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The implication of practising blended learning, and conventional learning towards student's achievement and attitude

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Abstract

This study aimed to use an appropriate learning method that can improve the achievement and attitudes of pupils from primary schools for Mathematics subjects. The type of this research was a quasi-experimental time-series design. The treatment group (n = 40) used blended learning (Moodle), while the control group (n = 40) used conventional teaching. The research instruments used were pre-Test, Test 1, Test 2, post-Test, and attitude questionnaire and interviews. The data analysis approach was evaluated using a one-way ANOVA to determine the differences between the experimental and control groups. The study found a statistically significant difference at p<0.05 level between the two strategies. The findings of the study showed that blended learning has successfully improved pupils' achievement. The findings also showed improvement in pupils' attitudes in the blended learning. The study findings through interviews also showed that pupils prefer blended learning to make mathematics easier to understand. In conclusion, pupils in the blended learning class outperformed those in conventional classes.

Keywords: Blended learning (moodle), conventional learning, student achievement, student attitude

Introduction

One of the essential educational sciences is mathematics. Every level of education is sure to get mathematical subjects. Education professionals want to create a learning experience that will ensure the acquisition of knowledge for all students. In today's diverse classrooms, teachers are constantly challenged to distinguish instruction to meet the learning needs of all students, especially those requiring accelerated growth in the areas of mathematical. Mathematics is a body of knowledge in science and technology. Mathematics is beautiful and exciting because of symbols, language, terms, technology, and others. (Raj Acharya, 2017). The generation of students born with digital technology has significant differences in the

learning approach. They are used to having access to multiple and instantaneous sources of information, multitasking, and connecting socially to each other via mobile devices. The combination of technology, cognitive and social for the new generation needs to be digitally enhanced, and this requires new skills to foster a learning concept (Kenedi et al., 2019). Students must change abstract concepts to be more concrete and understand them while working on them in learning mathematics. The role of education supported by technology is a combination of learning that helps students be able to concrete abstract concepts and facilitate configuration in students' minds (Asarta & Schmidt, 2020).

In studying mathematics, students rely on what is being. Learning is a process of interaction, communication, and negotiation between teachers and students. The method of communication is not always running smoothly. Even the communication process can lead to misunderstandings or misconceptions. For this reason, alternative learning for students to understand the concepts is given not only in the classroom but at any time. Therefore, computer technology and the internet in every learning make it easier for students to information widest. The Ministry of Education Malaysia does not miss seeing this electronic learning to help pupils understand the concepts of the subjects taught (Talirkodi, 2016). Malaysian education has drafted new changes in terms of the primary education system following technological developments. The influence of the development of Malaysian technical sophistication has dramatically changed the conventional education system to information and communication technology-based Education (Chiam & Abdullah, 2009). Blended learning is a concept of mixing blended and conventional learning models through modern technology (Yustina et al., 2020). The blended learning's definitions, most often employed in scholarly papers, as stated by Hrastinski (2019), are those by Graham (2006) and Garrison and Kanuka (2004). Blended learning systems, according to Graham (2006), integrate face-to-face and computer-mediated education. Meanwhile, Garrison and Kanuka (2004) looked at the careful integration of online learning and face-to-face experiences in a classroom setting. Youde and Andrew (2019) stated that blended learning definitions are problematic because they are vague and contain various teaching practices, with no agreement on what they include.

Primary education still fails to use modern technology to use highly advanced blended learning (Muhtadi, 2017). Furthermore, Mizza and Rubio (2020) advise that mathematics is an important subject. Teaching mathematics using modern technology using blended learning is still lacking in primary schools. Technology usage in mathematics teaching and learning can construct concepts effectively. According to Hermino and Arifin (2020), an atmosphere that can stimulate mathematical concepts can be achieved by providing appropriate computer software, and students can manipulate mathematical ideas. Bahador et al. (2018) said that the development of globalization is increasingly rapid and vibrant, making the world of technology essential for teaching mathematics in primary school education.

Pupils need to first understand and master the basic concepts in mathematics learning (Muhtadi & Prahmana, 2017). Unfortunately, students at the primary school level are still unable to master the concepts and skills in mathematics (Fakhri et al., 2016). The subject of mathematics is a subject that pupils often fear in primary schools, and they often complain and are very worried and guided with this subject (Hermino & Arifin, 2020). According to Anggo and Arapu (2018), pupils lose interest in learning mathematics due to various factors such as unattractive learning materials. They do not meet teaching objectives, unsystematic content organization, unsatisfactory learning environment, and static teaching approach. As a result, they were often considered difficult by most students. If viewed in terms of the performance of primary school students, the average is less encouraging. Therefore, they take the easy way by ignoring the subject of mathematics from the beginning

(Nor'Arifahwati,2020). These factors will cause students to drop out, and teachers will feel the burden of meeting pupils' various needs and demands.

