.3	Make a space for student to ask a question to teachers based on the digital content for requiring participation in the class (Class observation)
		11	Sharing the class materials before/after class with the students	11.1	Distribute the handout materials in advance for the practice questions or for explaining something that are not included in the textbook (Class observation)
11.2	Share the class materials through FB or school website before/after the class, so students can preview/review the class (for higher grade only, 11-12) (Gulbahar, 2007; Interview with professor S)				
5	Preparing the facility and environment for using digital content	12	Sharing the class materials after class with the students	12.1	Screen should be clear and big enough for the large number of students (Class observation)
				12.2	light should be off only the frontside to show the slide in order to show the digital content. It is not necessary to turn off all the light in the classroom. (Class observation)
				12.3	Proper sound system is required considering the big number of students in the class (Class observation)

2.2 Questionnaires the Second Internal Validation

2.2.1 Validity for the components of principles

The questionnaire below is *to examine the validity of the components that should be considered for developing principles*.

The components of the principles for using digital content have been developed through mainly interview with teachers, teachers' trainers, classroom observation in the period of Oct 1st to Nov 5th in Dhaka city, Bangladesh, and literature reviews.

Please carefully read the contents below and check the tick mark on the scale according to your opinion.

1. Strongly invalid, 2. Invalid, 3. Valid, 4. Strongly valid

Contents	1	2	3	4
1. Are the components valid enough to consider for developing the principles for using digital content in the classroom in the context of secondary school in Bangladesh?				
- Selecting the digital content for the lesson				
- Preparing the digital content				
- Preparing the learners				
- Pedagogical use of digital content				
- Preparing the facility and environment for using digital content				
2. Are the components clearly related to each principle?				
- Selecting the digital content for the lesson				
- Preparing the digital content				
- Preparing the learners				
- Pedagogical use of digital content				
- Preparing the facility and environment for using digital content				
3. Are the components using appropriate wording?				
- Selecting the digital content for the lesson				

- Preparing the digital content				
- Preparing the learners				
- Pedagogical use of digital content				
- Preparing the facility and environment for using digital content				

Please write down if you have additional opinion, especially for those you marked under 3 points. (e.g., some components should be deleted/combined with other component, or if there are other components that teachers should consider when they design the multimedia classroom)

2.2.2 Validity for the Principles and Specific Guidelines

The questionnaires below are *to examine the validity for the principles and specific guideline under each principle*. Please carefully read the contents below and check the tick mark on the scale according to your opinion. Please remember that these principles are for teachers who are currently using digital content in his/her class, and for those school whose ICT facility are properly set up.

1. Strongly invalid, 2. Invalid, 3. Valid, 4. Strongly valid

Components	Principles and detailed guideline	Validity			
		1	2	3	4
Selecting the digital content for the lesson	1. Linking the digital content to the learning outcome of the lesson				
	1.1. Select the most appropriate digital content that is the most suitable for the objective of the class				
	1.2. Use checklist to narrow teachers' choices and to focus on what will work best to help your students learn your contents among many digital content				
	2. Integrating digital content with other materials				
	2.1. Using other conventional materials such as whiteboard and textbook together with digital content. Depending on the teachers' pedagogy/objectives of the class, teachers should give some amount of time for students to be adjusted to use textbook.				
	2.2. Transition between one to another material during the class should be smoothly going on throughout the class, when various materials are included in the one class				

	2.3. Ensure that different media are properly synchronized with one another (seamless)				
	3. Using digital content as a supplementary resource for the class				
	3.1. Digital content should not be main component of the class, but supplementary. PPT should be less than 10-15 mins, and video or pictures should be displayed only when necessary				
Preparing the digital content	4. Attracting students with digital content				
	4.1. Use the enjoyable examples and reflect the context of Bangladesh				
	4.2. Use trigger animation by the change of color or arrow to show the clue for the contents				
	4.3. Give a small quiz for reviewing the previous class, and for motivating students for the contents				
	5. Selecting and creating the digital content by their own/from various source				
	5.1. Utilize various open sources from the internet such as YouTube, Khan Academy, UNESCO toolkit etc.				
	5.2. Try to require support from other experts (colleagues, family members, even advanced students)				
	5.3. Try to reflect the students' needs and interests when collecting the resource from the internet				
	6. Preparing the PowerPoint presentation (when necessary) with appropriate design				
	6.1. Keeping your point simple in digital content (Voss, 2004)				
	6.2. Consider the number of students in the class, while preparing the PPT presentation. Font size should be visible and understandable from every corner of the class				
	6.3. Design with visually comfortable (such as proximity, alignment, repetition and contrast on the PPT slide.				
	7. Preparing the backup plan in case that technology does not work				

	7.1. Get prepared for any kind of technological disruption in the class (e.g., load shedding, technical trouble)				
Preparing the learners	8. Preparing the learner before starting the class				
	8.1. Guide students with some complicated terms beforehand				
	8.2. Giving a short guideline to students in the beginning of the class - Instruct students how they should follow the digital content throughout the class				
Pedagogical use of digital content	9. Trying the participatory approach with digital content				
	9.1. Give students group/individual/pair work relevant the digital content				
	9.2. Specific work guideline in groupwork should be given to the students before the work				
	10. Interaction based on the digital content				
	10.1. Try various types of feedbacks				
	10.2. Do not explain the contents first, rather instruct students to explain/discuss the topic in class/group				
	10.3. Make a space for student to ask a question to teachers based on the digital content for requiring participation in the class				
	11. Sharing the class materials before/after class with the students				
	11.1. Distribute the handout materials in advance for the practice questions or for explaining something that are not included in the textbook				
	11.2. Share the class materials through Facebook or school website before/after the class, so students can preview/review the class (for higher grade only, 11-12)				
Preparing the facility and environment for using digital content	12. Setting up proper environment for multimedia class				
	12.1. Screen should be clear and big enough for the large number of students				
	12.2. light should be off only the frontside to show the slide in order to show the digital content. It is not necessary to turn off all the light in the classroom.				

	12.3. Proper sound system is required considering the big number of students in the class				
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Please write down if you have additional opinion, especially for those you marked under 3 points

2.2.3 Validity for the Overall Principles

The questionnaire below is *to examine the validity for the entire principles, detailed guideline* for using digital content in the secondary school in Bangladesh. Please carefully read the contents below and check the tick mark on the scale according to your opinion.

1. Strongly invalid, 2. Invalid, 3. Valid, 4. Strongly valid

Item	Question	1	2	3	4
Validity	This principle is valid for teachers to consider when they design the classroom with digital content				
Explanation	This principle is well explained for teachers what they should keep in mind when designing the classroom with digital content				
Usefulness	This principle can be useful for teachers to design the classroom with digital content				
Generality	This principle can be generalized in the whole context in Bangladesh				
Understandability	This principle is easily explained to understand what teachers should keep in mind when designing the classroom with digital content				

Please write down if you have additional opinion, especially for those you marked under 3 points

2.3 Result of the Second Internal Validation

2.3.1 Result of the Second Internal Validation for the Components of Principles

Questions	No	Experts							Mean	S. D	CVI	IRA
		A	B	C	D	E	F	G				
1. Are the components enough to consider for developing the principles for using digital content in the classroom in the context of secondary school in Bangladesh?	1.1	4	4	4	4	2	4	3	3.57	0.79	0.86	0.33
	1.2	2	4	4	3	2	4	3	3.14	0.90	0.71	
	1.3	3	4	2	3	3	4	3	3.14	0.69	0.86	
	1.4	4	4	4	4	3	4	3	3.71	0.49	1.00	
	1.5	4	4	3	4	2	4	3	3.43	0.79	0.86	
2. Are the components clearly related to each principle?	2.1	4	4	4	4	2	2	3	3.29	0.95	0.71	
	2.2	2	2	4	3	2	2	3	2.57	0.79	0.43	
	2.3	2	3	2	2	2	2	3	2.29	0.49	0.29	
	2.4	4	4	4	3	2	3	3	3.29	0.76	0.86	
	2.5	2	3	3	3	2	3	3	2.71	0.49	0.71	
3. Are the components using appropriate wording?	3.1	2	2	3	3	2	2	3	2.43	0.53	0.43	
	3.2	2	2	4	3	2	3	3	2.71	0.76	0.57	
	3.3	2	2	4	3	2	3	3	2.71	0.76	0.57	
	3.4	2	2	4	3	2	3	3	2.71	0.76	0.57	
	3.5	2	2	4	3	2	3	3	2.71	0.76	0.57	

