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Learning Achievement and Satisfaction in Online versus Face-to-Face Mathematics Classes: Primary Education in Bangladesh Perspective

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Abstract

Both online and offline classroom environments, there are inequalities between academic performance and sanctification. The purpose of the study was to examine the extent to which online learning influence students' academic achievement as compared to face-to-face mode in the context of primary education in Bangladesh. This study followed an explanatory mixed-method design where quantitative data was obtained by quasi-experimental design and qualitative data by semi-structured interviews. 12 teachers and 40 students of Grade- IV from JAAGO Foundation Online school of Bangladesh were treated as samples of the study. The results of the two-tailed T-test illustrate traditional face-to-face classroom learning as the more effective and qualitative study demonstrated the satisfactory level of online mathematics learning as an average. Colorful learning materials, content visualization, animated shows about mathematics, video storytelling of practicing arithmetic in real life, and some shortcomings, such as communication gaps, lack of effective evaluation, feedback, topic knowledge, and plagiarism practice, were among the qualitative findings. This research illustrates which platforms assist students in improving their academic performance and increasing teachers' satisfaction. However, students' satisfaction with online learning and how this satisfaction affects academic achievement could be the subject of future research.

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INTRODUCTION

The utilization of Information Technology (IT) has been fostered expeditiously these days. People are using computers and the internet as a new media of communication which has significantly changed many facets of society, specifically affecting the learning system of students. The demand for web-based teaching-learning is flourishing due to the accessibility and expansive nature of technology and this is how online learning has been developed faster (Parsad and Lewis, 2008). Online learning refers to the learning that partakes partially or wholly over the internet (U.S. Department of Education, 2010) which also permits learners the flexibility of learning regardless of time and place constraints (Chaney, 2001). Online courses were getting used since the early to mid-1990s (Kentnor, 2015) and now online education has been implicated to a significant extend regardless of the subject, area, and stages of education (Ch and Popuri, 2013). According to Karnal et al. (2015), online mathematics classes are affecting by different factors, for instance, content delivery, online pedagogy, materials, and so on. Lee (2014) added online mathematics education is affected by several factors where "human factor" and "design factor" are most prominent. In this study, along with factors that affect satisfaction, the researchers focused on comparing learning impact which may, at any rate, be comparable to learning face-to-face learning.

Online achievements are being a breakthrough over the years and could be bench-marked than the traditional whereas the rubrics needed to be set by teachers very carefully (Cassandra, 2019). Education in developing countries experiences huge challenges in many aspects (Evans, 2005; Gronlund, Andersson, and Hedstrom, 2005). One of the challenges is that online education has established and benefiting learners in all stages of education in many developed countries (Al-Omari, 2009; Halse and Mallinson, 2009; Komba, 2009) as a complement to traditional education but very few are reported in developing countries. Nevertheless, the effectiveness of online learning varies among age groups. Especially for younger ones, an organized structure is required, because children are more easily distracted. To acquire the maximum advantage of online learning, there needs to be a deliberate effort to provide sustainable configuration through video capabilities, rather, utilizing the effort of collaboration tools by going beyond recreating a physical class or lecture (Li, and Lalani, 2020).

Different students have different learning styles. The prominent educational theory of Maslow's learning theory is considered for exploring the learning experiences in online learning. Maslow (1943) believed that individuals like students are all motivated by specific needs which refer to psychological, security, social, self-esteem, and self-actualization needs respectively. In an online learning environment, students must access basic resources such as appropriate software, learning materials, computer with internet access to achieve the next step of Maslow's hierarchy which refers to feel secure and safe in a flexible learning environment. After that, students and teachers require to establish a friendly relationship, and thus, a sense of strong self-confidence will assist learners to achieve the ultimate goal. The ultimate goal is to take responsibility for students' self-learning through online education. If the instructor uses various strategies and learning materials and guides students to connect with enormous resources, students can get a better sense of self and fulfilment of their individual needs. Therefore, it is worth exploring the comparison of learning achievement and satisfaction in an online versus a traditional face-to-face mathematics class in primary education of Bangladesh.

