Implementation of Blended Learning Flex Model to Improve Chemistry Learning Outcomes in Acid and Base of Class XI MIPA SMAN 4 Pekanbaru

Maria Erna[1*], Abdullah Abdullah[1], and Faira Yovanie[1]

[1] Faculty of Teacher Training and Education, Riau University, Pekanbaru, Indonesia
mariaerna@lecturer.unri.ac.id

Abstract. The implementation of less effective learning models causes low student chemistry learning outcomes, so a learning model that involves students is needed to be active and independent. In this study, the Flex model Blended Learning was applied which can improve learning outcomes on acid and base. The research method used is Quasi Experimental with Nonequivalent Group Pretest Posttest Design. The results showed there was an increase in chemistry learning outcomes on acid and base at SMA Negeri 4 Pekanbaru. The data analysis techniques used are parametric tests in the form of normality tests, homogeneity test, N-Gain tests, and hypothesis tests. The results of the analysis showed that the data obtained were normally distributed and homogeneous. After obtaining normal and homogeneous distributed data, the N-Gain test is carried out. The N-Gain value has been obtained, then hypothesis test is carried out. The results of the hypothesis test showed an increase in learning outcomes after the implementation of the Flex Blended Learning model on acid and base.

Keywords: Blended Learning, Flex Model, Learning Outcomes

1 Introduction

Technology is an inseparable part, because it is a basic need of everyone and affects various fields including education. In the world of education, technology plays an important role, especially in the learning process. Global demands demand the world of education, especially for educators to always innovate and be creative by utilizing technology. Education prepares generations to technological advances that affect learning activities. The influence of technology on learning requires student and teacher to control technology, so that they have skills in applying it. The students are generation Z for now. Generation Z is a generation with advances in information technology. Generation Z presents new challenges for education [1]. The education passed by generation Z has experienced a shift both in the learning process and getting information. Generation Z in solving all problems tends to rely on the internet, because it is easier to access information. Generation Z is a global, social, visual and technological generation. The tendency of learning styles that they have are active, sequential, sensing, and visual. These

F. Khoerunnisa et al. (eds.), *Proceedings of the 9th Mathematics, Science, and Computer Science Education International Seminar (MSCEIS 2023)*, Advances in Social Science, Education and Humanities Research 860,
https://doi.org/10.2991/978-2-38476-283-5_4

four learning styles are in line with the learning styles of generation Z who are connected to all kinds of technology that makes everything easier [2]. In addition to being multitasking, generation Z is more trust to resources and virtual experiences. This is an impact on behavior patterns and learning process. The large role of technology in generation Z does not necessarily eliminate the role of educators in the process of providing knowledge [3]. Generation Z is a generation that is active in using technology, so teacher must be able to adjust with student. Learning with the use of technology is important, so that students are accustomed to the development of digital technology that is new, sophisticated, stable, and presents new challenges. Teacher are required to use more technology in teaching [4]. One of the uses technology such as the use of learning videos. Learning videos can be made by teacher as learning media. Videos given to students must be designed to be interesting and educating, so that student can understand the learning to be discussed [5]. Teacher must be able to understand and control technology. Teacher who are able to control learning technology can create learning success for student. But in fact, teachers still do not much apply in learning, especially in chemistry learning.

Chemistry is one of the basic science that studies the composition, structure, properties, changes, and energy that accompany it [6]. In high school books, chemistry is only briefly introduced in learning. Chemistry learning also contains complex and abstract concepts, so students need to be given an understanding of the learning that will be taught later. According to Margaret et al [7], understanding concepts is an important aspect of learning chemistry. Chemistry learning divides the three forms needed in interpreting and understanding chemistry in the form of macroscopic, microscopic, and symbolic. Chemistry learning should be able to state all three representations simultaneously.

Acid and base are part of class XI high school chemistry learning. Indicators of achieving the competence from acid and base are student can explain acid and base concepts, acid and base theory, acid and base reactions; student can calculate both Ka and Kb values and student can identify indicators of acid and base. Acid and base include theory, calculation, and practicum that are always related daily life.

Based on the results of an interview with a chemistry teacher of class XI MIPA SMAN 4 Pekanbaru, information was obtained that the learning outcomes of students on acid and base were still low, especially calculating the value of Ka and Kb. Students whose scores reach the minimum completeness criteria with a score of 75 are 51.35%. The average grade of class XI obtained on acid and base is 73.04.