2.3.2 Result of the Second Internal Validation for the Principles and Specific guidelines

Principles and Specific guideline	Experts							Mean	S. D	CVI	IRA
	A	B	C	D	E	F	G				
Principle 1. Linking the digital content to the learning outcome of the lesson	4	-	-	3	3	-	4	3.5	0.5	1	0.5
1.1 Select the most appropriate digital content that is the most suitable for the objective of the class	4	4	4	4	3	2	4	3.57	0.79	0.86	
1.2 Use checklist to narrow teachers' choices and to focus on what will work best to help your students learn your contents among many digital content	2	3	2	3	3	2	4	2.71	0.76	0.57	
Principle 2. Integrating digital content with other materials	2	-	-	3	2	-	4	2.8	0.83	0.5	
2.1 Using other conventional materials such as whiteboard and textbook together with digital content. Depending on the teachers' pedagogy/objectives of the class, teachers should give some amount of time for students to be adjusted to use textbook.	1	3	4	4	2	1	4	2.71	1.38	0.57	
2.2 Using other relevant materials (e.g., model, instruments, blocks, map, globe, newspaper and other subject specific materials	3	4	4	4	2	1	4	3.14	1.21	0.71	
2.3 Ensure that different media are properly synchronized with one another (seamless)	4	4	3	4	2	2	4	3.29	0.95	0.71	
Principle 3. Using digital content as a supplementary resource for the class	-	-	-	3	2	-	4	2.6	0.9	0.67	
3.1 Digital content should not be main component of the class, but supplementary. PPT should be less than 10-15 mins, and video or pictures should be displayed only when necessary	1	3	3	3	2	2	4	2.57	0.98	0.71	

Principle 4. Attracting students with digital content	-	-	-	3	3	-	4	3.3	0.47	1
4.1 Use the enjoyable examples and reflect the context of Bangladesh	3	4	4	3	2	2	4	3.14	0.90	0.71
4.2 Use trigger animation by the change of color or arrow to show the clue for the contents	4	4	3	3	2	2	4	3.14	0.90	0.71
4.3 Give a small quiz for reviewing the previous class, and for motivating students for the contents	4	4	3	3	2	2	3	3.00	0.82	0.71
Principle 5. Selecting and creating the digital content by their own/from various source	-	-	-	3	3	-	4	3.3	0.47	1
5.1 Utilize various open sources from the internet such as YouTube, Khan Academy, UNESCO toolkit etc.	3	4	3	4	3	2	4	3.29	0.76	0.86
5.2 Try to require support from other experts (colleagues, family members, even advanced students)	4	4	2	3	3	2	4	3.14	0.90	0.71
5.3 Try to reflect the students' needs and interests when collecting the resource from the internet	3	4	3	3	3	1	4	3.00	1.00	0.86
6. Preparing the PowerPoint presentation with appropriate design	4	-	-	3	2	-	3	3.0	0.71	0.75
6.1 Keeping your point simple in digital content (Voss, 2004)	2	4	3	3	2	3	3	2.86	0.69	0.71
6.2 Consider the number of students in the class, while preparing the PPT presentation. Font size should be visible and understandable from every corner of the class	4	4	4	4	2	3	3	3.43	0.79	0.86
6.3 Design with visually comfortable (such as proximity, alignment, repetition and contrast on the PPT slide.	4	4	4	3	2	3	3	3.29	0.76	0.86
Principle 7. Preparing the backup plan in case that technology does not work	4	-	-	4	3	-	4	3.8	0.43	1

7.1 Get prepared for any kind of technological disruption in the class (e.g., load shedding, technical trouble)	4	4	4	4	3	1	3	3.29	1.11	0.86
Principle 8. Preparing the learner before starting the class	-	-	-	3	3	-	3	3	0	1
8.1 Guide students with some complicated terms beforehand	4	4	2	3	2	4	3	3.14	0.90	0.71
8.2 Giving a short guideline to students in the beginning of the class - Instruct students how they should follow the digital content throughout the class	4	4	2	4	2	4	3	3.29	0.95	0.71
Principle 9. Trying the participatory approach with digital content	4	-	-	4	3	-	3	3.5	0.5	1
9.1 Give students group/individual/pair work relevant the digital content	4	4	4	4	3	3	3	3.57	0.53	1.00
9.2 Specific work guideline in groupwork should be given to the students before the work	4	4	2	4	3	3	3	3.29	0.76	0.86
Principle 10. Interaction based on the digital content	4	-	-	4	3	-	3	3.5	0.5	1
10.1 Try various types of feedbacks	4	4	4	4	3	3	3	3.57	0.53	1.00
10.2 Do not explain the contents first, rather instruct students to explain/discuss the topic in class/group	4	2	4	4	2	1	3	2.86	1.21	0.57
10.3 Make a space for student to ask a question to teachers based on the digital content for requiring participation in the class	4	4	4	4	2	4	3	3.57	0.79	0.86
Principle 11. Sharing the class materials before/after class with the students	3	-	-	3	2	-	4	3	0.71	0.75
11.1 Distribute the handout materials in advance for the practice questions or for explaining something that are not included in the textbook	3	2	3	3	2	3	4	2.86	0.69	0.71
11.2 Share the class materials through Facebook or	3	3	3	3	2	3	4	3.00	0.58	0.86

school website before/after the class, so students can preview/review the class (for higher grade only, 11-12)											
Principle 12. Setting up proper environment for multimedia class	4	-	-	4	3	-	4	3.75	0.43	1	
12.1. Screen should be clear and big enough for the large number of students	4	4	2	4	2	3	4	3.29	0.95	0.71	
12.2. light should be off only the frontside to show the slide in order to show the digital content. It is not necessary to turn off all the light in the classroom.	4	3	2	3	2	2	4	2.86	0.90	0.57	
12.3. Proper sound system is required considering the big number of students in the class	4	4	3	4	2	3	4	3.43	0.79	0.86	

2.3.3 Result of the Second Internal Validation for the Overall Principles

Questions	Experts							Mean	S. D	CVI	IRA
	A	B	C	D	E	F	G				
(Validity) This principle is valid for teachers to consider when they design the classroom with digital content	4	3	4	3	2	2	3	3.00	0.76	0.71	0.2
(Explanation) This principle is well explained for teachers what they should keep in mind when designing the classroom with digital content	2	2	3	4	2	1	3	2.43	0.90	0.43	
(Usefulness) This principle can be useful for teachers to design the classroom with digital content	4	4	4	4	2	3	3	3.43	0.73	0.86	
(Generality) This principle can be generalized in the whole context in Bangladesh	3	2	4	3	2	2	4	2.86	0.83	0.57	
(Understandability) This principle is easily explained to understand what teachers should keep in mind when designing the classroom with digital content	3	n/a	3	3	2	3	4	3.00	0.58	0.71	

2.3.4 Expert Comments from the Second Internal Validation

Category	Feedback
Modifying the Wording	(Component 2. Preparing the digital content) This component could be understood as “readiness for using digital content after digital content were all developed and selected”. Does this “preparing” means “designing or planning the class?”
	(Component 3. Preparing the learners) This component should be “guide learner” because it should be preparing the learning, not learner themselves? (Expert E)
	Please modify words to more specifically. The contents are very comprehensive and basic (expert F)
Considering the context of Bangladesh	Specific guideline should be different depending on the context and the level of students (Expert B)
	Some principles are very important, but these are not only applicable in the context of Bangladesh, but just one of the general instructional design principles (expert F)
	Too general. Specific guideline should be modified to a very specific level based on the context of specific class (expert E)
	Specific guideline should be modified to provide teachers “how” they “handle” this principle with specific expression that can be applicable in the context of Bangladesh (expert G)
Restructure of principles and guideline	The meaning of guidelines 2.1 and 2.2 look similar each other. Please check the link between the principles and specific guideline (expert E)
	(Principle 6) It is not appropriate to have “preparing the PPT presentation” in the instructional design principle. More various learning resources and material should be included (expert E)

3. The Third Version of Instructional Design Principles and Internal Validation

3.1 Third Version of Instructional Design Principles

Component		Principles		Specific guideline	
1	Selection of the digital content for the lesson	1	Selection of the digital content considering the class environment and learners	1.1	Check the most possible digital content that can be used in your class environment. See if electricity, internet access and sound systems etc. are properly working in your class before deciding to use the digital content. (Feedback from the 2nd Validity; Yildiz & Usluel, 2016; Wang & Woo; 2007)
				1.2	Consider the large number of students and their grade in the class (Yildiz & Usluel, 2016)
		2	Selection of the digital materials considering the learning outcome	2.1	Select the most appropriate digital content that is the most suitable for the learning outcome of the lesson. Do your research to find out suitable ICT materials for your class, and identify specific areas in the curriculum where technology can work (Newby et al., 2000; Yildiz & Usluel, 2016; Ertmer, 1999; Wang, 2008; Interview with teachers' trainer K, teacher R, Professor T)
				2.2	Develop a vision of how to use technology to achieve important educational goals, and share your vision with all stakeholders (colleagues, principal, administrators etc.). Then, when new issues, problems, or opportunities arise, the vision will keep you focused on what is central to our technology efforts (Ertmer, 1999).
				2.3	Justify that the rationale for using the technology is sound. See 1) why this technology is needed for the topic, 2) what added values the technology can offer, and 3) how the technology can support the instructional process, after selecting the digital content (Wang & Woo, 2007)

