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Abstract- Information and communication technologies (ICT) have become everyday entities in all spheres of life. ICT has fundamentally changed the pedagogy in education lend itself to more student-centred learning phenomena; hereafter, digital content, an ubiquitous part of ICT, is becoming more and more important. The purpose of the present paper is to examine the relationship between the use of digital content and students' performance and to give complementary explanations regarding causes and effects of using digital content in secondary education especially in biology subject. This study followed mixed method design including qualitative and quantitative data. The result of the study revealed that student's performance is mainly explained by student's characteristics, educational environment and teachers' characteristics and digital content have a concrete impact on these determining factors and consequently the outcome of education. The adoption of ICT equipment and use rates is relatively slow and differs from one institution to another. Henceforth, use of computer supportive instructional material need a change in the organisation of secondary education.

Descriptors: digital content, cause, effect, biology subject, secondary level of education, mixed method.

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Cause and Effect of using Digital Content in Biology Subject at Grade IX-X in Dhaka City

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Abstract- Information and communication technologies (ICT) have become everyday entities in all spheres of life. ICT has fundamentally changed the pedagogy in education lend itself to more student-centred learning phenomena; hereafter, digital content, an ubiquitous part of ICT, is becoming more and more important. The purpose of the present paper is to examine the relationship between the use of digital content and students' performance and to give complementary explanations regarding causes and effects of using digital content in secondary education especially in biology subject. This study followed mixed method design including qualitative and quantitative data. The result of the study revealed that student's performance is mainly explained by student's characteristics, educational environment and teachers' characteristics and digital content have a concrete impact on these determining factors and consequently the outcome of education. The adoption of ICT equipment and use rates is relatively slow and differs from one institution to another. Henceforth, use of computer supportive instructional material need a change in the organisation of secondary education. Government or PPP or school authority can take benign initiative to provide low-cost laptop, multimedia projector. Furthermore, continuous in-servicing training should be provided among teachers to ensure digitalized classroom and effective teaching-learning process.

Descriptors: digital content, cause, effect, biology subject, secondary level of education, mixed method.

I. Background and Rationale of the Study

Information and Communication Technology (ICT) placed one of the most prominent parts in the modern education. The mission of the school has changed rapidly from only information dissemination to form educational environment for the teaching content to be perceivable and learnable. To create digital content and to develop modern teaching and learning services is the part and parcel of education strategies. However, for effective insight of such strategy, it is necessary to know under what circumstances digital content can be effectively used and so on. On the other hand, it is not pivotal to move all teaching/learning content into digital milieus. Quite often what is taught at school is not interesting, even is boring, dead. Thus, there is a need to pedagogical improvement in certain knowledge sphere to overcome the scenario. Then again, information communication technologies highly influence students' everyday life. Effective application and usage of new technologies in education practice are at the core of attention of internal and external stakeholders of education. One of such ways is digitalization of education. Digital resources can make teaching-learning process more interesting, more effective. Various research works carried out in foreign countries prove the effectiveness of digital teaching content. It is affirmed that digital content develops the abilities of corporation (Bennett, Sandore, Miller, 2001), strengthens motivation, being interested in general, develops thinking abilities (Miyata, Ishigami, 2007). In general, digital content application in teaching-learning process together with other technologies strengthens and deepens learners' understanding (Dani, Koenig, 2008).

The vital aspect of such transition is to recognize the inter-relation between traditional teaching content and digital content. Digital teaching-learning infrastructure, teaching-learning process, program plan can play effective role to achieve better results , however, inclusion of digital content into education process is prioritization of endless continuation of computer supportive learning. Teachers' views and perceptions can play effective role to move forward to technology supported educational arena. Nevertheless, it is not right to refer only to research works carried out in other countries. It is necessary to assess the context of the country, to accomplish representative evaluations in the population of Bangladeshi students and teachers. As such, we are motivated to analyze the need of digital content in Biology teaching-learning process as well as to justify the improvement of educational process after such adoption. Even so, it is matter of great challenge to manage infrastructure as well as adopt effective pedagogy to turn monotonous classroom into pleasant one through proper match between traditional classroom and technology based modern classroom.