Understanding the difference in learning impact and satisfaction on online vs face-to-face education is important because a majority of the educators are suspicious about the impact of online education in terms of Bangladesh. To mention, the total number of Internet Subscribers has reached to 106.41 Million (mobile internet 97.84 million and fixed line

8.57 million) at the end of July 2020 (http://www.btrc.gov.bd). However, still there is limited scope of executing online education because of low throughput, improper interaction between teachers and students, traditional monotonous teaching methods (Grönlund., and Islam, 2010). Perhaps, due to these concerns and unavailability of intermittent internet access in rural areas, online learning is yet viewed as an inferior form of education, specifically in the learning of a computational skill like Mathematics. Online learning is a tempting field of research in many countries on which the studies illustrate whether student's academic achievement in online learning is better or worse than in face-to-face education (Allen et al., 2002; Bernard et al., 2004; Cavanaugh, 2001). It is reported that students' academic achievement in online learning can be as good as that in face-to-face learning while some studies (Shachar and Neumann 2003; Machtmes and Asher, 2000). However, there is very little literature available regarding online learning in primary education in the context of Bangladesh. This study focuses on comparing the learning impact of Mathematics classes both in online and face-to-face settings. The study, moreover, attempts to explore the factors that exist in satisfaction and dissatisfaction with online mathematics teaching-learning. Thus, the findings of the study will provide a guideline to the students, teachers, and policymakers regarding the scope and drawback of online education in the context of Bangladesh.

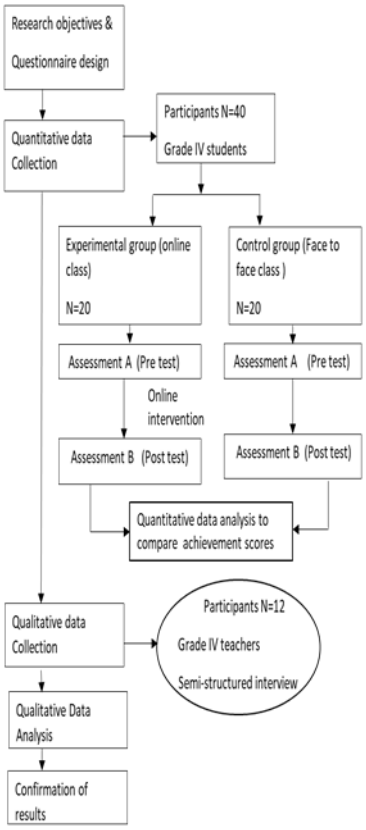
The Purpose of the study was to explore the impact of online vs on-campus Mathematics learning of primary school students of Bangladesh. To achieve the purpose of this study, the following sub-questions guided this research-

1. How academic achievement of students differs in face-to-face v/s online classes?
2. What factors exist in satisfaction and dissatisfaction with online mathematics teaching-learning?

METHODS

Study design

In this study, an explanatory mixed-method design was conducted where quantitative and qualitative data were collected sequentially. For quantitative design, a non-randomized pre-test post-test control group type quasi-experimental design was adopted in the first sequence to compare students' (N=40) learning impact in equivalent online and face-to-face Mathematics classes. Without disrupting classroom learning by creating artificial groups, the researchers assigned existing groups (online and offline) of classes to experimental and control groups. Next, a small qualitative design as a semi-structured interview of teachers (N=12) was followed up in the second phase to elaborate the quantitative results specifically to perceive factors that exist in satisfaction and dissatisfaction with online mathematics teaching-learning.



Sample

12 teachers and 40 students from Grade IV of JAAGO Foundation online schools were the sample of the study. The rationale behind selecting the school was that JAAGO Foundation is successfully running remotely-located online School branches for 13 years at the primary level (JAAGO Foundation, n.d). JAAGO Foundation School operates both face-to-face and online education for primary education. For this research, among 40 students, 20 students of Grade IV from face-to-face education were assigned to the control group and 20 students from online Grade IV were assigned to the experimental group in quasi-experiment conducted classes. Moreover, 12 teachers of Grade IV from online school were engaged for qualitative data collection. For selecting the grade and the teachers, a non-probability purposeful technique was used.

Instrument

An achievement test questionnaire of Mathematics for Grade IV students was constructed by the researchers to collect quantitative data for the study. The questionnaire was constructed and standardized by using Bloom's Taxonomy (1956). The questionnaire had 15 items constructed from the Mathematics curriculum of this Grade. The items include change of subject formulae, substitution in formulae, organizing and classifying numbers, using formulas, and solving word problems for evaluating students' learning achievement. The items were categorized from comprehension to evaluation levels of Bloom's taxonomy levels of the cognitive domain. The test questionnaire was validated by another two researchers from University of Dhaka and two primary school teachers of JAAGO Foundation Digital School. The instrument was then administered to the experimental and control group both in paper-based and online formats.