2	Preparation of the lesson plans with the digital content	3	Use of various resources and tools relevant to the curriculum	3.1	Utilize various open sources such as YouTube, Khan Academy, UNESCO toolkit etc., besides/beyond downloading PPT materials from the Shikkok Batayon (Interview with teachers' trainers A, teacher Sh)		
				3.2	Refer the official syllabus and curriculum when preparing the class with the digital content (Interview with teacher trainer K)		
		4	Community building for sharing ideas and supporting each other	4.1	Talk to others at the same grade level, or in the same content area, to share ideas about how and when to use technology (Ertmer, 1999)		
				4.2	Require support and feedback from other experts such as academic computing specialist, your colleagues, family members, even advanced students, when you have difficulties with preparing digital content. Networking with other teachers, researchers, teachers' trainers etc. have a positive impact on teachers' professional development on using ICT in education (Khan, 2014; Shohel & Power, 2010; Lee, 2012; Gulbahar, 2007; Jhurree, 2005; Ertmer, 1999)		
		5	Preparation of the digital content considering the number of students in the class	5.1	Control the class infrastructure and equipment and software requirements (such as a proper sound system) when you play the video or audio materials that can deliver to all students in the classroom (Class observation; Yildiz & Usluel, 2016)		
				5.2	Consider how digital content can be shared depending on a classroom type: computer lab where two or three students share a computer or general classroom in where many students are crammed (Wang & Woo, 2007)		
				5.3	Consider the font size to be visible and understandable from every corner of the class (Class observation, interview with teachers' trainer A)		
		3	Preparation of the learners for the multimedia class	6	Provision of guideline to the learner before starting the class with digital content	6.1	Guide students with some complicated terms beforehand if your class has more information than textbook (Mayer, 2002)
						6.2	Give a short guideline to students in the beginning of the class about how they participate with digital content throughout the class. For example, class rules and culture during the multimedia class can be established by teacher (Mayer, 2002; Merrill, 2002; Sarfo, 2007; Ertmer, 1999)

		7	Sharing the class materials before/after class with the students	7.1	Distribute the handout materials in advance for the practice questions or for explaining something that are not included in the textbook (Class observation; Wang & Woo, 2007)
				7.2	Share the class materials through FB/school website/any supplementary web site before/after the class, so students can access the resources anytime and anywhere, and encourage students' technology use (for higher grade only, 11-12) (Gulbahar, 2007; Interview with professor S)
4	Utilization of the digital content during the class	8	Participatory approach with digital content	8.1	Give students individual/pair work relevant the digital content, and specific work guideline should be given to the students (Interview with teachers' trainer K, teachers' trainer A, teacher Z; Cha et al, 2018)
				8.2	Consider the time distribution for trying the participatory approach with digital content, when the class time is very short (around 35mins) (Class observation; Interview with teacher N)
		9	Interaction based on the digital content	9.1	Try various types of feedbacks and reactions for facilitating interaction, besides questioning and answering. Teachers' actions can support children's learning and extend children's activities through 'offering ideas, know-how, and wisdom (Park et al., 1997; Tse-Kian, 2003; Dong & Newman, 2018)
				9.2	Try various types of interaction not only between teacher and learners, but also between individual learners and learners and content (Wang & Woo, 2007; Chou, 2003).
				9.3	Make a space for student to ask a question to teachers during the class with digital content in order to require students to participate in the class. Utilize FAQ (Frequently Asked Question), sometimes teachers should pause the presentation and show the questions on the slides (Interview with teacher trainer K; Lim, 1999; Class observation)
		10	Attracting students with digital content	10.1	Use the enjoyable examples and reflect the context of Bangladesh for attracting students (UNESCO, 2015; Lim, 1999; interview with teacher S, teacher Z)
				10.2	Use trigger animation by the change of color or arrow to show the clue for the contents (Lim, 1999)

		11	Integration of the digital content with other materials	11.1	Use other relevant educational technologies in the form of low-cost, high-impact, mass-delivery technologies such as TV, radio, and printed text, as well as conventional materials such as whiteboard and textbook, instruments, blocks, map, globe, newspaper and other subject specific materials together with digital content (Lim, 2001; Jhurree, 2005; Interview with teachers' trainer A)
				11.2	Ensure that different media are properly synchronized with one another. For example, transition between one to another material during the class should be smoothly going on throughout the class, when various materials are included in the one class (Lim, 2001; Newby et al., 2000).
				11.3	Remember that digital content should NOT be a main component of the class. Digital content should be used as a supplementary material, for facilitating the student-centered approach, not a technology-centered approach (interview with teachers' educator; Mayer, 2002)
5	Preparation of the facility and environment for using digital content	12	Organization of an appropriate environment for multimedia class	12.1	Set up the screen that is big enough considering the large number of students. Also, screen should not be replaced the whiteboard. Prepare the separate and (if possible) movable screen (Class observation, Interview with teachers' trainer A)
				12.2	Turn off the light only the frontside when showing the slide. It is not always necessary to turn off all the light in the classroom (Class observation)
				12.3	Prepare the backup plan in case that technology does not work: Get prepared for any kind of technological disruption in the class (e.g., load shedding, technical trouble) (Kim, 2003; Chowdhury, 2019; Cha et al., 2018)

3.2 Questionnaire for the Second Internal Validation

The questionnaires below are *to examine the validity for the principles and specific guideline*. Please carefully read the contents below and check the tick mark on the scale according to your opinion. Please remember that these principles are for teachers who are currently using digital content in his/her class, and for those schools whose ICT facilities are properly set up.

Components	Principle and Specific guideline		Validity			
			1	2	3	4
<i>1. Selection of the digital content for the lesson</i>	<i>Principle 1. Selection of the digital content considering the class environment and learners</i>					
	1.1	Check the most possible digital content that can be used in your class environment. See if electricity, internet access and sound systems etc. are properly working in your class before deciding to use the digital content. (Feedback from the 2nd Validity; Yildiz & Usluel, 2016; Wang & Woo; 2007)				
	1.2	Consider the large number of students and their grade in the class (Yildiz & Usluel, 2016)				
	<i>Principle 2. Selection of the digital materials considering the learning outcome</i>					
	2.1	Select the most appropriate digital content that is the most suitable for the learning outcome of the lesson. To be more specific, identify specific areas in the curriculum where technology can work (Newby et al., 2000; Yildiz & Usluel, 2016; Ertmer, 1999; Wang, 2008; Interview with teachers' trainer K, teacher R, Professor T)				

	2.2	Develop a vision of how to use technology to achieve important educational goals, and share your vision with all stakeholders (colleagues, principal, administrators etc.). Then, when new issues, problems, or opportunities arise, the vision will keep you focused on what is central to our technology efforts (Ertmer, 1999).				
	2.3	Justify that the rationale for using the technology is sound. See 1) why this technology is needed for the topic, 2) what added values the technology can offer, and 3) how the technology can support the instructional process, after selecting the digital content (Wang & Woo, 2007)				
2. Preparation of the lesson plans with the digital content	Principle 3. Use of various resources and tools that are relevant to the curriculum					
	3.1	Utilize various open sources such as YouTube, Khan Academy, UNESCO toolkit etc., besides/beyond downloading PPT materials from the Shikkhok Batayon (Interview with teachers' trainers A, teacher Sh)				
	3.2	Refer the official syllabus and curriculum when preparing the class with the digital content (Interview with teacher trainer K).				
	Principle 4. Community building for sharing ideas and supporting each other					
	4.1	Talk to others at the same grade level, or in the same content area, to share ideas about how and when to use technology (Ertmer, 1999)				
	4.2	Require support and feedback from other experts such as academic computing specialist, your colleagues, family members, even advanced students, when you have difficulties with preparing digital content. Networking with other teachers, researchers, teachers' trainers etc. have a positive impact on teachers' professional development on using ICT in education (Khan, 2014; Shohel & Power, 2010; Lee, 2012; Gulbahar, 2007; Jhurree, 2005; Ertmer, 1999)				
	Principle 5. Preparation of the digital content considering the number of students in the class					