Learning outcomes are low due to models that do not involve or activate students, so students have difficulty to understanding chemical concepts on acid and base learning and students are unable to explain learning. Learning outcomes are low due to other factors, such as the media used still cannot be utilized by students and teachers. Based on interviews and observations, video displayed by teachers have not been able to stimulate students to learn. The video given is still full of lectures. Teachers do not conduct group discussion activities with students, after giving learning videos. The impact is that the learning outcomes obtained by students are low and learning objectives that have not been achieved.

Based on the description above, efforts need to be made so that students can understand the learning concepts provided so that they can improve learning outcomes of acid and base learning. Efforts that can be made are teachers can apply appropriate models so that students are motivated in learning. The selection of this model is expected to improve learning outcomes. The average value of students in acid and base learning is still low, so the solution provided is to apply appropriate learning models and media for students. One of the learning models that is expected to overcome these problems is the Blended Learning model. The Blended Learning model can be used to carry out learning in generation Z. This model combines the best aspects of online learning, structured face-to-face activities, and approaches from various other information [8]. This model contains meaningful direct learning because the learning provided is designed in such a way that students more easily understand it [9].

Blended Learning as one of the learning models that has its own charm in the 21st century by combining faceto-face learning and online learning [10]. Blended learning visualizes an opportunity that integrates the innovation and technological advantages of online learning with the interaction and participation of the benefits derived from face-to-face learning [11]. Isti'anah [12] wrote in her study that Blended Learning provides an effective and efficient learning experience by combining learning environments that suit students. The Blended Learning model includes a learning model that helps students to gain a lot of knowledge from the lessons provided. Blended Learning can shift learning principles from teacher center to student center dynamically [13]. The characteristic of Blended Learning is that students can socialize with others and provide opportunities for students to think in order to affect their cognitive learning outcomes [14]. This Blended Learning model can be used in offline and online learning, the learning becomes effective and efficient, increases accessibility, the learning becomes flexible and not rigid [15]. There are several Blended Learning models, one of the Blended Learning models is the Flex model.

The Flex model is expected to be a solution in improving student learning outcomes in acid and base learning. Flex models utilize technology in the form of learning videos. Videos made by teachers to students related to learning. After getting individual learning videos, students discuss the lesson. The implementation of Flex model in this learning activity is student centered causing differences of opinion from students which makes students able to find solutions and increase participation in discussions [16].

The advantages of learning with the Flex model is that students can adjust learning based on their own pace and ability. Students can be more independent by using existing resources. Through the Flex model, students can repeat learning videos, if there is still something that is not understood. Learning videos provided to students withacid, and base learning can be created by teachers and follow the steps of the Flex model. Teachers will provide learning videos to students with the aim of being able to understand and take notes after watching videos. After that, discussion is held, and the teacher will provide direction on acid and base learning which aims to strengthen the learning concept for students. The purpose of providing learning videos is to increase students' sense of independence and responsibility. Learning videos and Flex models are expected to improve student learning outcomes, especially acid and base learning.

The use of the Flex model was carried out by Ariawan et al [17] and information was obtained that there were differences in student learning outcomes in ecosystem learning by experimental class using the Flex model and control class. The experimental class obtained higher scores than the control class, so learning using the Flex model on student learning outcomes in ecosystem learning is very influential. Another relevant research by Rahmadani [18] found information that there were differences of students' scores in learning computer systems in the control class and experimental class. This is evidenced by the increase in posttest scores of experimental class, so that Flex Blended Learning is more effective. Research by Siyamta [19] found information that using the Blended Learning Flex model strategy is more effective and efficient in teaching and learning activities. This can be proven by the attractiveness of learning is high.

1.1 Study Area

The research was conducted at SMAN 4 Pekanbaru. SMAN 4 Pekanbaru is one of the schools located in Riau Province and is part of the island of Sumatra, Indonesia.SMAN 4 Pekanbaru is located on AdiSucipto street number 67, Pekanbaru city and located in the Republic of Indonesia. Map of study area can be seen in Figure 1.