In the quantitative phase of the study, pre-test, and post design were administered in both control (N=20) and experimental group (N=20) to compare their achievement scores. However, a post-test was conducted after providing the online intervention for the experimental group (online group). The intervention and instrument were also fostered through Cisco WebEx platform to the experimental group. Both Mathematics teachers of the classes were equally experienced. In quasi-experiment conducted classes, for the experimental group (N=20), the teacher used online-based technology for teaching while another teacher used traditional methods for the control group (N=20). It was ensured that all the teachers used an equal length of time to teach the topics and evaluate through the questionnaire of both groups. The researchers also went around to supervise and ensured smooth teaching and execution of assessments in all classes. After obtaining the scores, both descriptive and statistical analyses were conducted using SPSS. Descriptive statistics as well as a two-tailed t-test was conducted to compare the groups. The null hypothesis was stated as "There will be no significant difference between face-to-face and online education on the impact of learning Mathematics". The result of this quantitative phase was analysed to compare the achievement scores for understanding the impact of learning in two modes.

To better understand the difference and factors exist in satisfaction and dissatisfaction with online mathematics teaching-learning, the second phase, the qualitative phase was conducted through individual semi-structured interviews of Grade IV mathematics teachers (N=12) of online school. The focus of the interview was to explore the attitude of the teachers towards the difference between online and on-campus learning of Mathematics and further understanding of different factors on the satisfaction and dissatisfaction of the learning impact. The data collection process was an individual semi-structured interview through online by developing a discussion theme based on research questions. The discussion theme remains the same for all participants and the answers were audio-recorded with participants' consent. In order to ensure an in-depth understanding of the topic, the questionnaire was a combined set of both open and close-

ended questions. After collecting the data, conceptualize analysis was adopted for data analysis as conceptual content analysis helps to quantify the number of times a word or text appears within texts (Christie, 2007). These interviews helped the researchers to elaborate on the relevant data. General Data Protection Regulations (GDPR) is followed to define and apply ethical considerations. The participants are informed about the purpose of the study and the dataset used in this research is completely anonymised.

RESULTS AND DISCUSSION

Quantitative component

An independent sample t-test was conducted to investigate the differences between the online intervention selected for the experimental group and face-to-face traditional mathematics teaching-learning for the control group. The two variables depicted here were students' scores as the dependent variable and learning method as the independent variable. The result (Table 1) showed that the control group have achieved better (M =-10.70, SD=7.45) score compared to the experimental group (M =-.95, SD=6.89) in terms of the intervened teaching-learning to a total number of 40 students at JAGGO foundation at same class on the same topic for this study.

Table 1. Group Statistics T-test

Group Statistics				
Group	N	Mean	Std. Deviation	Std. Error Mean
Control	20	10.7000	7.44877	1.66560
Experimental	20	-.9500	6.88610	1.53978

The result of the two-tailed t-test (Table 2) revealed that there was a significant difference between the achievement mean score of the control group and the experimental group. With regards to t-value (-4.298) and degrees of freedom (38), the p-value is .000 which is less than 0.05 (p=<.05). The test result confirmed that, at a 95% level of confidence interval, the Null hypothesis (There is no significant difference between the achievements score of control and experimental group) had been rejected. So, the alternative hypothesis had been accepted which indicated, there is a significant difference between the achievement mean score of control group and experimental group. Therefore, data based on descriptive statistics (Table 1) assured that traditional face-to-face classroom education is more effective than online mathematics education.

Table 2. Independent Sample t-test

Independent Samples Test					
	Levene's Test for Equality of Variances		t-test for Equality of Means		
	F	Sig.	t	df	Sig. (2-tailed)
Equal variances assumed	.003	.959	-4.298	38	.000
Equal variances not assumed			-4.298	37.768	.000

Qualitative component

In the semi-structured interview, participants were asked about their satisfaction and dissatisfaction with the learning achievement of their students and the possible factors behind this. Majority of the participants (N=9) considered online Mathematics learning as an average satisfactory level. And also, two participants described their satisfactory level as low while just one participant stated the satisfactory level as high. Moreover, through participants' interviews, some factors regarding their satisfaction and dissatisfaction are generated.