Moreover, in most of the mathematics lessons in primary schools, teachers still adhere to conventional learning because of the assumption of teachers, primary school pupils need to be instilled with knowledge face to face (Muhtadi, 2017). This match is also agreed by Suppiah, Kanmani, et al. (2016), especially for students considered weak in mathematics. According to Tohir, Maswar, et al. (2020), more study is still required to offer definite answers and information to improve primary schools' performance and efficiency especially in mathematics subjects. Research by Mahizer and Mohd Azli (2016) emphasize that although the government has made various efforts, there are still weaknesses in using modern technology with the help of blended learning in primary schools.

Problem statement

The wave of information and communication technology (ICT) has genuinely impacted the national education system (Yuen et al., 2018). School culture has changed to an informed, creative, intelligent, caring practice by applying the latest technology (Affan & Thohir 2020). Overall, schools worldwide try to facilitate an optimal learning environment for their students (Hasliza Hashim et al., 2016). The Malaysian Education Development Plan (PPPM 2013-2025) was explicitly created to guide the Malaysian education sector toward improving present performance and overcoming obstacles. According to PPPM 2013, there is an emphasis on expanding access to education, boosting quality or standards, and narrowing achievement disparities (equity). One of them argues that blended learning is applied using various multimedia applications in an ideal way to solve problems (Keshta, 2013). While according to Manfreda and Hodnik (2021), blended learning is one of the methods of learning in the knowledge age, where teachers take a role as facilitators, motivators, mentors, and consultants. Teachers also play a role as 'classmates' where they share ideas and share knowledge with students. Blended learning focus involves the platform used, how a teacher implements a class or a lesson, and the teaching model used according to the pupils' learning style. Technology helps the lesson process engage and change pupils' attitudes towards learning and facilitates various methods of information being disseminated and received (Chasanah et al.,2020). It is evident that teachers in primary schools also practice conventional teaching in mathematics classes (Wan Jaafar et al., 2020). The teacher has an essential role in describing the content and sequence of steps in conveying the students' content.

At the same time, the students listened carefully and recorded the essential facts presented by the teacher. The teacher dominates the whole learning. This results in students being passive because students only accept what is suggested by teachers. As a result, students are less interested in mathematics subjects, less initiative, and rely on teachers only (Johar &, 2015). Conventional learning materials are minimal because the main instructional activities are teachers only (Hamzah & Yeop, 2018). This instructional activity uses the teacher as the only source of learning while acting as a deliverer of the lesson's content. Pupils will follow the learning activities by listening to lectures from the teacher, taking notes, and working on the tasks given by the teacher. However, the Ministry has encouraged teachers to teach using blending methods. According to Mahizer and Mohd Azli (2016) and Shahaimi (2014), many teachers have returned to conventional methods because there is a perception that weaker students need greater attention and, therefore, more face-to-face teacher-centered learning is needed. Blended learning method in Malaysian education shows that studies have been conducted more on developing learning platforms (e.g., Komsas & Melayu, 2010; Salman Firdaus Sidek et al, 2014).

On the other hand, some studies such as Shahaimi and Khalid (2014), Hamzah and Mohd Azli (2018), have focused on practical perspectives that display the effectiveness of the blended learning usage, in education especially in subjects in secondary schools. According to Mazloumiyan, Shobeiri, and Farajollahi (2012), studies on blended learning in the primary school sector are not as much as in secondary schools, or research is a limited study published at the primary school level. However, learning in the classroom possesses a substantial role in the students' achievement (Wan Jaafar et al., 2020). Currently, low-achieving students are increasing in primary schools, as shown in table 1(Chung & Jamaludin Badusah, 2010). Therefore, according to Chung and Badusah (2010), there is a need to improve the mathematic achievement of year five students to follow the learning well. Teachers and the school's responsibility to provide ideal academic opportunities for these students equivalent to those given to their peers (Subramaniam, 2015). However, Various parties state that the level of mathematics proficiency is poor among most students (Grgurovic, 2017; Nor Erma & Leong, 2017). On the other hand, pupils consider mathematics a boring subject (Nor Erma & Leong, 2017). According to Nor Erma (2017), the primary causal factor of students' deterioration of mathematic results is the students' attitude. Many students are not diligent in mathematic classes because they consider this subject unimportant and not fun (Nur et al. 2017). Students' achievement will be impacted indirectly if they have a negative attitude and are uninterested in the subject (Nor Erma & Leong, 2017). According to Van de bogart et al. (2015) and Nor Erma (2017), the relationship between students' attitudes towards mathematics and teaching methods.

According to the Primary School Assessment report, Mathematics Achievement in the Primary School Achievement Test (UPSR) for 2018 and 2019 is at a low level as follows:

Table 1. A score of mathematics in UPSR for 2018 and 2019.