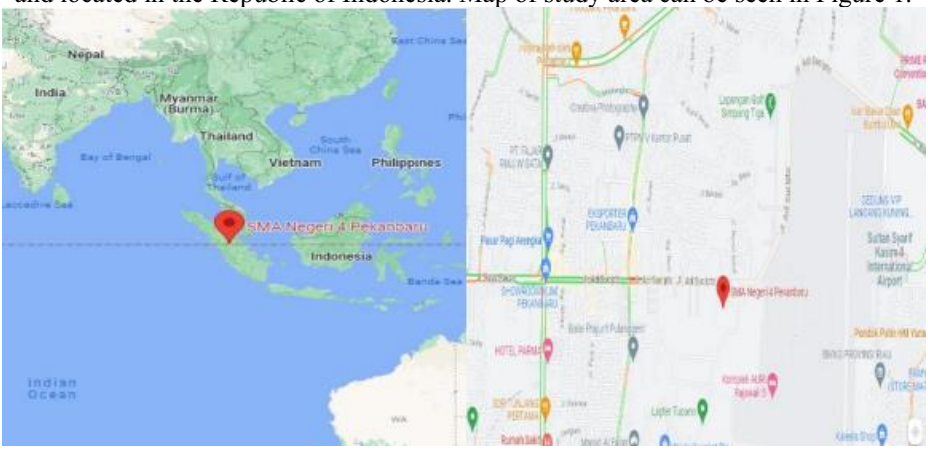

Fig 1. SMA Negeri 4 Pekanbaru as a research location

2 Methodology

This study is classified as a quasi-experimental with non-equivalentgroup pretest posttest design. The research was conducted at SMAN 4 Pekanbaru. The research population is students of class XI MIPA SMA Negeri 4 Pekanbaru in 2022/2023 year. The research sample was class XI MIPA C as an experimental class and class XI MIPA E as a control class. Sampling in the study was carried out randomly. After that, a normality test and homogeneity test were carried out through the previous learning test scores in the form of a Reaction Rate test.

This research includes two instruments in the form of learning implementation instruments and data collection instruments. Learning implementation instruments in the form of syllabus, learning plan, worksheets and learning videos according to meetings and data collection instruments in the form of pretest/posttest. The purpose of the pretest is to determine the initial knowledge of students regarding acid and base learning. While the posttest aims to determine the achievement of the final cognitive aspects of students about acid and base learning. In this study, a normality test was carried out using the Shapiro Wilk test, the equations can be seen in equations (1 and 2) [20]:

$$D = \sum_{i=1}^{n} \left(X_i - \bar{X} \right) \Big]^2 \tag{1}$$

$$T_3 = \frac{1}{D} \Big[\sum_{i=1}^{k} a_i \left(X_{n-i-1} - X_i \right) \Big]^2 \tag{2}$$

Terms of the shapiro wilk test: a) If the significance value > 0.05, then the research data is normally distributed; b) If the significance value < 0.05, then the research data is not normally distributed After the data obtained is normally distributed, a homogeneity test is carried out. The homogeneity test used is the F test, with theequation (3 and 4) [21]:

$$S^2 = \frac{n \sum X^2 - \left(\sum X \right)^2}{n(n-1)} \tag{3}$$

$$F_{count} = \frac{\text{largest variance}}{\text{smallest variance}} \quad or \quad F = \frac{S_1^2}{S_2^2} \tag{4}$$

Terms of homogeneity test : a) If the significance value > 0.05, then the research data is homogeneous b) If the significance value < 0.05, then the research data is not homogeneous

If the data obtained are normally distributed and homogeneous, the next step isN-Gain test. N-Gain testequation (5) [20] :

$$N - gain = \frac{\text{posttest score} - \text{pretest score}}{100 - \text{pretest score}} \tag{5}$$

The N-Gain value obtained is then analyzed using the criteria in the following Table 1

Table 1. N-gain criteria

N gain value	Criteria
N-Gain ≥ 070	High
0.30 <N-Gain< 0.70	Medium
N-Gain ≤ 0.30	Low

Based on the N-Gain value criteria, the learning model is effective if the learning outcomes of students obtain NGain value > 0.30. After obtaining the N-Gain value, the next step is to test the hypothesis. Hypothesis using Independent Sample T-Test with SPSS 25. Independent sample T-test equation (6):

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 - n_2 - 2}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} \tag{5}$$

Terms of hypothesis test: a) If the value of sig.(2-tailed) < 0.05, then there was a significant improvement between learning outcomes in the experimental class and the control class b) If the value of sig. (2-tailed) > 0.05, then there was not a significant improvement between learning outcomes in the experimental class and the control class.

