**Research Paper**

# Effect of Blended Learning on Academic Achievement in Mathematics Among IX Grade Students

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## ABSTRACT

The present study investigates the academic achievement of IX grade students in mathematics by comparing blended learning instruction and traditional face-to-face instruction. Students of both genders constitute the population of this study. The sample has selected randomly from IX grade students of a school located in Amritsar. The study has been conducted with 65 participants, 33 for the experimental group and 32 for the control group. The experimental group has been taught using blended learning instruction and the control group by using traditional face-to-face instruction. In this experimental study, the same content has been taught in both groups simultaneously for 6 weeks. Achievement test in mathematics has been constructed according to the content taught in both groups. The finding of the study indicates a significant difference in the academic achievement of the experimental group than the control group.

I n the 21st century, today's students grow up with new technologies and are considered digital natives. They spend maximum time surrounded by and using computers, video games, digital music players, video cams, cell phones, and all the other toys and tools of the digital age. Computer games, email, the Internet, cell phones, and instant messaging are integral parts of their lives. The use of technology-based tools such as YouTube, Facebook, WhatsApp, Telegram, Wikipedia, and many more, which young people consider being a natural part of their world, is affecting not only the way they spend their leisure time but also the way they learn and work.

Education is one of the sectors that can be the most benefited from the current technological advancement. Thus, Instructors should not ignore new developments in Educational Technologies, which create rich learning environments. Also, instructors should include digital materials in their learning environments so that more sharing and accessibility will be possible with the Z-generation students, who have new skills and interests in different instructional materials. Under these circumstances, policymakers of schools' systems have to make a renovation to educate new generations (Prensky, 2001).

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The development and spread of Internet technologies accelerated the process in education, and in recent years, with the increasing number of schools and institutions giving education via the Internet, the concept of e-learning, online learning has entered our lives. The research literature describes the current situation of e-learning as a fast-developing field, with academic institutions offering more and more online courses, which are becoming increasingly popular among students (Njenga & Fourie, 2010). E-learning environments pave the way for instructional innovations for new generations and make individuals equipped with technological devices and software which provide a pervasive learning environment. Rich educational environments that contain mobile devices, web platforms, and instructional software initiate a new period in education using e-learning environments. (Horton, 2002).

E-learning is considered among the most modern learning methods and has been associated with many advantages. Among these advantages are its ability to resolve the problem of knowledge explosion and growing demand for education (Abadi, 2002); address the problem of overcrowded classrooms, if used as a means for distance learning; and provide opportunities for acceptance of diversity in education. E-learning has become a popular approach to effective learning within the wider academic community because of the extensive use of web systems in learning. There is a range of benefits of learning supported by technology, or e-learning. It is largely flexible, allowing learning to occur at a distance, at a time and pace appropriate to the needs of the students (Allan and Lawless, 2005; Kimathi and Zhang, 2019). The changes in science and technology bring many new teaching and learning methods, such as e-learning and blended learning particularly in research and self-development areas, and a revolution in information technology, which has virtually turned the world into a global village. The former led to a greater need for learners to engage in multivendor environments, and the latter, for people to share experiences with others (Owies, 2018).

Research findings have supported the use of technology in teaching, and the advantage educational institutions like universities and schools stand to gain from the use of technology and the internet (Bøe, 2018). This has promoted a shift from a teacher-centered approach to learning to a more student-centered one (Bøe, 2018). Despite all these rapid developments, face-to-face instruction has never lost its popularity. One of the reasons for this the student-teacher interaction achieved in face-to-face instruction cannot be achieved in e-learning applications. However, e-learning can have negative aspects such as technology dependence, lack of motivation, and lack of human touch. Such an interaction seems to be a must for permanent learning and the teacher's control over this activity. On the other hand, in face-to-face instruction, individualization has stayed in the background (Bonk and Graham, 2012). Moreover, similar to traditional face-to-face learning environments, there are several limitations of e-learning environments. This fact led to the idea of the Blended Learning approach, which brings two teaching approaches together correcting their deficiencies. Yılmaz & Orhan (2010) has stated that the best way to solve the lack of interaction problem faced in technology-based learning is to blend traditional learning and online learning. Laurillard (2002) has stated that technological tools should be used to a certain extent for learning and teaching to be more effective. However, he also emphasizes that information and technology tools along with multimedia tools cannot guarantee the complete success of teaching and learning.