	5.1	Control the class infrastructure and equipment and software requirements (such as a proper sound system) when you play the video or audio materials that can deliver to all students in the classroom (Class observation; Yildiz & Usluel, 2016)				
	5.2	Consider how digital content can be shared depending on a classroom type: computer lab where two or three students share a computer or general classroom in where many students are crammed (Wang & Woo, 2007)				
	5.3	Consider the font size to be visible and understandable from every corner of the class (Class observation, interview with teachers' trainer A)				
3. Preparation of the learners for the multimedia class	Principle 6. Provision of guideline to the learner before starting the class with digital content					
	6.1	Guide students with some complicated terms beforehand if your class has more information than textbook (Mayer, 2002)				
	6.2	Give a short guideline to students in the beginning of the class about how they participate with digital content throughout the class. For example, class rules and culture during the multimedia class can be established by teacher (Mayer, 2002; Merrill, 2002; Sarfo, 2007; Ertmer, 1999)				
	Principle 7. Sharing the class materials before/after class with the students					
	7.1	Distribute the handout materials in advance for the practice questions or for explaining something that are not included in the textbook (Class observation; Wang & Woo, 2007)				
	7.2	Share the class materials through FB/school website/any supplementary web site before/after the class, so students can access the resources anytime and anywhere, and encourage students' technology use (for higher grade only, 11-12) (Gulbahar, 2007; Interview with professor S)				
Principle 8. Participatory approach with digital content						

4. Utilization of the digital content during the class	8.1	Give students individual/pair work relevant the digital content, and specific work guideline should be given to the students (Interview with teachers' trainer K, teachers' trainer A, teacher Z; Cha et al, 2018)				
	8.2	Consider the time distribution for trying the participatory approach with digital content, when the class time is very short (around 35mins) (Class observation; Interview with teacher N)				
	Principle 9. Interaction based on the digital content					
	9.1	Try various types of feedbacks and reactions for facilitating interaction, besides questioning and answering. Teachers' actions can support children's learning and extend children's activities through 'offering ideas, know-how, and wisdom (Park et al., 1997; Tse-Kian, 2003; Dong & Newman, 2018)				
	9.2	Try various types of interaction not only between teacher and learners, but also between individual learners and learners and content (Wang & Woo, 2007; Chou, 2003).				
	9.3	Make a space for student to ask a question to teachers during the class with digital content in order to require students to participate in the class. Utilize FAQ (Frequently Asked Question) sometimes teachers should pause the presentation and show the questions on the slides (Interview with teacher trainer K; Lim, 1999; Class observation)				
	Principle 10. Attracting students with digital content					
	10.1	Use the enjoyable examples and reflect the context of Bangladesh for attracting students (UNESCO, 2015; Lim, 1999; interview with teacher S, teacher Z)				
	10.2	Use trigger animation by the change of color or arrow to show the clue for the contents (Lim, 1999)				
	Principle 11. Integration of the digital content with other materials					
	11.1	Use other relevant educational technologies in the form of low-cost, high-impact, mass-delivery technologies such as TV, radio, and printed text, as well as conventional materials				

		such as whiteboard and textbook, instruments, blocks, map, globe, newspaper and other subject specific materials together with digital content (Lim, 2001; Jhurree, 2005; Interview with teachers' trainer A; 1st internal validity test)				
	11.2	Ensure that different media are properly synchronized with one another. For example, transition between one to another material during the class should be smoothly going on throughout the class, when various materials are included in the one class (Lim, 2001; Newby et al., 2000).				
	11.3	Remember that digital content should NOT be a main component of the class. Digital content should be used as a supplementary material, for facilitating the student-centered approach, not a technology-centered approach. (Interview with teachers' educator; Mayer, 2002)				
5. Preparation of the facility and environment for using digital content	Principle 12. Organization of an appropriate environment for multimedia class					
	12.1	Set up the screen that is big enough considering the large number of students. Also, screen should not be replaced the whiteboard. Prepare the separate and (if possible) movable screen (Class observation, Interview with teachers' trainer A)				
	12.2	Turn off the light only the frontside when showing the slide. It is not always necessary to turn off all the light in the classroom (Class observation)				
	12.3	Prepare the backup plan in case that technology does not work: Get prepared for any kind of technological disruption in the class (e.g., load shedding, technical trouble) (Kim, 2003; Chowdhury, 2019; Cha et al., 2018)				

3.3 Result of the Third internal Validation

3.3.1 Validity for the principles and specific guidelines

Principles and guidelines	Expert					Mean	S. D	CVI	IRA
	A	B	C	D	E				
Principle 1. Selection of the digital content considering the class environment and learners	-	-	3	-	4	3.5	0.50	1	0.92
1.1 Check the most possible digital content that can be used in your class environment. See if electricity, internet access and sound systems etc. are properly working in your class before deciding to use the digital content. (Feedback from the 2nd Validity; Yildiz & Usluel, 2016; Wang & Woo; 2007)	3	4	3	4	4	3.6	0.49	1	
1.2 Consider the large number of students and their grade in the class (Yildiz & Usluel, 2016; feedback from 1st validity)	3	4	3	3	4	3.4	0.49	1	
Principle 2. Selection of the digital materials considering the learning outcome	-	-	3	-	4	3.5	0.50	1	
2.1 Select the most appropriate digital content that is the most suitable for the learning outcome of the lesson. To be more specific, identify specific areas in the curriculum where technology can work (Newby et al., 2000; Kang & Kim, 2012; Yildiz & Usluel, 2016; Ertmer, 1999; Interview with teachers' trainer K, teacher R)	4	4	3	3	4	3.6	0.49	1	
2.2 Develop a vision of how to use technology to achieve important educational goals, and share your vision with all stakeholders (colleagues, principal, administrators, etc.). Then, when new issues, problems, or opportunities arise, the vision will keep you focused on what is central to our technology efforts (Ertmer, 1999).	4	3	4	4	4	3.8	0.40	1	
2.3 Justify that the rationale for using the technology is sound. See 1) why this technology is needed for the topic, 2) what added values the technology can offer, and 3) how the technology can support the instructional process, after selecting the digital content (Wang & Woo, 2007)	4	2	4	4	4	3.6	0.80	0.8	

Principle 3. Use of various resources and tools that are relevant to the curriculum	-	-	4	-	4	4	0.00	1	
3.1 Utilize various open sources such as YouTube, Khan Academy, UNESCO toolkit etc., besides/beyond downloading PPT materials from the Shikhhok Batayon (Interviewed with teachers' trainers A, teacher Sh)	3	4	4	2	4	3.4	0.80	0.8	
3.2 Refer the official syllabus and curriculum when preparing the class with the digital content (Interview with teacher trainer K).	3	4	4	2	4	3.4	0.80	0.8	
Principle 4. Community building for sharing ideas and supporting each other	-	-	3	-	4	3.5	0.50	1	
4.1 Talk to others at the same grade level, or in the same content area, to share ideas about how and when to use technology (Ertmer, 1999)	3	3	3	4	4	3.4	0.49	1	
4.2 Require support and feedback from other experts such as academic computing specialist, your colleagues, family members, even advanced students, when you have difficulties with preparing digital content. Networking with other teachers, researchers, teachers' trainers etc. have a positive impact on teachers' professional development on using ICT in education (Khan, 2014; MacKinnon & MacKinnon, 2014; Shohel & Power, 2010; Lee, 2012; Gulbahar, 2007; Jhuree, 2005; Ertmer, 1999)	4	3	3	4	4	3.6	0.49	1	
Principle 5. Preparation of the digital content considering the number of students in the class	-	-	2	-	4	3	1.00	0.5	
5.1 Control the class infrastructure and equipment and software requirements (such as a proper sound system) when you play the video or audio materials that can deliver to all students in the classroom (Class observation; Yildiz & Usluel, 2016)	3	2	3	4	4	3.2	0.75	0.8	
5.2 Consider how digital content can be shared depending on a classroom type: computer lab where two or three students share a computer or general classroom in where many students are crammed (Wang & Woo, 2007)	3	3	3	4	4	3.4	0.49	1	
5.3 Consider the font size to be visible and understandable from every corner of the class (Class observation, interview with teachers' trainer A)	3	3	2	3	4	3	0.63	0.8	
Principle 6. Provision of guideline to the learner before starting the class with digital content	-	-	4	-	4	4	0.00	1	