	PERCENTAGE (%)					
GRADE	**A**	**B**	**C**	**D**	**E**	**TOTAL CANDIDATE**
2018	18.22	15.52	16.96	29.80	19.50	427 126
2019	19.43	16.84	16.63	30.23	16.87	431 610

The number of UPSR examination candidates for 2018 is 427 126 and for 2019 is 431 610, different candidates are 0.01%. The table above shows that the UPSR achievement for Mathematics is still at an unsatisfactory level. However, there is an increase in students getting grades A compared to 2018 and 2019. This should not be considered a proud achievement. Many students' grades are grade D, 30.23% in 2019, and 29.80% in 2018. Grade A only gets 18.22% in 2018 and 19.43% in 2019. The achievement of Mathematics can be said to be at the guiding level. If compare scores A and D. Score D are more numerous with scores A, B, and C.

In a statement, the international high-level benchmark mathematics questions in the Trends In International Mathematics and Science Study (TIMSS 2019), Ministry of Education (MOE), said a total of 25 TIMSS paper students and 65 ETIMSS students obtained scores above 700. However, for Mathematics in ETIMSS, Malaysia received an average score of 461, four points lower than TIMSS 2015. Mathematics not only requires counting skills but also needs to understand the theory and master problem-solving skills. Tambychik and Meerah (2010) stated that most students solve mathematical problems without mastering mathematical skills. Therefore, teaching and learning strategies are essential in helping students improve students' mathematical achievement in Malaysia. Thus, the implementation

of this study in the subject of Mathematics Year 5 is highly encouraged to form a more effective lesson. The accomplishment of Malaysian pupils in both international assessments and boost Malaysia's achievement to be in the top third in TIMSS and PISA by 2025 (Malaysia Education Blueprint, 2013). In finding this solution, modern technology with blended learning may be a solution for students to improve achievement and attitude towards mathematics subjects (Amrien Hamila & Mohamed Amin, 2016) found that students taught with blended learning showed positive performance compared to conventional methods. In addition, the attitude of students became more interested in mathematics subjects. This situation also helps to improve students' achievement, according to Al-Qahtani and Higgins (2013) in their study, which showed that students' expectations of blended learning were positive and students' attitudes showed positive.

Conceptual framework

This study uses constructivism theory, the proximal development zone (PZP), and the 3P model to guide the research. Constructivism theory is a teaching approach based on research on how students learn or the process of student learning (Baytak et al., 2011). Conceptual framework studies through the 3P learning model show the relationship between teaching and learning and ultimately influence student learning outcomes (Termit & Noorma, 2015). Thus, through this model, teachers can formulate more clearly daily lesson plans to implement activities in the classroom and ultimately achieve learning objectives. The rationale for using the 3P model in this study is to plan continuity according to the stages. Therefore, researchers can design strategies to produce encouraging research findings. In the context of this study, learning outcomes are assessed based on student achievement and attitudes. Figure 1 shows the conceptual framework of the study as discussed. PZP in this study involved the improvement of students' abilities with support through different instructional methods. In this study, blended learning instructional method and conventional instructional method are two teaching methods that aim to help improve student achievement and attitudes and, at the same time, succeed in the learning process. The actual capability in this study is the knowledge built by Year 5 students during the learning process.

Meanwhile, this study's improvement of student abilities refers to improving student achievement, while the potential ability to measure student learning outcomes in terms of achievement and attitude during the teaching process. In the context of this study, teachers play a role in applying whether moodle and conventional instructional can bridge the existing knowledge gap of students. Thus, PZP has potential abilities that can generate moodle, and conventional instructional will act as the methods used in the learning process. Within the PZP, students can process information during the learning process.