Areas of satisfaction and motivation in online learning in terms of Mathematics

The findings of the study refer to possible benefits such as

I. Colourful learning materials
II. Visualization of content

III. Animated show regarding Mathematics
IV. Video storytelling of performing math in real life

Majority of the teachers (N=11) expressed that demonstrating a variety of contents at a time including colourful learning materials and learning videos for teaching Mathematics is the most enchanting learning method than any other method. One interviewee stated,

"Students are taught with digital content. As a result, their knowledge of each topic becomes clearer."

Another most important point claimed by few participants (N=3) is introducing the technological device at an early age is a blessing. One interviewee commented,

"It brought education at home, students are being introduced to technology at an earlier age, globally connection at ease"

For students learning online is a matter of enthusiasm as there are more attractive content which are visual as well as digital. Teachers (N=10) perceived that online learning comes up with the opportunity to learn from anywhere and anytime so students can learn easily and motivate through varieties of content. Moreover, they can learn in their comfort zone and they can also reach towards global standard content with distance learning opportunities which are available online. Participating teachers (N=5) perceived that different types of learning materials namely educational cartoons, geometrical shapes, math learning videos, digital content can motivate these young learners. Regarding pedagogical aspects, the interviewees perceived that it is easy to manage classes online. Besides, quiz competitions, group work, playing games, drawing, and learning using the board can enhance the motivation for Mathematics learning through online. Some teachers (N=6) emphasized that, for mathematics, different approaches of online namely, availability of multiple learning resources, reflectiveness, and representation with the audio-visual graphics could make traditional mathematics learning more eye-catching and learner friendly. One participant mentioned,

"Basic terms should persuade with real-time objects. I also give homework to my students to prepare different geometrical shapes and show it to me the next day so that the students can touch and learn with motivation."

Area of dissatisfaction towards online versus face-to-face learning

Majority of the participants (N=10) stated that achievement scores in online mathematics are not up to the mark. In most cases, there are several negative factors such as

I. Communication gap,
II. Improper assessment,
III. Plagiarism,
IV. Lack scope of providing feedback and individual intervention,
V. Less understanding of content through online

All these factors result in poor scores in online Mathematics learning. The two participants who disagreed that the scores differ, one of them expressed his views as,

"I believe with appropriate efforts from both online and offline teachers the scores will not vary much"

From pedagogical point of view, teachers sometimes face lack of enthusiasm when they face, few scopes for eye contact, less scope of providing feedback, teaching large size classes online, lower attendance, unstructured exam system, lack of logistical and financial support, capability gap for technology use, especially for mathematics. One of the teachers claimed that,

"For online, it is very difficult to indicate example from surroundings and the scopes for enquiring of every student is less"

It is evident that sometimes a typical mindset towards online class also affects online learning. But one of the participating teachers mentioned,

"If the learning outcomes such as students' academic grade through online classes could be higher, this dissatisfaction then might be reduced."

Very few participants (N=2) stated the less scope of improving writing skills and handwriting as another barrier to online

education. Monitoring and assessment of Mathematics through online is a real challenge identified by all of the participants. One participant commented,

"As this is not possible to keep eye on every student through online, there is a chance of misleading the students. They may do unfair actions in the classroom."

In terms of online education, one fact mentioned by the participants is both as an advantage as well as disadvantage which is online education in rural areas. For rural areas, online education is a blessing as students who may not be able to attend classes on-campus, can easily attend online classes at a convenient time, and simultaneously, getting intermittent internet connection in rural areas is a real challenge which is a barrier for effective online learning.

"Our teaching-learning process disrupts intensely due to lack of high-speed internet and power outage in the rural area. Thus, we also experience struggle with class management."

Very few teachers (N=3) also mentioned a major fact and that is, due to exposure to technology sometimes students get derailed with these electronic devices.