6.1 Guide students with some complicated terms beforehand if your class has more information than textbook (Mayer, 2002)	3	3	4	3	4	3.4	0.49	1	
6.2 Give a short guideline to students in the beginning of the class about how they participate with digital content throughout the class. For example, class rules and culture during the multimedia class can be established by teacher (Mayer, 2002; Sarfo, 2007; Ertmer, 1999)	3	3	4	4	4	3.6	0.49	1	
Principle 7. Sharing the class materials before/after class with the students	-	-	2	-	4	3	1.00	0.5	
7.1 Distribute the handout materials in advance for the practice questions or for explaining something that are not included in the textbook (Class observation; Wang & Woo, 2007)	3	4	2	4	4	3.4	0.80	0.8	
7.2 Share the class materials through FB/school website/any supplementary web site before/after the class, so students can access the resources anytime and anywhere, and encourage students' technology use (for higher grade only, 11-12) (Gulbahar, 2007; Interview with professor S)	3	2	2	4	4	3	0.89	0.6	
Principle 8. Participatory approach with digital content	-	-	3	-	4	3.5	0.50	1	
8.1 Give students individual/pair work relevant the digital content, and specific work guideline should be given to the students (Interview with teachers' trainer K, teachers' trainer A, teacher Z; Cha et al, 2018)	3	3	3	4	4	3.4	0.49	1	
8.2 Consider the time distribution for trying the participatory approach with digital content, when the class time is very short (around 35mins) (Class observation; Interview with teacher N)	3	3	3	1	4	2.8	0.98	0.8	
Principle 9. Interaction based on the digital content	-	-	3	-	4	3.5	0.50	1	
9.1 Try various types of feedbacks and reactions for facilitating interaction, besides questioning and answering. Teachers' actions can support children's learning and extend children's activities through 'offering ideas, know-how, and wisdom (Park et al., 1997; Tse-Kian, 2003; Dong & Newman, 2018)	4	3	3	4	4	3.6	0.49	1	
9.2 Try various types of interaction not only between teacher and learners, but also between individual learners and learners and content (Wang & Woo, 2007; Chou, 2003; Moore, 1989).	4	3	3	4	4	3.6	0.49	1	

9.3 Make a space for student to ask a question to teachers during the class with digital content in order to require students to participate in the class. Utilize FAQ (Frequently Asked Question), sometimes teachers should pause the presentation and show the questions on the slides (Interview with teacher trainer K; Lim, 1999; Class observation)	4	3	3	4	4	3.6	0.49	1
Principle 10. Attracting students with digital content	-	-	3	-	4	3.5	0.50	1
10.1 Use the enjoyable examples and reflect the context of Bangladesh for attracting students (UNESCO, 2015; Lim, 1999; interview with teacher S, teacher Z)	3	3	3	4	4	3.4	0.49	1
10.2 Use trigger animation by the change of color or arrow to show the clue for the contents (Lim, 1999)	3	2	3	4	4	3.2	0.75	0.8
Principle 11. Integration of the digital content with other materials	-	-	3	-	4	3.5	0.50	1
11.1 Use other relevant educational technologies in the form of low-cost, high-impact, mass-delivery technologies such as TV, radio, and printed text, as well as conventional materials such as whiteboard and textbook, instruments, blocks, map, globe, newspaper and other subject specific materials together with digital content (Lim, 2001; Jhurree, 2005; Interview with teachers' trainer A; 1st internal validity test)	3	4	3	3	4	3.4	0.49	1
11.2 Ensure that different media are properly synchronized with one another. For example, transition between one to another material during the class should be smoothly going on throughout the class, when various materials are included in the one class (Lim, 2001; Newby et al., 2000).	3	3	2	4	4	3.2	0.75	0.8
11.3 Remember that digital content should NOT be a main component of the class. Digital content should be used as a supplementary material, for facilitating the student-centered approach, not a technology-centered approach (interview with teachers' educator; Mayer, 2002; Norman, 1993)	3	4	2	4	4	3.4	0.80	0.8
Principle 12. Organization of an appropriate environment for multimedia class	-	-	3	-	4	3.5	0.50	1
12.1 Set up the screen that is big enough considering the large number of students. Also, screen should not be replaced the whiteboard. Prepare the	3	4	3	4	4	3.6	0.49	1

separate and (if possible) movable screen (Class observation, Interview with teachers' trainer A)									
12.2 Turn off the light only the frontside when showing the slide. It is not always necessary to turn off all the light in the classroom (Class observation)	3	3	3	4	4	3.4	0.49	1	
12.3 Prepare the backup plan in case that technology does not work: Get prepared for any kind of technological disruption in the class (e.g., load shedding, technical trouble) (Kim, 2003; Chowdhury, 2019; Cha et al., 2018)	3	4	-	4	4	3.75	0.43	0.8	

3.3.2 Expert Comments from the Third Internal Validation

Category	Feedback
Reorganizing the components and principles	Principle 1 and 2 are not clearly divided (Digital content vs digital materials) (expert B)
	(Principle 5) are you considering the number of students only? What about the characteristics of students or condition of classroom? (Expert C)
	(Principle 5) this category needs to consider not only the number of students but also characteristics of students, contents, learning outcome, teaching and learning methods, classroom environments etc. Does this guideline include all these factors? (Expert D)
	The component 4 and 5 are not well divided (expert B)
	The component 5 and component 2, 3 are similar each other, and it is not appropriately placed (expert C)
	(Principle 7) this principle indicates the sharing learning materials before and after, so this could be beyond the "preparation of the learners for the multimedia class". It needs to include the "factors facilitating the successful learning in the multimedia classroom" (expert C).
	(Specific Guideline 2.1) this guideline should be included the "strategy to select the digital materials" in order to link to the principle 2 (expert C)
	(Specific Guideline 11.3) Can this guideline (digital content should be used as a supplementary material) be included under the principle 11? (Expert C)
	Please review once again the linkage between principles and the guideline (expert E)
Specifying the	(Specific Guideline 5.1 and 6.1) What do you mean by "control" and "your class"? the meaning is not clear (expert B)

wording	(Principle 4) Does this “community” means “teacher community”? not a learning community? (Component 2) the word “lesson plan” does not look appropriate in this component (expert C)
	(Principle 8) Does this “participatory approach” mean the “student-centered learning/active learning”? (Expert C) (Principle 9) Interaction can be occurred in a various form, but do you mean in this principle the “interaction among students” or just “communication”? if these principles indicate the “facilitating the communication among people”, what is the different from principle 8? the “participatory approach” can also elicit the active communication (expert C)
	(Specific Guideline 2.1) “selection of the digital content” and the “identify specific areas in the curriculum where technology can work” has different meaning each other. More correct expression is required (expert D)
	(Specific Guideline 3.2) It is not clear how to refer the official syllabus and curriculum for using various resources (expert D) (Specific Guideline 6.1) this is of course very valid, but the sentence needs to be more clear (expert D)
	(Consistency of the sentence) “principle” normally uses the “verb” (for example, “integrate” the digital content and other materials) or use the “noun” (for example, the principle of integration) (expert E)
Adding more specific guideline	(Principle 10) it would be better to have more specific guideline that increase the motivation (expert C)
	(Specific Guideline 1.2) There are more factors to be considered and many factors are not included under the principle 1 (expert D)
	(Specific Guideline 3.1) This guideline seems that the PPT is the only way to use digital content. There are many media and program to use digital content such as simulation, interaction, gamification and drill and practice etc. and it would be helpful for teacher to mention all these media and programs (expert D)
	(Specific Guideline 5.3) Regarding the screen design, there are more factors to be considered, as well as font size (expert D)
Necessity of principles and specific guideline in the context of Bangladesh	There are more general and universal principles and do not reflect the context of developing countries like Bangladesh. More scrupulous investigation needs to be conducted in terms of curriculum, physical environment and characteristics of teachers and learner (Expert C)

4. The Revised Instructional Design Principles based on the Result of the Internal Validation

Component		Principles		Specific guideline	
1	Selection of the digital content for the lesson	1	Confirming the available resource	1.1	Check the most possible digital content in your class environment. See if electricity, internet access and sound systems etc. are properly working in your class before deciding to use the digital content. (Feedback from the 2nd Validity; Yildiz & Usluel, 2016; Wang & Woo; 2007)
				1.2	Check your technical know-how toward the available resources or on how to improvise a new technology/media in line with teaching objectives (Olayinka et al., 2018).
				1.3	Find the most appropriate digital content suitable for the large number of students and their grade (Yildiz & Usluel, 2016; feedback from 1st validity)
		2	Linking the ICT materials to your learning outcome	2.1	Find out the most suitable ICT materials for the learning outcome, and identify specific areas during the class where technology can work (Newby et al., 2000; Yildiz & Usluel, 2016; Ertmer, 1999; Wang, 2008; Interview with teachers' trainer K, teacher R, Professor T; feedback from 3rd validity test)
				2.2	Develop a vision of how to use technology to achieve important educational goals. Then, when new issues, problems, or opportunities arise, the vision will keep you focused on what is central to our technology efforts (Ertmer, 1999).
				2.3	Justify that the rationale for using the technology is sound. See why this technology is needed for the topic, and how the technology can support the instructional process (Wang & Woo, 2007)
2	Preparation of the lesson plans with the digital content	3	Use of various resources and activities relevant to the curriculum	3.1	Utilize various open sources such as YouTube, Khan Academy, UNESCO toolkit etc., besides/beyond downloading PPT slides from the Shikkhok Batayon (Interviewed with teachers' trainers A, teacher Sh)