II. Literature Review

Today, the use of digital content-based education is getting more popular in many areas of learning and training as it stimulates new ways in information delivery with the concerns of accessibility, reusability and individualization to fulfil the needs for

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different types of learners, but not just limited to conventional teaching and learning methods (Haque, Raihan& Clement, 2016).Basically, digital content refers all types of content like audios, videos, virtual text; eBooks etc. exists in the form of digital data in a digital storage system. So, it is easily used in the purpose of education in this digital age.

One of the most vital contributions of digital content in the field of education is- easy access to learning. With the help of ICT, students can now browse through e-books, sample examination papers, previous year papers etc. and can also have an easy access to resource persons, mentors, experts, researchers, professionals, and peers-all over the world.

ICT provides opportunities to access digital content based information using multiple information resources and viewing information from multiple perspectives, thus fostering the authenticity of learning environments. Digital content may also make complex processes easier to understand through simulations that, again, contribute to authentic learning environments. Thus, digital content may function as a facilitator of active learning and higher-order thinking (Alexander, 1999; Jonassen, 1999). The use of digital content may foster co-operative learning and reflection about the content (Susman, 1998). Furthermore, digital content may serve as a tool, providing opportunities for adapting the learning content and tasks to the needs and capabilities of each individual pupil and by providing tailored feedback (Mooij, 1999; Smeets & Mooij, 2001). As Stoddart and Niederhauser (1993) point out, digital content may fit into a spectrum of instructional approaches, varying from traditional to innovative. Digital content can help deepen students' content knowledge, engage them in constructing their own knowledge, and support the development of complex thinking skills (Webb & Cox, 2004).

Viewing the previous studies is important for providing scientific facts which serve this study. A number of researchers are dealing with this field. Some of the most important studies are presented here for understanding the glimpse about this topic.

Haque, Raihan& Clement (2016) conducted a study namely 'Compare the Effectiveness of Digital Content Teaching and Traditional Teaching to Academic Achievement: Reference to the Selected Technical School and College in Bangladesh'. In their study, the statistical data analysis result proved that digital content teaching is more effective to learning higher level of learning skills like comprehension level, application level than the traditional teaching. In knowledge level digital content teaching and traditional teaching are similarly effective to academic achievement.

Jena (2013) study result reveals that smart class learning environment is better to teach both low achievers and high achievers than traditional class.

Beach, R. (2012) found relatively high levels of students' engagement through their uses of digital tools for the social purposes of accessing, sharing, communicating, and reflecting on knowledge as part of a shared learning commons.

Similarly, Lamanauskas, Slekiene, Raguliene & Bilbokaite (2011) study results' asserted that digital teaching/learning content is a perspective way searching to improve education process.

A study namely 'Innovative teaching: Using multimedia in a problem-based learning environment' conducted by Neo & Neo (2001). The purpose of that project was to access the students' skills in framing and solving problems using multimedia technologies. Results showed that the students were very positive toward the project, enjoyed teamwork, able to think critically and became active participants in their learning process.

Hong et al. (2001) conducted a study which aimed at finding out the impact of multimedia software on students' academic achievement. The results showed that statistically-significant differences between the average marks of the experimental group students' achievement and that of the control group in favour of the experimental group (as cited in Aloraini, 2012). In the same way Beichner (1994) study's found out that the multimedia have a positive effect on the knowledge and emotions of the students who study scientific subjects.

Abu Yunus (2005) conducted a study entitled as "The effectiveness of multimedia software to teach Geometry in the school grade of pre-paratoryschools" aimed at identifying to what extent multimedia software helps in the academic achievement of the preparatory school students in the subject geometry and its remembrance. The results of this experimental study showed significant statistical differences in the average of academic achievement of the experimental and control groups in the test conducted after the experimental in favour of experimental group. Likewise, Alorani (2012) study showed that the multimedia has effective use compared to the traditional methods of teaching.

In the other way, Menon (2015) study analyzes the effectiveness of smart classroom teaching on the achievement in chemistry of secondary school students. The results revealed that students achieved higher when taught in smart classes as compared to conventional mode of instruction. Learning styles of students did not affect their achievement in experimental and control group.

Youssef, A. B. & Dahmani, M. (2008) in their study entitled "The Impact of ICT on Student Performance in Higher Education: Direct Effects, Indirect Effects and Organisational Change" showed that ICT whereas digital content also included has an edit effect in terms of quality of student work and practical examples through visualisation, allowed students to

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learn independently, which has enabled more work to be completed, enhanced achievement due to the reinforcement and practice, encourages independent learning and individual preferences for process, layout, style and format.