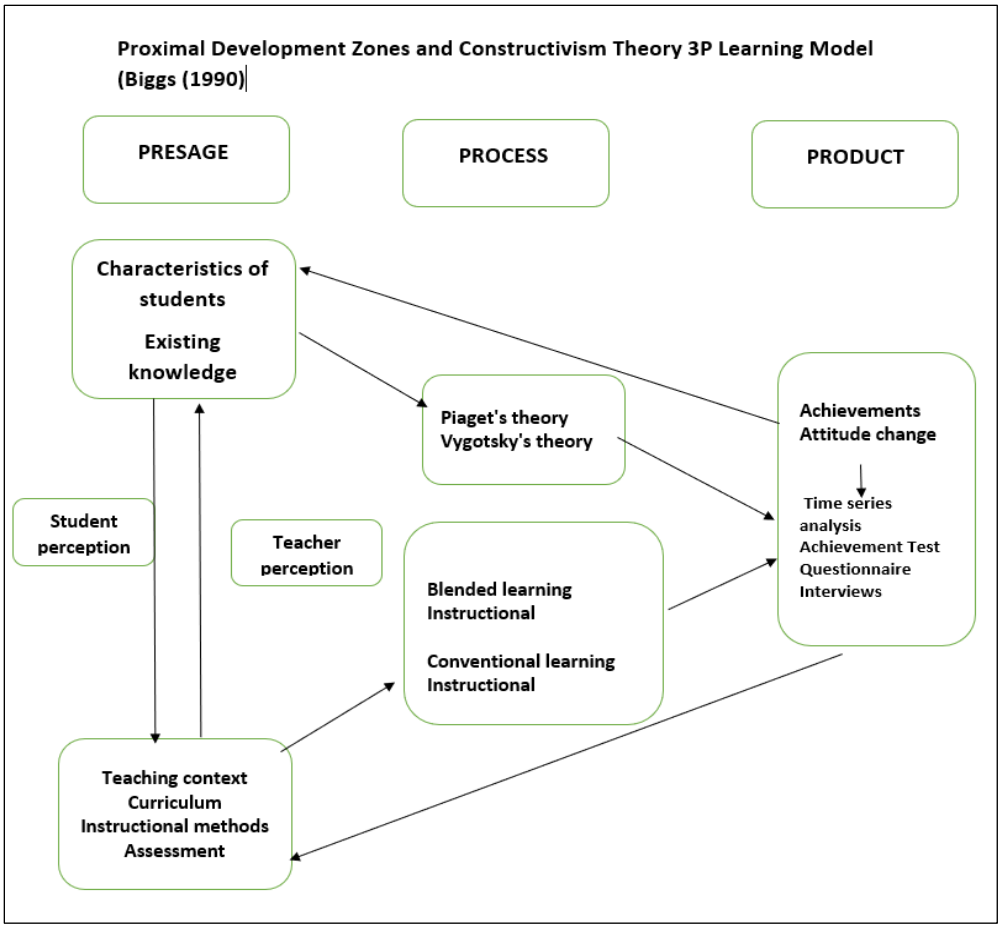


Figure 1 Conceptual framework of the study
Source: Modifications from Constructivism Theory, Biggs' 3P Learning Model (1990), and Vygotsky's Theory (1978).

According to constructivism theory, the researchers modified the conceptual framework for the study, PDZ (Proximal Development Zone), and the 3P model as an aid and reference to conduct blended learning and conventional learning in year five classrooms for mathematics subjects. The learning method employed in this study is the independent variable, while the dependent variable is composed of student achievement scores. The conceptual framework of this study can be divided into three stages, namely presage: a time before beginning the teaching-learning process, process: refers to how learning tasks are undertaken, and product: this includes learning outcomes.

The presage stage refers to the characteristics of stable learning that encompass learning styles and concepts (Bulut & Delen, 2011). At this stage, there is the student's actual ability and the existing knowledge of the student. After that, in the process stage elements of teaching and learning are discussed (Campbell et al., 1963). The process stage in this study refers to blended learning instructional methods and conventional instructional methods and detailed exposure through blending learning and conventional instructional. PDZ acts as a link between the process stage and the production stage. The application of PDZ in this study also involves the distance between the actual developmental stage and the developmental

stage of individual potential. According to Vygotsky (1986), PDZ is a gap of a pupil's existing knowledge with the help needed by more skilled others. Therefore, the potential ability of students will be tested to determine the learning outcomes of students. Within the PDZ, pupils can process information during the learning process.

Research objectives

This study aims to investigate if there were any changes in attitudes and achievement between Year 5 pupils who gained instruction through blended learning and conventional methods. As a result, the following are the study's particular objectives:

a) To investigate the effect of blended learning instructional method on Year 5 students' achievement compared to conventional learning instructional method related to mathematics subjects.
b) To investigate the effect of blended learning instructional method on the attitude of Year 5 pupils in comparison to conventional learning instructional method related to mathematics subjects.

Methodology

Research design

This research employed a time series quasi-experimental study design (Creswell, 2014). In this study, a quasi-experimental method was used to gain effectiveness when the study respondents could not be randomly distributed (Chua, 2011). This study was conducted in the district of Kinta Utara, Perak, involving Sekolah Rendah Kebangsaan (SK). This is because the researcher could not randomly distribute the respondents from the actual class not to disrupt the daily lesson. Both groups were taught in the original learning environment according to a schedule determined by the school. Table 2 portrays the time series design as shown below. This study utilized the descriptive survey method of research. This method involves information about variables, and it is employed to measure the existing phenomenon.

Table 2

Week / Group	0 Pre test	1-4	5		6-9		10		11-12	13 Post test	
Treatment group	U1	X1	U2	Q1	X1	U3	Q2	X1	U4	Q3	Y1
Control group	U1	X2	U2	Q1	X3	U3	Q2	X2	U4	Q3	Y1

Scale:
X1= Blending learning
X2= Conventional learning
U1 = Pre test
U2 =Test 1
U3 =Test 2
U4 = Post test
Q1 = Questionnaire 1
Q2 = Questionnaire 2