				3.2	Consider more various activities such as simulation, gamification, maker education etc. as well as presenting the PPT (Feedback from expert D in the 3rd validation test)
				3.3	Make sure that your digital content is appropriately linking the official syllabus and curriculum when preparing the class with the digital content (Interview with teacher trainer K).
		4	Building a learning community with expert teacher	4.1	Talk to other teachers, teachers' trainers and other experts in ICT at the same grade level, or in the same content area, to share ideas about how and when to use technology (Ertmer, 1999)
				4.2	Require support and feedback from other experts such as academic computing specialist, your colleagues, family members, even advanced students, when you have difficulties with preparing digital content. Networking with other teachers, researchers, teachers' trainers etc. have a positive impact on teachers' professional development on using ICT in education (Khan, 2014; Shohel & Power, 2010; Lee, 2012; Gulbahar, 2007; Jhurree, 2005; Ertmer, 1999)
		5	Organizing an appropriate environment for multimedia class	5.1	Set up the screen that is big enough considering the large number of students. Font size and pictures should be visible enough and understandable from every corner of the class. (Class observation, Interview with teachers' trainer A)
				5.2	Do not replace the whiteboard with screen. Prepare the separate and (if possible) movable screen (Class observation, Interview with teachers' trainer A)
				5.3	Turn off the light only the frontside when showing the slide. It is not always necessary to turn off all the light in the classroom (Class observation)
				5.4	Prepare the backup plan in case that technology does not work: Get prepared for any kind of technological disruption in the class (e.g., load shedding, technical trouble) (Kim, 2003; Chowdhury, 2019; Cha et al., 2018)

3	Preparation of the learners for the multimedia class	6	Provision of guideline to the learner before starting the class with digital content	6.1	Give a short guideline to students at the beginning of the class about how they participate with digital content throughout the class. For example, class rules and culture during the multimedia class can be established by teacher (Mayer, 2002; Merrill, 2002; Sarfo, 2007; Ertmer, 1999). Also, guidance needs to be delivered for students to share the computer with two or three students together if your class are conducted in the computer classroom with limited number of computers (Wang & Woo, 2007).
				6.2	Guide students with some complicated terms or important context beforehand if your digital content have some information that is not included in the textbook. For example, teachers can distribute the handout materials in advance for the practice questions (Class observation; Wang & Woo, 2007; Mayer, 2002)
4	Utilization of the digital content during the class	7	Attracting students with digital content	7.1	Use the enjoyable examples and reflect the context of Bangladesh for attracting students (UNESCO, 2015; Lim, 1999; interview with teacher S, teacher Z)
				7.2	Use trigger animation by the change of color or arrow to show the clue for the contents (Lim, 1999)
		8	Facilitating participatory approach with digital content	8.1	Give students individual/pair work, and specific work guideline should be given to the students (Interview with teachers' trainer K, teachers' trainer A, teacher Z; Cha et al, 2018)
				8.2	Try various types of feedbacks and reactions for facilitating interaction, besides questioning and answering. Teachers' actions can support children's learning and extend children's activities through 'offering ideas, know-how, and wisdom (Park et al., 1997; Tse-Kian, 2003; Dong & Newman, 2018)
				8.3	Try various types of interaction not only between teacher and learners, but also between individual learners (Wang & Woo, 2007; Chou, 2003). Although there are large number of students crammed in the one classroom, teachers should give a space to interact among students.

				8.4	Make a space for student to ask a question to teachers during the class in order to require students to participate in the class. Utilize FAQ (Frequently Asked Question), sometimes teachers should pause the presentation and show the questions on the slides (Interview with teacher trainer K; Lim, 1999; Class observation)
		9	Integration of the digital content with other materials	9.1	Use other relevant educational technologies in the form of low-cost, high-impact, mass-delivery technologies such as TV, radio, and printed text, as well as conventional materials such as whiteboard and textbook, instruments, blocks, map, globe, newspaper and other subject specific materials together with digital content (Lim, 2001; Jhurree, 2005; Interview with teachers' trainer A; 1st internal validity test)
				9.2	Ensure that different media are properly synchronized with one another. For example, transition between one to another material during the class should be smoothly going on throughout the class, when various materials are included in the one class (Lim, 2001; Newby et al., 2000).
5	Reflection	10	Sharing the class materials after class with the students	10.1	Share the class materials through Face Book/school website/any supplementary web site after the class, so students can access the resources anytime and anywhere, and encourage students' technology use (for higher grade only, 11-12) (Gulbahar, 2007; Interview with professor S)

5. Results of the Usability Test

5.1 Strength of the Principles resulted from the Usability Test

Category	Principles and Specific Guidelines	Specific Guideline
Teachers' preparation	Principle 2: Linking the ICT materials to your learning outcome	<i>specific guideline 2.1:</i> Find out the most suitable ICT materials for the learning outcome, and identify specific areas during the class where technology can work
		<i>specific guideline 2.2:</i> Develop a vision of how to use technology to achieve important educational goals. Then, when new issues, problems, or opportunities arise, the vision will keep you focused on what is central to our technology efforts
		<i>specific guideline 2.3:</i> Justify that the rationale for using the technology is sound. See why this technology is needed for the topic, and how the technology can support the instructional process
	Principle 3: Use of various resources and activities that are relevant to the curriculum	<i>specific guideline 3.1:</i> Utilize various open sources such as YouTube, Khan Academy, UNESCO toolkit etc., besides/beyond downloading PPT slides from the Shikkok Batayon
		<i>specific guideline 3.2:</i> Consider more various activities such as simulation, gamification, maker education etc. as well as presenting the PPT
		<i>specific guideline 3.3:</i> Make sure that your digital content is appropriately linking the official syllabus and curriculum when preparing the class with the digital content
Students' participation	Principle 7: Attracting students with digital content	<i>specific guideline 7.1:</i> Use the enjoyable examples and reflect the context of Bangladesh for attracting students
		<i>specific guideline 7.2:</i> Use trigger animation by the change of color or arrow to show the clue for the contents
	Principle 10: Sharing the class materials after class with the students	<i>specific guideline 10.1:</i> Share the class materials through Face Book/school website/any supplementary web site after the class, so students can access the resources anytime and anywhere, and encourage students' technology use

Utilization of digital content as a supplementary tool	Principle 9: Integration of the digital content with other materials	specific guideline 9.1: Use other relevant educational technologies in the form of low-cost, high-impact, mass-delivery technologies such as TV, radio, and printed text, as well as conventional materials such as whiteboard and textbook, instruments, blocks, map, globe, newspaper and other subject specific materials together with digital content
		specific guideline 9.2: Ensure that different media are properly synchronized with one another. For example, transition between one to another material during the class should be smoothly going on throughout the class, when various materials are included in the one class
Consideration of Bangladeshi Context	Principle 1: Confirming the available resource	specific guideline 1.1: Check the most possible digital content in your class environment. See if electricity, internet access and sound systems etc. are properly working in your class before deciding to use the digital content
		specific guideline 1.2: Check your technical know-how toward the available resources or on how to improvise a new technology/media in line with teaching objectives
		specific guideline 1.3: Find the most appropriate digital content suitable for the large number of students and their grade
	Principle 4: Building a learning community with expert teacher	specific guideline 4.1: Talk to other teachers, teachers' trainers and other experts in ICT at the same grade level, or in the same content area, to share ideas about how and when to use technology
		specific guideline 4.2: Require support and feedback from other experts such as academic computing specialist, your colleagues, family members, even advanced students, when you have difficulties with preparing digital content. Networking with other teachers, researchers, teachers' trainers etc. have a positive impact on teachers' professional development on using ICT in education
	Principle 5: Organizing an appropriate environment for multimedia class	specific guideline 5.4: Prepare the backup plan in case that technology does not work: Get prepared for any kind of technological disruption in the class (e.g., load shedding, technical trouble)