III. Research Objectives

Current research is limited to cause and the almost immediate and after impact of the incorporation of digital content in Biology subject. The following research objectives were designed to expand existing research concerning use of digital content in the biology subject to:

- find out the causes of using digital content in the Biology subject;
- trace out the effects of using digital content in the Biology subject;
- identify the challenges of using digital content in the Biology subject.

IV. Methodology

The research framework led us methodologically to design a mixed method according to research objectives where qualitative and quantitative data were collected to compile the whole picture.

Data source, sample size, sampling process and research tools

For accomplishing the study, data were collected from eight purposively selected secondary science teachers (Biology teachers) and 150+ randomly selected students from grade IX-X science students who had taken biology subject. Total six secondary schools were chosen through convenient sampling process from the Dhaka city where three schools were government and three were private schools. Data was collected as per the instruction of the school authority. The participants were not required to write their names on the questionnaire. As the nature of this study was mixed method, so it demanded to collect both qualitative and quantitative data at a time. Thus findings from the research are based on semi-structured interview schedule for teachers and semi-structured questionnaires for students to ensure valid and quality data as well as to find the complete picture about the research field.

V. Analysis and Discussion of the Findings

This segment discusses findings of research objectives under three sub-sections wherein detailed analysis and discussion was carried out.

a) To find out the causes of using DC in the biology subject

Biology is a science of life and living matter defined by organisms, rudimentary chemistry of life, biological molecules, plants, building-block of all life, the cell, functions of tissues, organs, diversity of life etc. Naturally, students struggle to visualize the complexity of these processes and their interrelation is often difficult for the student to understand. For example, RNA transcription involves RNA polymerase, but RNA polymerase itself is complex to understand. A major challenge to biology educators is to teach these processes to students to comprehend and understand. Because of this challenge, teachers are looking for new approaches such as visualization to enhance student learning of biological processes instead of only lecture in the class room or reading text books.

On the other hand, digital learning tool namely digital content expresses topics lively which contains digital photo, videos, audios, animation etc. and displays any ideas/thoughts visually popularly known as power point presented through projectors. According to $Student_1$, *"Digital content is an ICT based thing by which many analog or theoretical contents can be showed much effectively and precisely through digital equipment."* and $Student_2$ utters a digital content means text, pictures or information in a digital form which is visually representable. $Teacher_1$ says, digital content may be extended from slides to online contents ensuring linkage with information gateway to form multimedia based blended classroom or to make resources available beyond time and space. It enhances quality of teaching-learning process in all subjects especially science and technology at all levels of education.

From our collected data it is revealed that several causes make the use of digital content in Biology subject as essential. Among the reasons, greater attention and engagement, easier presentation of complex content are more dominating (Figure-1).