Q3 = Questionnaire 3
Y1 = Interview

Sample of the study

The Year 5 class selected as the sample is comprised of three classes in 2021. In determining the study sample, the researcher uses random number generation software. Through this software, the researcher can select the study sample from the 3 existing classes. Once all the class numbers are entered into the random number generation system, the system is run to obtain the class number to be sampled. The random number generation software was run twice and the class number listed was used as the treatment group of 40 students.
In comparison, the unlisted class number was used as a control group comprising 40 students. Based on the selected group of students, the treatment group consisted of 40 students in a blended learning class (BL). The control group will consist of 40 students conducting conventional learning (CL). The number of samples selected is in line with Fraenkel et al. (2012), who stated that the adequate number of models for the experimental study design was between 30-45 people. Therefore the number of samples formed in this study is suitable to conduct experimental studies. The rationale of simple random sampling by class was performed to ensure that the students involved in this study have the same likelihood of being sampled and compared according to different learning methods (Noraini, 2016). Table 3 portrays the number of pupils in the study sample group:

Table 3. Number of pupils in the study sample group

Group	Number of Pupils
Treatment group (BL)	40
Control group (CL)	40

Research instruments

The mathematics test is the study's primary instrument (pretest, test 1, test 2, and post-test), consisting of 40 multiple-choice questions. In the formation of research instruments, several steps have been identified by researchers to produce quality instruments. At the initial stage, the researcher formulates the study's objectives, and at the same time, the researcher lists the variables used in this study. These pretests, tests 1, 2, and post-test, are formed based on the Year 5 Mathematics Curriculum and Assessment Standard Document (DSKP). The selected Year 5 mathematics chapter titles include addition, subtraction, multiplication, division, fractions, and decimals. This option was set after discussing with the district's head mathematics coach the student's needs for these topics. These are the common topics faced by the students in exams. Through measurements on the pretest, the researcher can obtain information about the results of the respondents before this study and then compare it with the results of the post-test after the respondents were given treatment (Chua, 2011). In designing and conducting this study, researchers have involved two groups that practice different instructional methods: treatment group (BL) and control group (CL). This instrument was designed to gather information on students' conceptual understanding in blended and traditional learning settings. A post-test was given to all control and experimental groups participants at the end of the practical instruction to collect data on the students' conceptual understanding. The validity of the instrument's quality and content with difficult and discriminant question's index was used to measure students' mathematical achievement. The instrument was submitted to the Expert Panel Guide (PPP) formed by the researcher for validity. PPP consists of three mathematicians, namely the Head of the Mathematics Committee and two mathematicians (Head Coach) with more than ten years of experience.

Validity assessment forms are distributed to PPP members. Questions are scored based on a question suitability checklist. Questions that scored three and four were accepted as a pretest, test 1, test 2, and post-test questions from PPP. Questions that get a low score of 2 will be modified. Among the modifications of the questions performed included changing the sentence structure of the question changing the answer choices. The evaluator gave suggestions for improvements, and all questions were modified before use. The modification of the question was reviewed again by the PPP.

The items were reviewed and constructed by a team of researchers and school teachers with expertise in mathematics to guarantee the instrument's content appropriateness, clarity, and validity to the student's grade level. The test was piloted with 30 students in Year 5 from several schools. The term "reliability" resembles the consistency of a test used to assess a student's mathematics achievement. This study used a pre-post test interrupted time-series quasi-experimental study design (Pretest-posttest Interrupted Time-Series Designs) (Hudson et al., 2019).

Figure 2 shows the quasi-experimental design of the pre-post-test interrupted time series between treatment group (BL) (X1) and control group (CL) (X2) treatments conducted over 13 weeks. Before starting treatment, a pretest (T1) is administered to respondents in the first week. From weeks 2 - 4, X1 and X2 treatments were performed and followed by test 1 (T2). Then, X1 and X2 treatments were performed for six weeks (Weeks 6-9 and Weeks 10 - 12). Finally, the second test (T3) and the post-test (T4) were administered at weeks 10 and 13.