Blended Learning is a combination of students' needs, technological feasibility, and a professional preference toward face-to-face instruction to provide a perfect environment that

combines the best features of face-to-face, videoconferencing, and online instruction. These media are designed to complement each other and promote learning processes (Khan, 2005). Garrison and Kanuka (2004) argued that Blended learning is a term that explains the various attempts made by teachers to incorporate the element of technology into the traditional classroom setting, because of the efficiency this arrangement brings. Blended learning aims at interactive learning, resulting in the blending or mixing of a teacher's role in a traditional classroom with that in the virtual one. Blended Learning can be defined as a delivery method that combines a variety of traditional and non-traditional instructional techniques, tools, and approaches to design, develop, manage and evaluate the learning process; and a blended program is one where between (30-79%) of the program content is delivered online (Allen, Seaman & Garrett, 2007). Thus, Blended Learning offers a 21st-century education program that balances the best of face-to-face instruction with the personalized potential of online learning. Blended Learning can provide a higher level of achievement for students and improved working conditions for teachers by using the best of both.

Mathematics as a subject has remained mysteriously difficult and unpopular for most students. This is even though no one is in doubt of its importance in almost all careers, especially in the science and technological fields. Many studies have found attitude to be one of the stumbling blocks for progress or otherwise in learning mathematics (Aiken, 1976). Most of the public schools' results indicate that the achievement tests in mathematics declining. Thus, the integration of traditional learning and e-learning is an urgent requirement to achieve returns of the learning process and blended learning.

Unless successfully planned and executed, blended learning could have disadvantages in technical aspects since it has a strong dependence on the technical resources or tools with which the blended learning experience is delivered. These tools need to be reliable, easy to use, and up to date, for them to have a meaningful impact on the learning experience or achievement.

Extensive studies have been conducted on blended learning and its impact on students' achievement in educational institutions such as schools and universities. Although the majority of research connected to blended learning has taken place in the post-secondary stage, such as universities, some studies have found that this approach is useful for school students. According to Chen and Jones (2007), a wide range of research studies have found that the blended learning approach has positive effects on student achievement in various school subjects, while other studies have indicated that there does not exist any significant achievement level of students due to blended learning. But a few studies have been conducted in mathematics at the school level.

Several studies have been conducted to use blended learning in teaching rather than traditional learning in educational institutions such as universities and schools(Ahmed, 2011; Al-Hasan, 2013; Ali, 2012; Almasaeid, 2014; Akbarov et al., 2018; Akkoyunlu and Soylu, 2008; AlQahtani, 2015; Bakeer, 2018; Bayram, et al., 2008, Boyle et al.,2003; Chang, et al.,2014, Ja'ashan, 2015; Khader, 2016; Lin, et al., 2016; Maccoun, 2016; Maguire, 2005; Mantei, 2000; Motteram, 2006; Okaz, 2015; Pereira et al.,2007; Shahin, 2008; Utami, 2018; Vernadakis et al., 2012; Yagci, 2016) confirmed that blended learning was found to be more effective than traditional learning in terms of students' grades and pass rates. On the other hand, studies such as Bailey, 2003; Balentyne and Varga, 2016; Bata-Jones and Avery, 2004; Kazu and Demirkol (2014), Rattanvijai and Sharma, 2003; Tosun (2015) and Wei et al. (2017) have found no significant effect through the use of

blended learning, finding no statistically significant differences between groups taught with blended learning techniques and traditional techniques. They, therefore, conclude that blended learning does not have a positive impact on students' achievement. The studies on the relationship between Blended Learning & Achievement in Mathematics have been negligible.

### *The aim of the study*
This study aims to identify the effect of blended learning on academic achievement in mathematics among XI grade students.