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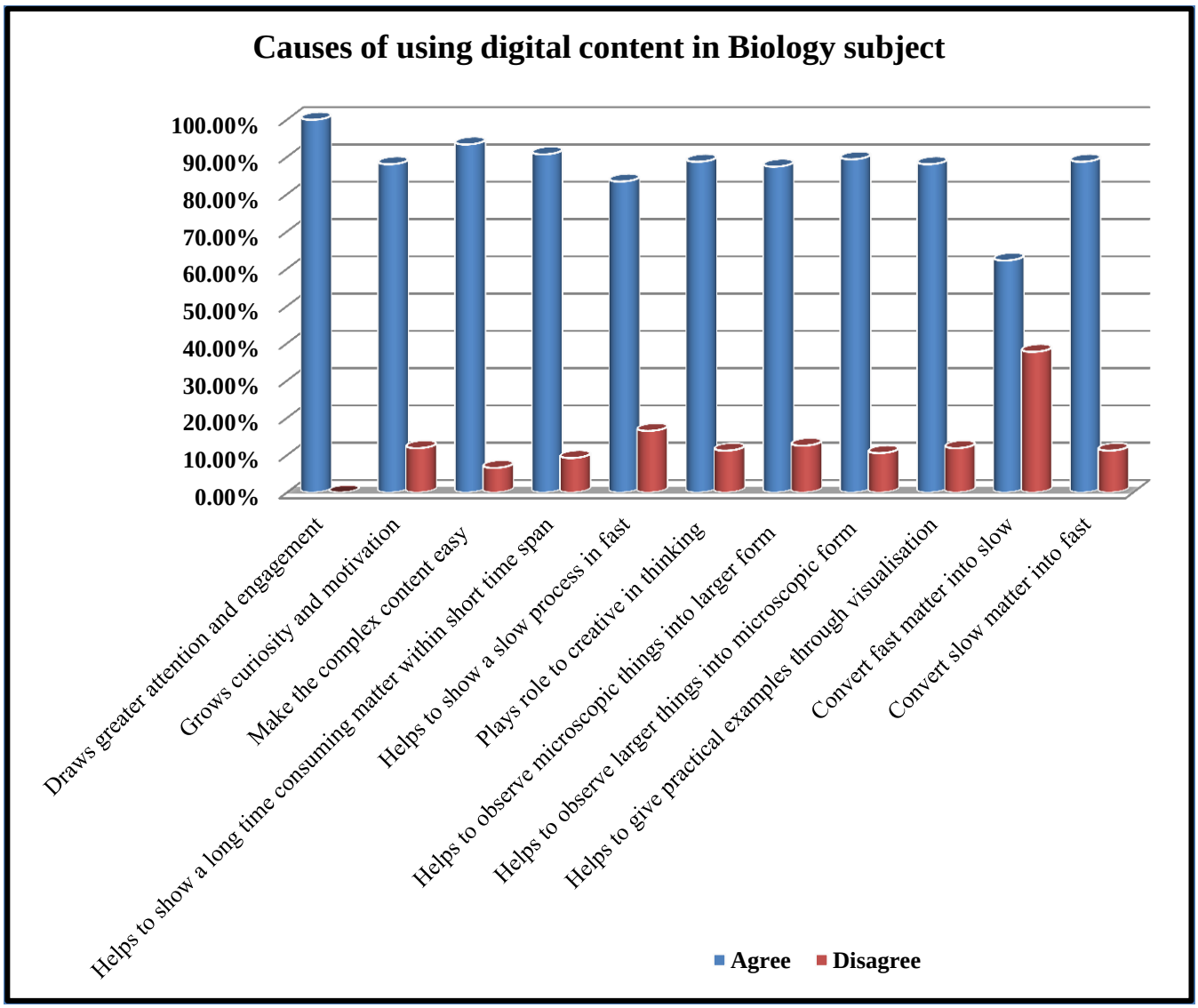


Figure-1: Students' opinions about the causes of using digital content in Biology subject

Moreover, students of digital age use digital content for multiple causes. As, there are some limitations in school at biology class, so maximum students who have digital technological equipment like personal computer, laptop, tab, smart phone etc. use biology related various digital content. Most of the students mentioned that they get advantages by using digital content personally at outside classroom in terms of: improvement of skills, easier visualization of invisible thinks, to comprehend in a short time by themselves.

According to Student$_3$, *"In our country we do very little in practically, but if we can use digital content in our studies it will help to realize the facts of every experiment."*

Furthermore, Student$_4$ denotes that-

"Our biology textbook has many complex things that are written in short and information is not sufficient, it may confuse me sometimes but using digital content transforms clear idea about concepts as well as transforms understanding to application, hence make the learning easily plausible, enjoyable and everlasting."

Interestingly it can be said a video is more effective than reading a topic. It seems to them as the supplementary of biology lab. Henceforth, source of learning has been diversified, rather than only dependency on books.

When teachers were inquired in their interview session that what the reasons behind the usage of digital content in their biology class. In response, they mentioned some remarkable causes that are: instructional materials can be used repeatedly by making once that reduces wastage of time which leads them to teach freely and effectively. Some topics in biology subject are so critical that it takes longer time to teach and sometimes tends to impossible for students

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to effectively realize, in contrary, digital content shapes complex topics into easily understandable format through using multimedia such an imperative manner that students become curious to learn more and more, inherit their latent talent.

Teacher$_2$ is so exultant about using digital content by mentioning *"It is quite impossible to teach biology subject without touch of digital content in modern age. It is obviously crucial need for biology subject compare to other subjects."* Some teachers also claimed that usage of digital content in biology class makes controlled classroom in turn makes the assessment system efficient and effective.

Teachers along with students solemnly feel that digital content is vital for easier illustration of various biological topics. We have collected their opinion about wherein digital content crucially needed and categorize their responses into chapter wise (Table – 1).