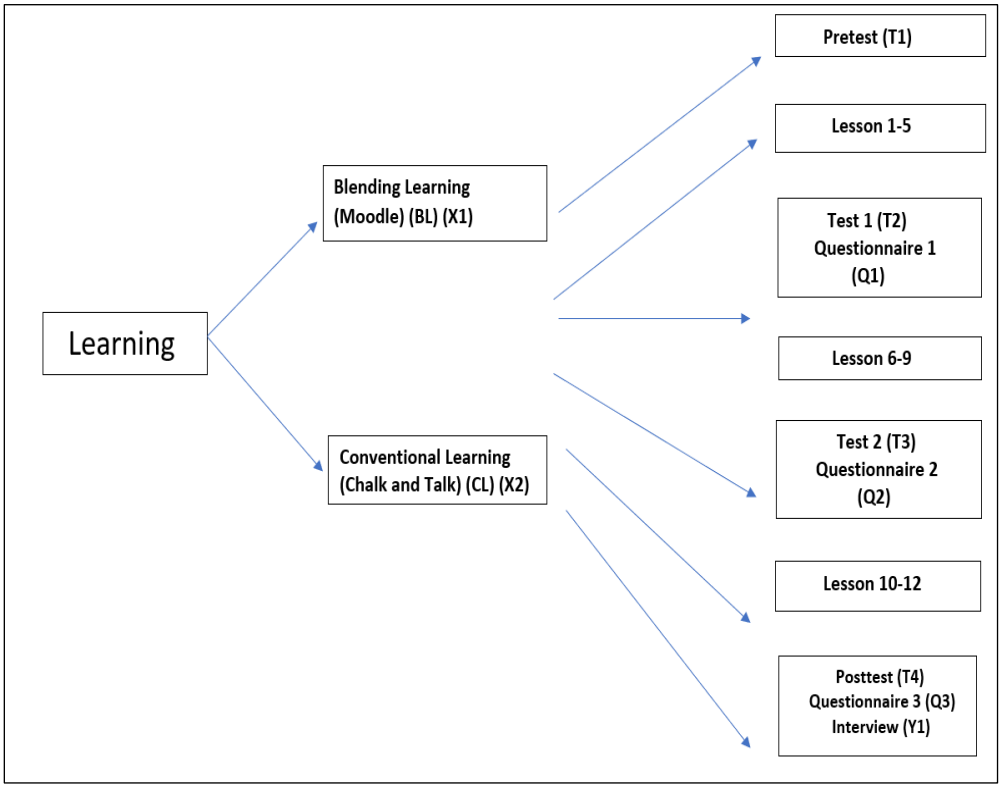
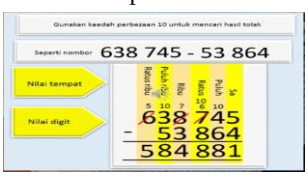


Figure 2: Quasi-experimental design time series of the pre-post test

Blended learning uses the moodle platform in this study. Researchers provide power point materials on multimedia in the moodle platform for each teaching topic, as shown in Figure 3.

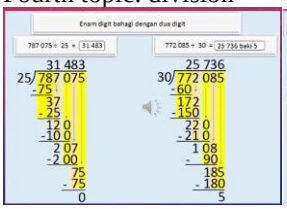
First Topic: Additional

Second Topic: Subtraction

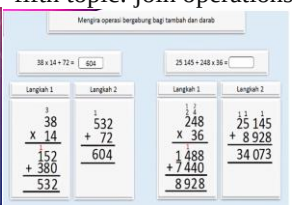


Third Topic: multiplication

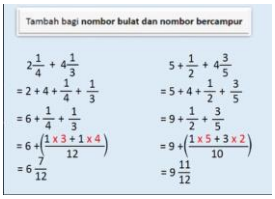
Fourth topic: division



fifth topic: join operations



sixth topic: fractions



Seventh topic: decimals

Figure 3

According to Chua (2011), the sample could only concentrate on the questionnaire items for 10-20 minutes only. Therefore, the number of questionnaire items has proposed a minimum of 10 articles and 30 items. Twenty-one items tested attitudes in this questionnaire. This is a 1-4 Likert scale questionnaire in which students are acquired to determine if they strongly agree, agree, disagree, or strongly disagree with the things presented. This questionnaires to measure students' attitudes towards the lessons followed. This questionnaire was modified to be more appropriate to the research question.

In most cases, questionnaires are linked with quantitative research (Bryman, 2015 & Creswell 2014). As a result, Bryman (2015) highlights the advantages of including open questions that allow respondents to react in their way. According to Creswell (2014), "survey research" (p9) is mainly correlated with quantitative studies. On the other hand, open-ended questions in interviews might inspire participants to interact and express their ideas on a topic. The purpose of interviews in this study is to support and complement the qualitative findings. This lesson plan will be prepared based on the Gagne model (1992). The Gagne model (1992) applies methods, and the teaching model is important to achieve a learning objective. Based on this Model, a lesson plan will be formed for all 13 weeks of instruction.

Treatment group

In this research, students learned mathematics in two ways: blended learning involving Moodle (experimental group) or textbook learning (control group). The two conditions are similar in decimals, fractions, operations, division, multiplication, subtraction, and addition in

learning materials. The number of study hours in school is 13 weeks, with each day would last approximately 60 minutes. Students in both classrooms are exposed to the same material with not similar conventional and blended teaching methods. The experimental group was taught using a blending learning method associated with Moodle. Students in the blended class followed math learning in a computer lab for 13 weeks. In blended learning employing Moodle, teachers recorded the teaching materials as a PowerPoint video or searched for internet resources to be uploaded in Moodle.

Additionally, teachers also provided the homework for students before each class. Students may also view the PowerPoint videos in mathematic class anytime they have free time. Students were given a set of questions to answer before each session, which were also instructed to prepare one or two questions to be asked in class after viewing the provided videos. Students were asked to jot down and participate in a discussion session to share their thoughts during the class. Teachers assisted and discussed concerns raised by students during the discussion. An online assessment was given at the end of each lesson. However, students in the control group learn mathematics via conventional teaching methods similar to what they are used to. The lesson is classified into three parts in the conventional teaching method: (1) opening: introduction to the learning material (around 10 minutes); (2) teachers describe the material and students working on problems relying on the textbook individually or in groups (approximately 50 minutes); (3) closing: teacher's review of the primary thoughts of the lesson with the entire class (about 50 minutes) (about 20 minutes). During the closing session, students are evaluated at the end of each class.