3 Result and Discussion

This research is a quasi-experimental aimed at determining the improvement of student learning outcomes on acid and base learning by applying the Flex model. The research was carried out at SMAN 4 Pekanbaru of class XI MIPA in January until February 2023 year. From entire population, two classes were selected as research samples in the form of class XI MIPA C as an experimental class and class XI MIPA E as a control class. There are two selected classes were given different treatment six times, experimental classes are given treatment of applying Blended Learning Flex model and control class without Blended Learning Flex model. The results of research data were carried out with normality tests, homogeneity tests, and hypothesis tests. The processing of research data is described as follows:

3.1 Results of normality and homogeneity prettest

Normality test

The normality test is performed on the pretest value data of acid base lesson. The results of normality test show that both classes are normally distributed because of the value data of (sig.) > 0.05. The results of normality test analysis of the pretest values are presented in Table 2.

Table 2. Analysis results of normality Pretest

Variable	Class	*Shapiro-Wilk*		
		Statistic	df	Sig.
Pretest	XI MIPA C	0.960	36	0.213
	XI MIPA E	0.951	36	0.110

Table 1 shows the significance value of the pretest for class XI MIPA C (0.213) and class XI MIPA E (0.110) greater than (0.05), so that the data obtained is normally distributed.

Homogeneity test

The homogeneity test is performed on normally distributed pairs of classes. The results of homogeneity test analysis show that class XI MIPA C and class XI MIPA E are homogeneous class pairs. The results showed class XI MIPA C as the experimental class and class XI MIPA E as the control class. The results of homogeneity test analysis are presented in Table 3.

Table 3. Analysis results of homogeneity Pretest

Class	*n*	Σ*X*	$\bar{X}$	F_{count}	F_{table}	t_{count}	t_{table}	Sig.	F	df_1	df_2	Declaration
XI MIPA C	36	1160	32.22	0.914	1.76	0.372	1.994	0.914	0.920	1	70	Homogeneous
XI MIPA E	36	1132	31.44									

The significance value obtained is (0.914) and the value is greater than (0.05). This means that data in class XI MIPA C and class XI MIPA E from populations that have the same variance. The value of ttabel with values α (0.05) and dk (36+36-2 = 70) is 1.994. Based on calculatations, it is obtained that t_{count} between -t_{table} and t_{table} (-$t_{tabel} \leq t_{count} \leq t_{tabel}$), are $-1.994 \leq 0.372 \leq 1.994$. The data show that the abilities of both classes are same or homogeneous.

3.2 Results of normality and homogeneity posttest

Normality test

The normality test is performed on the posttest value data of acid base lesson. The results of normality test show that both classes are normally distributed because of the value data of (sig.) > 0.05. The results of normality test analysis of the posttest values are presented in Table 4.

Table 4. Analysis results of normality Posttest

Variable	Class	*Shapiro-Wilk*		
		Statistic	df	Sig.
Pretest	XI MIPA C	0.186	36	0.061
	XI MIPA E	0.134	36	0.067

Table 4 shows the significance value of the posttest for class XI MIPA C (0.061) and class XI MIPA E (0.067) greater than (0.05), so that the data obtained is normally distributed

Homogeneity test

The homogeneity test is performed on normally distributed pairs of classes. The results of homogeneity test analysis show that class XI MIPA C and class XI MIPA E are

homogeneous class pairs. The results showed class XI MIPA C as the experimental class and class XI MIPA E as the control class. The results of homogeneity test analysis are presented in Table 5.

Table 5. Analysis results of homogeneity Posttest

Class	*n*	Σ*X*	$\bar{X}$	F_{count}	F_{table}	t_{count}	t_{table}	Sig.	F	df_1	df_2	Declaration
XI MIPA C	36	2852	79.22	0.058	1.76	0.527	1.994	0.058	3.72	1	70	Homogene-
XI MIPA E	36	2660	73.89									ous

The significance value obtained is (0.058) and the value is greater than (0.05). This means that data in class XI MIPA C and class XI MIPA E from populations that have the same variance. The value of ttabel with values α (0.05) and dk (36+36-2 = 70) is 1.994. Based on calculatations, it is obtained that t_{count} between $-t_{table}$ and t_{table} ($-t_{tabel} \leq t_{count} \leq t_{tabel}$), are $-1.994 \leq 0.527 \leq 1.994$. The data show that the abilities of both classes are same or homogeneous.

3.3 Results of N-gain Test

N-Gain is a test used to determine the increase in class scores. N-Gain test results compared with established criteria. The results of N-Gain test analysis are presented in Table 6.

Table 6. Analysis results of N-Gain test

Class	*N-gain*	Criteria
Experiment	0.70	High
Control	0.61	Medium

Table 6 shows that the experimental class has an N-Gain of 0.70 which is categorized the score increase is high. While the control class has an N-Gain of 0.61, the score increase is medium. The results showed that the use of Flex model in the experimental class was more effective.