Table-1: Topics where digital content is more important according to students' and teachers' view

Chapter no.	Chapter name	Content/Topics
1	Lesson of life	Branches of biology, Classification of plant kingdom, Classification of animal kingdom, System of Binomial Nomenclature.
2	Cell and Tissue of Organism	Various types of cells, Plant tissues, Animal tissues.
3	Cell Division	Parts of flower, Works and parts of trees, Cell divide.
4	Bioenergetics	Blooming of flowers, Photosynthesis, Respiration
5	Food, Nutrition and Digestion	Living style and food receiving process, nutrition produce and acquiring process, Nutrition, Digestive system.
6	Transport in Organisms	Blood, Blood circulation Hormones, WBC, RBC, platelets, Process of transpiration.
7	Exchange of Gases	Respiration system, Structure and function of lungs.
8	Human Excretion	Structure and functions of kidney, Structure and functions of nephron.
9	Firmness and Locomotion	Human skeleton, Bone, cartilage and bone joint, Tendon and ligament.
10	Co-ordination Process in Animal	Co-ordination system in plants, Co-ordination system in animals, Structure and functions of a neuron, Nervous system, Hormone and gland.
11	Reproduction	Reproduction in organism, Life cycle of flowering plants, Embryonic growth and development.
12	Heredity in Organisms and Evolution	DNA replication, Theory of evolution.
13	Environment around Life	Ecosystem, Food chain and food web, Bio-diversity.
14	Biotechnology	Bio technology, Preparation of DNA or GMO, Steps of tissue culture, Genetic engineering.

b) To trace out the effects of using DC in the biology subject

Teachers show central tendency to explain the effects of digital content in biology subject. They are highly agreed that digital content helps to develop conceptualization through avoiding memorizing as well as uplifting thinking level of students that increases realization among students; in a nutshell, It makes learning outcome fruitful and longer which is reflected in case of evaluation. In addition, it develops confidence among students to answer against creative questions.

Students also coincide with the opinions of teachers regarding effect of digital content in biology subject. Digital content influences the students so vividly that they are interested to understand the ins and outs of topics rather cramming. Through segregation / modularization of pictures/figures they get the flavour of hands-on activity at biology laboratory. Due to visibility improvement, their confidence level reaches to peak to think creatively, to be spontaneous to solve many things as well as to achieve expected grade in the examination. In this regard student$_5$ positively says-

"Digital content helps us to apprehend difficult parts of biology when I see some video related to biology which keeps a permanent place in my mind. I never forget it. So I write it in examination promptly with resilience."

Digital content has changed the paradigm of teaching-learning process along with views and perceptions of teachers and students. To clarify the cause and effectiveness of using digital content, respondent teachers and students categorized the biology class' changing scenario as follows:

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Table-2: Comparison between biology class with and without digital content

Biology class without digital content	Biology class with digital content
Conventional: Text , Poster presentation/Chart/Board etc.	Digitalized presentation: Combination of audio, video, image, animation etc. along with text.
Students are sometimes passive, thus lower rate involvement and engagement of them.	Higher rate of students' involvement and engagement.
Lecture based class presentation.	Elaborate explanation in graphical mode.
Typical and marks oriented.	Interesting and knowledge oriented.
Need imagination in some cases.	Effective visualization in most cases.
Emphasis on memorizing.	Easier to show trivial matter.
Class room dependency.	Anytime, anywhere learning.
Tendency to read books more and more.	Deviation from reading text books.
Monotonous in some cases.	Lively in maximum cases.
Laboratory related tasks are overlooked due to lack of infrastructure.	Laboratory related tasks are taught through digitalized simulation.
Rigid, teacher dependent.	Flexible, self-assisted and teacher facilitated.

c) To identify challenges of using digital content in the Biology subject

Bangladesh is moving forward towards technology based classroom. Transition is really crucial in context of expertise, infrastructure, and mind-set. Expertise of teacher is highly needed to use digital content aptly. It is really tough for teacher to match the hurdles of small time duration and large class size. Teachers have heavy class load and in a tremendous pressure to complete the syllabus. So, the above contradictory situations make them puzzled whether they should go for digital content or not. Still most of schools are not equipped with digital content because of financial constraints. Electricity crisis and negative comments from colleagues (who are not interested to use digital content) sometimes bind them to stop. However, access to digital content still not convenient for all students due to unavailability of digital content supported device. Figure-2 shows that 88.74% students pointed out that lack of technological infrastructure is the most noticeable obstacle of using digital content in biology subject. As well, Lack of skilled & trained teachers also a big hinder of using digital content.