### *Research question*
This study has the following major question that led to identifying the impact of teaching mathematics using blended learning instruction on academic achievement:
What is the effect of blended learning on academic achievement in mathematics among IX grade students?
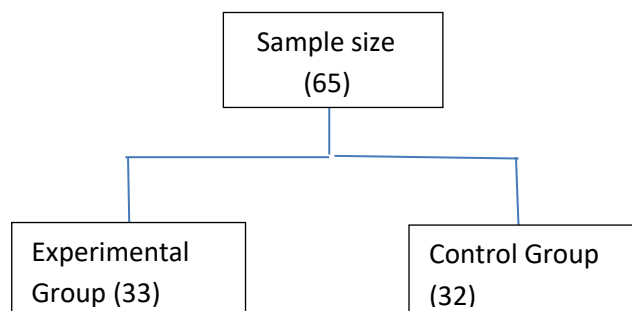
## METHODOLOGY
### *Sample*
In the present study, random sampling is used. Keeping in view the time factor and availability of IX grade mathematics students from the selected School of Amritsar city was selected.
The sample size is (65) students further divided into two groups:
- G1 – 33 students which is an experimental group
- G2 – 32 students which is a controlled group

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                    ┌─────────────────┐
                    │   Sample size   │
                    │      (65)       │
                    └─────────────────┘
                             │
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    ┌───────────────────┐        ┌───────────────────┐
    │   Experimental    │        │   Control Group   │
    │    Group (33)     │        │       (32)        │
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### *Tools*
Achievement Test in Mathematics: The investigator prepared the achievement test in mathematics which covered the topics of geometry from the NCERT syllabus for IX grade selected for this experiment.

The achievement test contained 30 objective-type test items. A draft of 50 test items was prepared out of which 30 test items were selected after analyzing the question items which include the difficulty index, discrimination index, reliability, and validity.

Blended Learning Lesson Plans: Blended Learning lesson plans have been prepared by the investigator of some topics of geometry from the NCERT book of mathematics for grade nine students. Blended learning lesson plans have been designed in multiple effects such as PPT, images, sounds, videos in the classroom as well as online content through LMS Google Classroom to send the classroom activities, content, videos, etc. which guide to attract students' concepts clarity of those topics of geometry.

### *Variables of the study*
Independent variables:
- Blended learning
- Traditional methods of teaching.

Dependent variables: Achievement of IX grade students in Mathematics measured by Achievement test prepared by the investigator.

### *Design of the Study*
The present study is experimental aims to study the effect of Blended Learning on Achievement in Mathematics of grade IX students was conducted in four phases as given below:
- **Phase – I:** It involved the development of Blended Learning lesson plans by the investigator. An Achievement test in Mathematics was also constructed by the investigator.
- **Phase - II:** It involved the formation of equivalent groups i.e., experimental and control groups (33 students in the Experimental group and 32 in the Control group) from a sample of 65 students of grade IX. A pre-test of Achievement in Mathematics was used to form the equivalent groups. The groups were matched on the variable of Achievement test scores in Mathematics.
- **Phase - III:** In this phase, the experimental group was taught through Blended Learning mode whereas the control group was taught through the traditional mode of instruction.
- **Phase - IV:** At this phase, administration of post-test of mathematics achievement to both the groups

### *Procedure*
The method of the study and collection of data in the present study employed the use of randomized sampling. Keeping in view the time factor and availability of students, one school in Amritsar city was selected for the present study. Sixty-five students were selected for the above research which was again divided into two equivalent groups based on pre-test scores of these students on the achievement test in mathematics which has been constructed by the investigator according to the content selected for the experiment. Out of these two groups, one group was taught through blended learning instructions and the other was taught by the Traditional Method. In this experimental study, the same content has been taught in both groups simultaneously for 4 weeks. Then after teaching the same topics of geometry in mathematics to the students of ninth grade, the post-test was administrated where the same achievement test was used to access the achievement of ninth-grade students in mathematics. Then the scores of pre-test and post-test were recorded for further analysis.

### *Statistical Techniques*
The data obtained were analyzed to know the normality and homogeneity. Finally, a t-test for independent samples was conducted. The aim behind this method is to detect the effect of teaching mathematics using blended learning instruction on achievement in mathematics among students of ninth grade by comparing it with the effect of the traditional teaching method of instruction.

## RESULTS AND INTERPRETATION

To find out whether there are statistically significant differences at the level (0.05) for the effect of teaching mathematics using blended learning instruction on achievement in mathematics among ninth-grade students compared to the traditional method of instruction, we start with calculating means and standard deviations for the performance in achievement test of the study subjects according to the group as shown in table (1).