Results and findings

The results of the achievement tests of the experimental and control class revealed that students taught via blended learning performed better than those taught using conventional methods. This may be seen in the mean score when the standard deviation is taken into consideration. Table 4 highlights the descriptions of achievement data. As a result, a one-way Anova test is necessary to obtain this information.

Table 4. Descriptive Statistics between the experimental group (Treatment group (BL) and control group (CL)

Group	Analysis	N	Pretest	Test 1	Test 2	Pos test
Treatment	Mean	40	38.20	44.75	55.28	66.53
	SD		8.321	8.2049	7.027	9.484
Control	Mean	40	42.20	41.75	41.78	43.33
	SD		10.799	10.075	8.784	9.739

The Mean value of treatment group (BL) in the pre-test was (M = 38.20, SD = 8.321). The control group CL) mean value was higher than the treatment group (BL). The significance value was higher than the 0.05 level. Then this indicates a statistically significant not difference between the two experimental groups, t (80) = 1.856, p> 0.05). This fact indicates that respondents always use conventional learning. Mean value of treatment group (BL) in test 1 was (M = 44.75, SD = 8.205) while control group CL (Conventional Learning) was (M = 41.75 SD = 10.075). This indicates a statistically not significant difference between the two experimental groups, t (80) = 1.460, p> 0.05). In test 1, the treatment group showed little improvement in mean value compared to the control group. This clearly shows that students are mastering and accepting changes in the teaching of mathematics. Mean value of treatment group (BL) in test 2 was (M = 55.28, SD = 7.03) while treatment group (KL) was (M = 41.78 SD = 8.784). This indicates statistically not a significant difference between the two experimental groups, t (80) = 7.590, p <0.05). Mean value of treatment group (BL) in posttest

was (M = 66.53, SD = 9.484) while control group KK (Conventional Learning) was (M = 43.98 SD = 9.437). This indicates a statistically significant difference between treatment group 1 and the control group, t (80) = 10.794, p <0.05). In conclusion, the mean value of blended learning showed a continuous increase from test 1 to post-test. Compared to conventional learning, the mean value is initially higher than blended learning in the pretest. This is because students never follow other learning methods other than conventional learning. After following blended learning, student achievement increased dramatically.

The impact of blended learning on students' conceptual understanding was determined using a One-way Analysis of Variance In both conditions, Table 5 shows the mean scores, standard deviation, and estimated effect size. A statistically significant difference between groups was determined by one-way ANOVA (F (1,79) = 2.94, p = 0.032). A Tukey post hoc test revealed that the time to complete the problem was statistically significantly lower after taking the intermediate (test1) (44.8 ± 55.3 min, p = 0.043) and advanced (test 2) (55.28 ± 66.5 min, p = 0.045) compared to the pretest (38.2 ± 44.8 min). There was no statistically significant difference between the intermediate and advanced groups (p = 0.216). There was a greater difference between the blended learning method and the conventional method, resulting in these results under the post-test. Students who studied using the blended learning technique had a higher mean score than those taught using the conventional method, as portrayed in Table 5. This reveals that the blended learning method had an impact on student achievement.

Table 5. Estimated effect sizes of control and experiment groups

Group	Pretest Mean (SD)	Test 1 Mean (SD)	Test 2 Mean (SD)	Post-test Mean (SD)	Effect time
Treatment	38.20 (8.321)	44.75 (8.204)	55.28 (7.027)	66.53 (9.48)	1.25
Control	42.20 (10.799)	41.75 (10.07)	41.78 (8.78)	43.33 (9.74)	0.91

Next, the questionnaire data on students' attitudes towards mathematics subjects were also analyzed to show the mean and standard deviation obtained by students' attitudes, as shown in Table 5. The questionnaire was conducted three times with week 6 (questionnaire 1), week 10 (questionnaire 2), and week 13 (questionnaire 3). Data collection was carried out smoothly, where the students who answered the questionnaire cooperated. Table 6 shows that the students' attitude scores on questionnaire 1 are nearly similar.

Table 6. shows the score of students' attitudes towards questionnaire 1

Group	Questionnaire 1 Mean (SD)	Questionnaire 2 Mean (SD)	Questionnaire 3 Mean (SD)	Effect time
Treatment	43.10 (9.172)	56.05 (3.47)	48.71 (7.66)	1.19
Control	40.33 (10.63)	45.44 (8.63)	63.70 (3.79)	0.89

Table 7. One-way ANOVA test to assess students' attitudes on questionnaire 1.