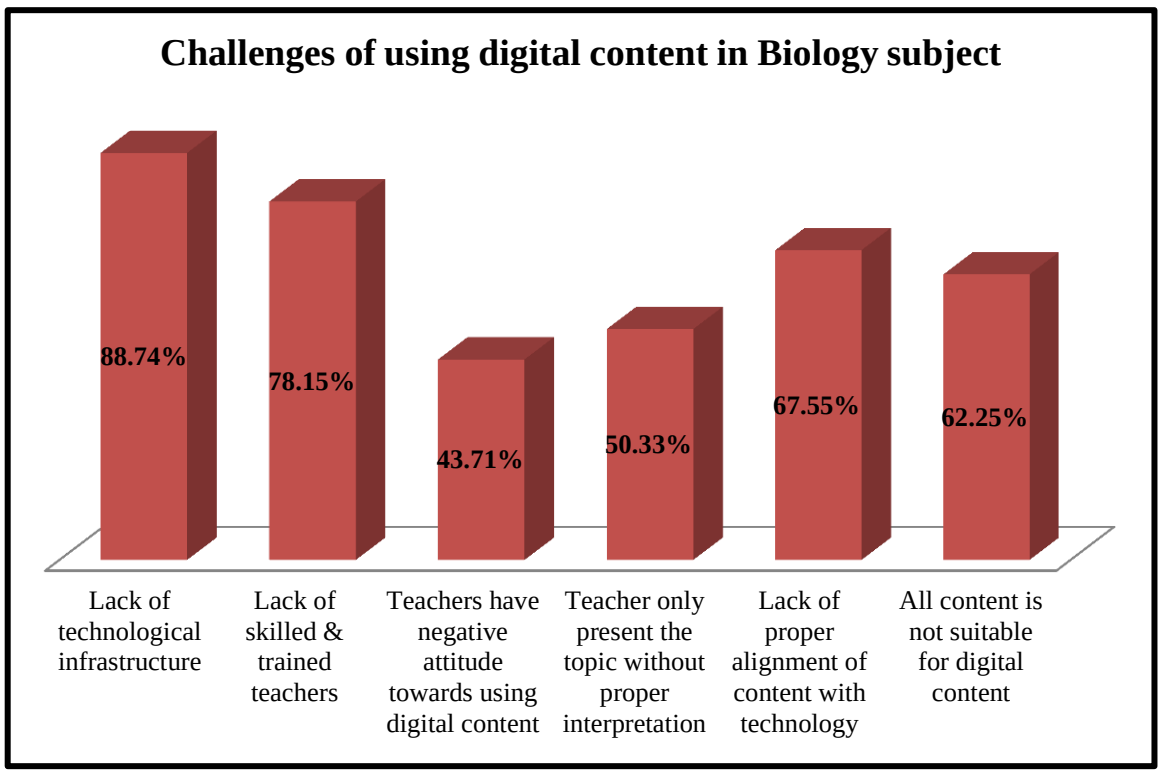


Figure-2: Students' perception about challenges of using digital content in Biology subject

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VI. Recommendation and Conclusion

In-service training can change the mentality as well as expertise of teachers. Training should be sound enough so that can find the scope in which topic they can use digital content because it is vital to ensure the best inter-relation between traditional teaching content/ tasks and digital content. Continuity of in-service training can make the teachers upgraded in accordance with the latest innovation of technology.

Government or PPP (Public-Private Partnership) or school authority can take benevolent initiative to provide low-cost laptop like 'Doel Laptop' to each teacher. Education can only change the nation. So, corporate houses may extend their helping hand through Corporate Social Responsibilities (CSR) by providing multimedia projectors to schools to ensure digitalized classroom and effective teaching-learning process.

The researcher tend to be suggested to conduct further study on comparing between effectiveness of digital content and traditional content/materials; to conduct study on cause and effect of using digital content in various subjects at other grade in a large scale.

Beyond doubt that by integrating digital content into the biology teaching and learning process enable students to equip with greater visualization, critical thinking, problem-solving skills and to experience on digital mediated learning situation, hence, lead to student-centered learning approach. At the same time, the role of the teacher drives from the "sage on the stage" to a "guide on the side" providing students with assistance and facilitation to explore a subject area instead of imparting knowledge through lecture.

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