*Table (1) Mean and Standard deviation for the performance in pre achievement test of mathematics by both the groups*

| Group | Number | Mean | Standard Deviation | Difference | Standard error | df | t-statistic | Level of Significance |
|---|---|---|---|---|---|---|---|---|
| G 1- Experimental Group | 33 | 13.030 | 5.833 | 0.060 | 1.465 | 63 | 0.041 | 0.05 |
| G 2 – Control Group | 32 | 12.969 | 6.063 | | | | | |

Based on the result of the table above, it can be interpreted that there was no significant difference between (at 0.05 level) the experimental group and control group scores as calculated value of t < table value of t. It states that the students in the experimental group and control group had similar levels of knowledge.

*Table (2) Mean and Standard deviation for the performance in achievement test in post-test of mathematics by each group*

| Group | Number | Mean | Standard Deviation | Difference | Standard error | df | t-statistic | Level of Significance |
|---|---|---|---|---|---|---|---|---|
| G1 - Experimental Group | 33 | 18.78 | 6.222 | 3.440 | 1.484 | 63 | 2.319 | 0.05 |
| G 2 – Control Group | 32 | 15.34 | 5.719 | | | | | |

Table-2 shows the existence of a difference between the means of the experimental and control groups in the post mathematics achievement test. To check for the significance of the differences, depending on the method of instruction, the t- value was calculated on the scores of the posttest to calculate the effect of the study variable, teaching methods. The statistically significant effect (t > 0.05) on the mathematics achievement posttest was attributable to the methods of instruction, in which the students in the experimental group (modified arithmetic mean = 18.78), who were taught using Blended Learning and the traditional method, performed better than their counterpart in the control group (modified mean = 15.34), who were taught using the traditional method only. The results demonstrated that the high performance of the experimental group could be attributed to the advantage of the blend of face-to-face and online learning in providing information. The advantages of face to face and online learning may have contributed to the better performance of the students in the experimental group who were taught using online LMS Google Classroom, video and content material designed to be attractive, interesting, and enjoyable for students and contains sight and sound features that far outweigh the rigid drawings in the book, thus making learning more fun. Online submission and return of assignment provided immediate feedback and encouragement. Thus, blended learning can also be attributed to the novelty in teaching mathematics concepts. The results of this study were consistent with those of Ahmed, 2011; Al-Hasan, 2013; Ali, 2012; Almasaeid, 2014; Akbarov et al., 2018;

Akkoyunlu and Soylu, 2008; AlQahtani, 2015; Bakeer, 2018; Bayram, et al., 2008, Boyle et al., 2003; Chang, et al., 2014, Ja'ashan, 2015; Khader, 2016; Lin, et al., 2016; Maccoun, 2016; Maguire, 2005; Mantei, 2000; Motteram, 2006; Okaz, 2015; Pereira et al., 2007; Shahin, 2008; Utami, 2018; Vernadakis et al., 2012; Yagci, 2016 ) study, which proved the effectiveness of blended learning on achievement.

Thus, the analysis shows that the scores achieved by the students who were taught in the traditional way scoring lower than the students who taught by blended learning strategy. The present study was to determine the effect of blended learning on academic achievement in mathematics among ninth-grade students by comparing it with the traditional method of instruction. In this experimental study, learning activities were done online as well as face to face, it takes advantage of both two teaching methods.

## CONCLUSION AND IMPLICATIONS

Blended learning represents an effective method in teaching mathematics, and it reflects positively on the student's performance in the specific subject of mathematics. This method makes it as important due to the use of both, the e-learning and traditional method and as a result of this, the student's achievement in mathematics was improved. The use of a blended learning strategy plays a major role in turning the educational environment into a creative and interactive one; it involves the learners and the teacher in the education process. The teacher and the learner, represent a major part of blended learning strategy, thus, the class and subject turn into fun and attractive. Besides, the interaction between the learner and the learning materials in the electronic environment without the need for the presence of the teacher develop the skill of self-learning, in other words, allows the transition from education to learning and concentration on the teacher to be concentrated on the learner and thereby improve the quality of the learning process education as a whole. Finally, using a blended learning strategy as a teaching method reflects on raising student achievement. Moreover, it develops interaction between the student and the teacher as well as the students' feeling towards this method that they play a major role during learning. A blended learning strategy saves time for both the teacher and the student.

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