5.2 Weakness of the Principles resulted from the Usability Test

Category	Principles	Specific Guideline
Inapplicable principles in the current educational system of Bangladesh	Principle 5: Organizing an appropriate environment for multimedia class	specific guideline 5.1: Set up the screen that is big enough considering the large number of students. Font size and pictures should be visible enough and understandable from every corner of the class.
		specific guideline 5.2: Do not replace the whiteboard with screen. Prepare the separate and (if possible) movable screen 5.3
		specific guideline 5.3: Turn off the light only the frontside when showing the slide. It is not always necessary to turn off all the light in the classroom
Replaceable principles with more appropriate guidelines	Principle 6: Provision of guideline to the learner before starting the class with digital content	specific guideline 6.1: Give a short guideline to students in the beginning of the class about how they participate with digital content throughout the class. For example, class rules and culture during the multimedia class can be established by teacher. Also, guidance needs to be delivered for students to share the computer with two or three students together if your class are conducted in the computer classroom with limited number of computers
		specific guideline 6.2: Guide students with some complicated terms or important context beforehand if your digital content has some information that is not included in the textbook. For example, teachers can distribute the handout materials in advance for the practice questions
	Principle 8: Facilitating participatory approach with digital content	specific Guideline 8.1: Give students individual/pair work, and specific work guideline should be given to the students
		specific guideline 8.2: Try various types of feedbacks and reactions for facilitating interaction, besides questioning and answering. Teachers' actions can support children's learning and extend children's activities through 'offering ideas, know-how, and wisdom
		specific guideline 8.3: Try various types of interaction not only between teacher and learners, but also between individual learners. Although there are large number of students crammed in the one classroom, teachers should give a space to interact among students.
		specific Guideline 8.4: Make a space for student to ask a question to teachers during the class in order to require students to participate in the class. Utilize FAQ (Frequently Asked Question), sometimes teachers should pause the presentation and show the questions on the slides

6. Final Instructional Design Principles and Specific Guidelines

Component		Principles		Specific Guidelines	
1	Selection of the digital content for the lesson	1	Confirming the available resources	1.1	Check the most possible digital content in your class environment. See if electricity, internet access and sound systems etc. are properly working in your class before deciding to use the digital content.
				1.2	Check your technical knowledge of the available resources or on how to improvise a new technology/media in line with teaching objectives
				1.3	Find the most appropriate digital content suitable to handle the large number of students
		2	Linking the ICT materials to the learning outcome	2.1	Plan when and which specific areas during the class you are going to use ICT materials in order to achieve the learning outcome
				2.2	Justify that the rationale for using the technology is sound. See why this technology is needed for the topic, and how the technology can support the instructional process.
2	Preparation of the lesson plans with the digital content	3	Use of various resources and activities relevant to the curriculum	3.1	Utilize various open sources such as YouTube, UNESCO toolkit etc. for preparing the multimedia class
				3.2	Try more various activities such as simulation and gamification as well as presenting the PPT
				3.3	Make sure that your digital content is appropriately linking the official syllabus and curriculum when preparing the class with the digital content
		4	Building a learning community with expert teachers	4.1	Talk to other teachers, teachers' trainers and other experts in ICT at the same grade level, or in the same content area, to share ideas about how and when to use technology
				4.2	Have a teacher community to give a motivation each other to use ICT in education

		5	Organizing an appropriate environment for multimedia class	5.1	Set up the environment considering the large number of students. Font size and pictures should be clearly visible and understandable from every corner of the class	
				5.2	Plan for the specific time distribution to use the digital content.	
				5.3	Prepare the backup plan in case that technology does not work: Get prepared for any kind of technological disruption in the class (e.g., load shedding, technical trouble)	
3	Preparation of the learners for the multimedia class	6	Provision of guideline to the learner	6.1	Give a guideline to students at the beginning of the academic year about how they participate with digital content throughout the class. For example, class rules and culture during the multimedia class can be established by teacher	
		7	Attracting students with digital content	7.1	Use the enjoyable examples and reflect the context of Bangladesh for attracting students	
				7.2	Use trigger animation by the change of color or arrow to show the clue for the contents	
4	Utilization of the digital content for the class	8	Responsive pedagogy with digital content	8.1	Try various types of feedbacks and reactions for facilitating interaction through ICT. Teachers' actions can support children's learning and extend children's activities through 'offering ideas, know-how, and wisdom	
				8.2	Try various types of interaction not only between teacher and learners, but also between individual learners through ICT	
		9	Integration of the digital content with other materials	9.1	Combine with other relevant educational technologies such as low-cost, high-impact, mass-delivery approach as well as printed text together with digital content challenges	
				9.2	Ensure that different media are properly synchronized with one another. For example, transition between one to another material during the class should be smoothly going on throughout the class, when various materials are included in the one class	
5	Utilization of the digital content by students	10	Provision of opportunity for students to use ICT materials	10.1	Share the class materials with students before/after the class, so that students can access the resources anytime and anywhere. For example, teachers can distribute the softcopy of the class materials via google classroom, Facebook group or school website before the class	
				10.2	Encouraging students to use technology for an assignment or project.	

7. Lesson Plan for the Usability Test

Date	2021.	Grade	Class 9	Instructor	-	
Subject	English for Today	Time	45mins	Topic	Pastimes	
Learning Objective	1. To be able to explain my and friends' pastimes in English 2. To be able to participate in conversation, discussions and debates in English 3. To be able to write my hobbies and pastimes in English.					
Activity	Description for Teaching and Learning Activity			Time	Materials	Note
Greetings	Warmer (Book closed)			1mins	-	
Introduction of Learning objectives and activities	[Explaining about learning objectives and activities] [Drawing attention] Teachers briefly explain today's class			3mins	-	Specific Guideline 6.1: Give a short guideline to students in the beginning of the class about how they participate with digital content throughout the class.
-	[Start to use Digital content] Teacher shows some pictures related to pastimes and ask students questions. - What are the persons doing here? - When do they do these kinds of activities?			4mins	PPT slides/ pictures	Specific Guideline 7.1: Use the enjoyable examples and reflect the context of Bangladesh for attracting students Specific Guideline 7.2: Use trigger animation by the change of color or arrow to show the clue for the contents
Activity 1	[Teachers' lecture about pastime] - why people need to have pastime? - what is my pastime?			3mins	PPT slides	

	<p>- what is the most popular pastime in Bangladesh?</p> <p>[Reading out together] – using textbook</p> <p>‘Tiya and Anusha’s conversation’ at p.15 in the textbook</p> <p>1) teachers ask two students stand up and take a role in the dialogue 2) two students are reading out the text (silent reading) 3) teacher explains some grammar and expression for example, - You look () - Regularly (sometimes, often, rarely etc.) - I like (ing), I like to () - Would you please?</p>	10mins	Textbook only	<p>Specific Guideline 9.1: Use other relevant educational technologies in the form of low-cost, high-impact, mass-delivery technologies such as TV, radio, and printed text, as well as conventional materials such as whiteboard and textbook, instruments, blocks, map, globe, newspaper and other subject specific materials together with digital content</p> <p>Specific Guideline 9.2: Ensure that different media are properly synchronized with one another.</p> <p>* (if possible) teachers distribute the handout materials in advance for the practice questions or for explaining something that are not included in the textbook (or make it digital file and share with students after the class)</p>
	<p>[Group work - What is your hobby?]</p> <p>1) Ask students to make a group with classmate seating nearby (4-6 students in a group)</p> <p>2) Students are talking about pastime with their pair (2-3 students are talking, the other 2-3 students are writing down the dialogue)</p> <p>*Conversation can be based on the ‘Tiya and Anusha’s</p>	5mins for conversation	-	<p>Specific Guideline 8.1: Give students individual/pair work, and specific work guideline should be given to the students</p>

	conversation' at p.15 in the textbook			
	<p>[Presenting about pastime of my group member]</p> <p>One person in each group makes a presentation about what they have talked about and answered the following questions</p> <p>1) why does she/he like something (hobbies, pastime) 2) what else my group member like to do in pastime? 3) How they started their pastimes? (How to learn, where to learn etc.)</p> <p>*Not only teachers, but also classmate can correct mistake of grammar/expression etc. *Teachers should give students chance to participate in the correction</p> <p>(The questions are based on the questions at p.16 in the textbook)</p>	12 mins	-	<p>Specific Guideline 8.2: Try various types of feedbacks and reactions for facilitating interaction, besides questioning and answering.</p> <p>Specific Guideline 8.3: try various types of interaction not only between teacher and learners, but also between individual learners.</p>
Q&A	<p>[Q&A]</p> <p>Teachers give sometimes for questions by pausing the PPT</p>			Specific Guideline 8.4: Make a space for student to ask a question to teachers during the class in order to require students to participate in the class.
Activity 2 (HW)	<p>[Homework – reading the text]</p> <p>- Read the Text (G) (p.18)</p>		Textbook/ hand out materials	

	- Write about your own pastime by developing a dialogue between two persons talking about their pastimes			
[After the class] Sharing the materials	[Sharing the class materials after class with the students]	-		Specific Guideline 10.1: Share the class materials through Facebook/school website/any supplementary web site after the class, so students can access the resources anytime and anywhere, and encourage students' technology use

8. Class Observation Checklist

Date of Observation:

Class time:

Section A: Information

1. Name of the school:
2. Name of the teacher:
3. Teaching experience/ ICT experience:
4. Class Subject:
5. Year:
6. Number of students in the class: (female)/ (male)
7. Number of students in school
8. Number of multimedia projector in the school

Section B: Facility and ICT components in classroom

- a) Multimedia Projector
- b) Black/Whiteboard
- c) Smart board
- d) Teachers' own laptop
- e) ICT materials for students
- f) Others:

Opinion:

Section C: Teachers' strategies and Method

- a) Lecturing
- b) Discussion
- c) Small group work
- d) Question and answer
- e) Showing Video/Picture
- f) Examples
- g) Others:

Section D: Teaching and Learning with digital content

- a) What did teacher prepare for digital content?
- b) How teachers interact with students?
- c) Ratio of using PPT during the lecture
- d) Relation between PPT slides and lesson
- e) How learners react?
- f) Teachers' voice?
- g) How teachers attract students to actively participate in the class?
- h) Does teacher do the Group work?
- i) How does teacher assess/evaluate the class?
- j) What should be done to improve the class with digital content?