Comparison of online and on-campus learning has no doubt been a tempting field of research in many contexts, as online education is being preferable to students for convenience and flexibility. However, the inquiry remains on how the delivery formats, online or offline impact students' performance and learning. Numerous studies report mixed outcomes. And our study introduces an approach in the context of primary education of Bangladesh by opening a discussion for further researchers to consider effective online learning in every stage of education. By comparing the learning impact of online and on-campus in terms of Mathematics, the study suggests that traditional on-campus learning is still more effective than online education in Bangladesh. Students still prefer studying mathematics in a group as well as in a participatory approach which is in a line with findings of Adhi Susanto et al (2021) & Dwi Resmi Novita Sari (2020) et al. The comparison result of scores illustrates a significant difference and a poor learning impact in the online mode of education. These findings contradict that of Alshahrani et al. (2017); Connolly et al. (2007) from UK and Qureshi, Ilyas, Yasmin, and Whitty, 2012) from Pakistan found online education more impactful than on-campus education. On the other hand, our findings are in a line with Visser et al (2002) suggested that students in the on-campus group performed significantly better than an online group.

This study will assist students in understanding whether offline or online learning is more advantageous for them. For mathematics learning, there is a diversity of learner types (Bosman and Schulze, 2018); this study will determine the ideal platform for increasing students' satisfaction and engagement. However, this study may provide a rationale behind the convenience of the learning platform for the students who are kinesthetic learners or learners who learn mathematics through motor and practical interaction.

This study also suggested some factors that exist in satisfaction and dissatisfaction with online mathematics teaching-learning such as lack of convincing teaching aids, improper teaching strategy, teacher-students relationship, less scope of direct eye contact, disruption of electricity and internet, improper monitoring, and assessment. The majority of the teachers perceived the need for improvement in the online teaching-learning process to compete with the impact of on-campus learning. In general, the teachers agreed that proper teaching strategy, monitoring, and assessment are the keys to improve the effectiveness of online learning. The study of Eom et al. (2006) from the USA; Khan et al. (2012) from Bangladesh also showed the same outcomes. Our study also shows that online classes in Bangladesh are challenged by issues like technological skills, environment, connectivity which is also supported by Lee (2014) who stated that, online education in math is affected by several factors where the design factor is most important.

In the context of Bangladesh, the government has already emphasized newer

teaching strategy including digital learning (Shirin, 2020). Thus, it can be high time to excel in the sphere of online learning in primary education in Bangladesh. The removal of factors that exists with dissatisfactions found from the study can make online education more effective. The implications of these findings unfold better understanding of online Mathematics learning and an attempt to engage teachers, policymakers, and stakeholders for further planning about digital education.

As with any study, some limitations of the study should be noted. The sample of the study is not necessarily representative of other courses and other teaching approaches or other school student populations. Additional research is required with a diversity of samples in a broader aspect. In addition, this study did not include any demographic factor and perspective of students, which can be valuable in future research. Finally, for selecting the participants, the study used a non-probability purposeful technique and therefore the findings should be not be treated as generalized.

This study represents the difference in academic achievements between online and face-to-face learning of primary education students. It shows lesser effectiveness in academic performances through online learning and at the same time by the satisfaction level of teachers it also depicts the way by which online learning can be more effective.

Therefore, the findings of the study demonstrate quite the current scenario of online learning at the primary education level of Bangladesh. As COVID-19 already showed us the extensive necessity of online education and after COVID world will also focus on online learning, the findings of this study can impact heavily the policymakers and stakeholders to initiate a learner-friendly online learning system with more effectiveness in academic performances. There can be different sorts of formative assessment, project assessment, quiz, and assignment assessment for more effectiveness in academic performances of primary level. Thus, some significant changes in the teaching delivery and assessment system can bring satisfactory academic performance at the primary education level.

As per time and budget constraints, the sample of this study was not sufficient for a greater conclusion. Further studies can be carried out on differences in learning achievement both in secondary level and higher education by also focusing on diversified subjects. Moreover, the researcher can also focus on the perception of students' satisfaction and dissatisfaction regarding online learning at a higher level.

CONCLUSION

This study provides a beginning point for larger-scale studies of the impact of online learning in the Bangladeshi education sector. By comparing achievement scores and teachers' perception in terms of satisfaction and dissatisfaction, it is possible both to assess the changing perspectives and to provide a guideline to teachers and policymakers on the changing needs and experiences of teachers and students. Furthermore, the result of the comparison also states the current status of online education, and the findings from the interview draw a clear picture of the factors that exist in satisfaction and dissatisfaction regarding this. Therefore, for effective learning outcomes and satisfaction through online education, t taking proper steps by the government along with educational institutions would be a milestone to adapt to this changing learning landscape.

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