Source	Statistic test	sig	alpha	Conclusion
Between	One way ANOVA	0.601	0.05	No Differences

Table 7 indicates that there are no differences between treatment group and control group, (F(1,79) = 1.356, p < 0.05).

Table 8. One-way ANOVA test to measure students' attitudes on questionnaire 2.

Source	Statistic test	sig	alpha	Conclusion
Between	One way ANOVA	0.201	0.05	No Differences

Table 8 indicates that there are no differences between treatment group and control group, ($F(1,79) = 1.078$, $p < 0.05$).

Table 9. One-way ANOVA test to measure students' attitudes on questionnaire 3.

Source	Statistic test	sig	alpha	Conclusion
Between	One way ANOVA	0.00	0.05	Differences

One-way ANOVA was conducted to assess the change in students' attitudes toward mathematics, and the results are shown in Table 9. Table 9 portrays that student in the treatment class possesses a positive attitude change against blending learning compared to conventional learning. This proves that students who learn using the blending learning method understand mathematics, and there is a change in attitude towards the subject compared to the conventional learning method. In the moodle assisted in blended learning, students can learn according to their respective learning styles. Students can follow the lessons easily, and the learning materials make it easier for students to learn more easily. Teaching materials that are not yet understandably can be learned conventionally. Table 8 indicates that there are differences between treatment group and control group, ($F(1,79) = 31.204$, $p > 0.05$). One-way ANOVA findings showed statistically significant differences, so the post hoc test (LSD) was tested using Tukey HSD to ensure statistically significant differences between the treatment group (Blended Learning) and control group for questionnaire 3, as portrayed in Table 10.

Table 10. Post hoc Tukey test was performed to assess differences in students' attitudes on questionnaire 3

Source	Statistic test	sig	alpha	Conclusion
Blending and conventional	Post hoc Tukey	0.00	0.05	Differences

In a mathematics lesson, actual interview on students' perceptions of blended learning, most students in the experimental group has a good perspective of blended learning. More than half of students (89%) agree they can learn mathematics more conveniently since they can explore material utilizing PowerPoint videos and the internet at home instead of reading textbooks. This indicates that they favor blended learning in mathematics lessons. Meanwhile, most students believe that blended learning is an intriguing teaching method that may be employed as an alternative.

Nonetheless, students ran into several issues during the online phase of blended learning, including a lack of internet access, difficulties in understanding the content, and attention issues. As a result, they choose non-blended learning. When students in the experimental group were asked if blended learning might assist them in acquiring mathematical concepts, the majority of them agreed that it could. Students benefited the most from video usage since they enjoy watching videos on mathematical concepts rather than reading textbooks.

Conclusions and recommendations

Students who were taught using a blended learning method outperformed their counterparts who were conducted using a conventional teaching method, according to the results presented in the preceding section. As previously said, several studies have shown that blended learning is more successful than the traditional method in terms of academic achievement (Asarta and Schmidt 2020). According to this study, blended learning outperforms conventional learning methods to boost students' performance in mathematical lessons. This may be due to the flexibility offered by blended learning. If each student has access to learning materials, they may choose their speed and go back over any material they find difficult. This was not the case with the conventional method; pupils couldn't catch up if they missed some information. In addition, students can explore learning materials as much as they need during the online phase of blended learning and repeat exercises to ensure that they grasp the material. Instead of passively absorbing information or learning material from teachers, pupils actively employed learning resources in these procedures. This can help students understand mathematical concepts better (Yustina et al., 2020). This is supported by interview findings, which show that 89% of the students in the experiment group prefer blended learning since it gives them more time to study by allowing them to repeat the materials and exercises.

Additionally, online assessment and immediate feedback might help in the improvement of mathematic comprehension. Students who obtain immediate feedback score better than students who receive no feedback at all or who had deferred feedback (Ghazali, Othman, et al., 2010). In blended learning, students received homework through Moodle. Hence, this could be another element that supports students learning. Attard and Holmes (2020) noted that students learned more successfully utilizing web-based homework with instant feedback rather than paper-based reading. According to the interview data, students prefer blended learning because it gives instant feedback to learn from it, essentially when they obtain incorrect answers. As a result, blended learning could be regarded one of the options for improving students' conceptual understanding in mathematics class. However, as the interview revealed, some students experience difficulties while adopting blended learning. The first problem is an internet connection, which means that teachers must ensure and examine that students have enough internet access before implementing this strategy to benefit students. The second issue, challenges in understanding learning material, can indeed be mitigated by discussing challenging material in a face-to-face setting. On the other hand, the teachers can provide inspiration and determination to students, allowing them to focus on studying rather than opening other applications.

The teachers who completed this lesson will continue to do so for at least another three years to see if their students' test scores change. According to research, it takes time for a new program to settle in. As a result, it may take more than a year to see a difference in student achievement. Teachers must continue experimenting with new ideas that may help their students, as education is constantly evolving. Almost every district now requires the use of technology. We may see a different change in students when Blending Learning (Moodle) is deployed.

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