Opinion:

9. Field Research Photos



10. IRB

심의결과 통보서

수신

연구책임자	이름: 황운정	소속: 교육학과 글로벌교육협력	직위: 박사과정
지원기관	해당없음		

과제정보

승인번호	IRB No. 1909/003-012		
연구과제명	방글라데시 중등교육에서의 ICT 활용을 위한 교수설계모형 탐색		
연구종류	학위 논문 연구, 참여관찰, 면담(FGI 포함), 공개된 정보를 이용하는 연구		
심의종류	지속		
심의일자	2020-10-27		
심의대상	연구결과관리양식, 재심의 답변서		
심의결과	승인		
승인일자	2020-10-27	승인유효기간	2021-09-21
정기보고주기	12개월		
심의의견	<ol style="list-style-type: none"> 1. 심의결과 제출하신 연구계획에 대해 승인합니다. 2. 연구자께서는 승인된 문서를 사용하여 연구를 진행하시기 바라며, 만일 연구진행 과정에서 계획상에 변경사항(연구자 변경, 연구내용 변경 등)이 발생할 경우 본 위원회에 변경신청을 하여 승인 받은 후 연구를 진행하여 주십시오. 3. 유효기간 내 연구가 끝났을 경우 종료 보고서를 제출하여야 하며, 승인유효기간 이후에도 연구를 계속하고자 할 경우, 2021-08-22까지 지속심의를 받도록 하여 주십시오. 		
검토의견	계획서 검토의견		
	동의서 검토의견		
	기타 검토의견		

2020년 10월 27일

서울대학교 생명윤리위원회 위원장



국문초록

방글라데시 중등학교 맥락에서의 ICT 활용을 위한 교수설계원리 개발연구

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2000년대 초반부터 ICT의 교육적활용에 대한 효과성 및 중요성이 주목을 받으면서, 개발도상국을 대상으로 한 다양한 ICT 활용교육 관련 ODA 사업 및 연구들이 활발히 이루어지고 있다. 본 연구의 사례국가인 방글라데시 또한 “Digital Bangladesh” 라는 정책 아젠다를 기반으로 ICT를 교육에 적극 도입시키고 학생들의 적극적인 참여와 양질의 교육을 강조하고 있다. 하지만, ICT의 교육적활용에 대한 다양한 논의가 이루어지고 있음에도 불구하고, 교사가 ICT를 효율적으로 활용하고 있지 못하는 문제는 여전히 해결되지 않고 있다. 특히 지금까지 개도국에서의 ICT 활용교육에 대한 논의는 ICT의 역할 및 그 중요성 자체에만 초점이 맞춰져 왔으며, 실제 ICT를 활용하게 될 교사들을 위한 실천적인 교수설계 및 교수법에 대한 논의는 거의 이루어지지 않았다. 방글라데시의 경우에도 정부는 교사의 디지털콘텐츠 활용을 위한 교사연수에 많은 노력을 기울이고 있지만, 대부분의 교사들은 PPT를 활용하여 내용을 전달하는 교사 주도적인 수업방식

을 사용하고 있다.

이러한 배경하에 본 연구에서는 방글라데시의 중등교육의 맥락을 반영하여 ICT 활용수업을 위한 교수설계원리를 개발하고자 하였다. 이를 위해 “개발연구방법”을 적용하였으며, 연구는 다음과 같은 절차로 수행되었다. 먼저 현지연구와 문헌연구를 기반으로 하여 1차 교수설계원리를 개발하고, 초기설계원리의 타당성을 검증하기 위해 방글라데시교육, 국제개발협력 전문가, 교육공학 전문가를 대상으로 총 3차례에 걸쳐 전문가타당화 검토를 실시하였다. 이후 전문가타당화 검토의 결과를 반영하여 수정된 설계원리에 대한 사용성평가를 실시하였다. 사용성평가는 현재 코로나사태로 인하여 방글라데시 학교에 방문할 수 없는 점을 감안하여 줌회의를 통해 방글라데시 중등 교사들을 대상으로 수정된 설계원리와 상세지침들이 실제 방글라데시 교실에 적용가능한지에 대해 심층면담을 실시하였다.

사용성평가 결과 개발된 설계원리의 강점, 약점, 개선점을 확인할 수 있었다. 대체로 대부분의 설계원리는 ICT 활용교육을 위해 실제 방글라데시 교육현장에 활용가능한 유용한 원리들임을 확인하였으나, “멀티미디어 수업을 위한 적절한 환경 조성,” “디지털콘텐츠 수업 전 학습자 가이드라인 제공,” “디지털 콘텐츠를 활용한 학생들의 참여적 수업 촉진”의 원리들은 방글라데시의 맥락을 반영하여 추가 개선이 필요하고, 일부 상세지침들은 적용하기 어렵다는 점을 확인하였다.

이러한 사용성평가에서 도출된 교사들의 피드백을 반영하여 결과적으로 총 5개의 구성요소, 10개의 설계원리, 그리고 22개의 상세지침을 포함한 최종 교수설계원리를 개발하였다. 최종 설계원리는 크게 “ICT를 활용한 수업을 계획하기 위한 교사의 준비”와 관련한

원리들 (설계원리 1-5번)과, “ICT를 활용한 교수학습활동” 과 관련한 원리들 (설계원리 6-10)로 구성되었다. 또한 (1) ICT 선도교사들의 역할을 활용하는 것과 (2) 학생들이 ICT를 학습에 활용할 수 있도록 기회를 제공하는 것이 개발도상국의 맥락에서 교수설계원리를 개발하는 과정에서 고려해야 할 특징적인 요소로 도출되었다.

마지막으로 본 연구의 결과를 기반으로 교육공학 및 교육개발협력의 두 가지 측면에서 개발도상국 맥락에서의 교수설계원리를 개발하고 적용하는 것에 대한 의미와 중요성에 대해 논의하였다. 첫째, 교육공학 측면의 논의에서는 방글라데시 교사들의 ICT 활용역량 강화를 목표로 하는 교수설계원리를 개발하기 위해서는 해당 국가의 맥락적 이해가 가장 중요하며, 교실환경 및 교사연수체제 등과 관련한 독특한 특징들이 설계원리에 잘 드러나도록 반영할 수 있어야 한다. 또한 방글라데시에서 개발된 설계원리를 적용하기 위해서는 (1) ICT 교사연수 시스템이 선도교사를 중심으로 한 교사공동체를 활용할 수 있는 더욱 유연하고 협력적인 연수 체제가 가능하도록 변화해야 하며, (2) 개도국에서의 “ICT in education” 이라는 개념이 학생들의 ICT활용도 포함할 수 있는 방향으로 더욱 확장되어야 한다. 둘째, 교육개발협력 측면의 논의에서는 ICT 활용교육에 있어 테크놀로지 자체 보다 교사의 페다고지에 더욱 중점을 두어야 할 것을 강조하였다. 이를 설명하기 위하여 현재 방글라데시에서 ICT활용교육에 필요한 실질적인 지침의 부족으로 인해 발생하는 멀티미디어 교실 구축 정책과 실행의 구조적 간극을 비판하고, 개도국에서 ICT를 교육에 효과적으로 활용하기 위해서는 교사들의 실질적인 역량개발을 위한 실천적이고 적용가능한 교수설계원리가 제공되어야 함을 주장하였다.

주제어: 방글라데시, 교수체제설계, 교육공학, 개발도상국, 교육정보화
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