3.4 Results of Hypothesis test

Hypothesis test using N-Gain data through the Independent Sample T-test. The results of hypothesis test analysis are presented in Table 7.

Table 7. Analysis results of Hy[oyhesis

Assumed	T-test for equations Average	
	df	Sig. (2-tailed)
Equal variances assumed	70	0.004
Equal variances not assumed	57.935	0.004

Table 7 shows N-Gain using Independent Sample T-test with SPSS 25. The result obtained with a sig. (2- tailed) value of 0.004. The value indicates smaller than 0.05 means Ha is accepted and H0 is rejected, so that there is an increase chemistry learning outcomes on acid base lessons using the Flex Blended Learning model in class XI MIPA SMAN 4 Pekanbaru.

Improving student learning outcomes through the implementation of Flex model because the stages of Flex model have been designed to direct students in building on their previous knowledge with new knowledge so that an understanding is formed. Learning using the Flex model is more flexible and adaptive to the needs of students making learning more focused on the abilities of each student [18]. Before implementing the Flex model and without the Flex model, pretest are given to students. Pretest values that have been obtained by students will be tested for normality and homogeneity test. The significance value of the pretest in class XI MIPA C (0.213) and class XI MIPA E (0.110) is greater than (0.05), so that the data obtained are normally distributed. After the pretest value data for class XI MIPA C and XI MIPA E are normally distributed, then homogeneity test is carried out on the pretest value data of the both classes. The significance value obtained is 0.914 which value is greater than (0.05), so the distribution of data is homogeneous. The purpose of giving pretest is to find out the initial ability of students related to the lessons to be delivered. After giving the pretest, the learning process will continue for the next meeting.

The learning process for experimental classes using the Flex model is carried out in the classroom face to face. Flex model is type of Blended Learning model, where lessons are delivered through online learning videos with offline learning activities. Instructional learning is carried out through video media, but interaction between teachers and students is face to face both individually and in groups according to the needs of students [22]. The provision of videos aims to make students understand the learning independently and during discussions students can understand the problems given to worksheets. Teacher prepared six learning videos, in the form of the first video containing lessons about substances that are acid and base in everyday life and the concept of acid base according to Arrhenius, Bronsted Lowry, and lewis. The second video contains lessons on acid and base indicators and solution pH using several indicators. The third video contains lessons on simple acid base practicum in the form of changes in litmus paper and extracts of natural materials. The fourth video contains lessons on water equilibrium and pH of strong acid and strong base solutions. The fifth video contains lesson on calculating the Ka values of weak acids and Kb values of weak base with known concentrations and pH. The sixth video contains lessons on calculating value of degree ionization and the reaction of acid and base.

The learning video provided, begins with a command to make learning summary. Learning video begins with statements related to everyday life about acid and base. Then a brief explanation of learning, besides that several questions must be answered by students. Technical provision of this learning video is through Google Drive link. This stage, students are expected to have understood the lesson and recorded things that are not understood by lesson explained in the learning video. Learning videos given to students affect learning outcomes, this is accordance with the research conducted byAriawan et al [17] using media in the form of learning videos in learning process has

an influence on student learning outcomes. Learning videos including technology-based learning media. According to Erna M [23] technology-based learning media has the potential to facilitate the achievement of independent learning atmosphere. Media needs to be built interactively so that it can be used as a complement to motivate students independently and easily, anywhere, and anytime to improve student learning outcomes.

Learning videos given to students will be written in notebooks. The learning videos provided include the seeking of information stage. Teacher checks the student's notes from the video that has been given regarding the lesson summary, the answer to questions from learning video. All students work on lesson summaries, answer questions in learning videos and record questions that students do not understand [24]. For example, at the first meeting there were some students who did not understand the concept of Bronsted Lowry acid base, the fifth meeting had some students who did not understand how to calculate Ka and Kb of an acid and base solution. The second, third, fourth, and sixth meetings had no record of questions about the lesson that had not been understood. This question will be discussed through group discussion. In Figure 2, one of the students can be seen observing the learning video.

Fig 2. Learning videos for experimental class

The next stage is acsquiting of information. This stage explains that students conduct group discussions and work on worksheets and problem questions that have been determined, students are given the freedom to search for literature in chemistry learning books and internet. After the discussion activity is over, students enter the final stage in the form of synthesizing of knowledge. This stage explains that knowledge is obtained through the process and results of discussions and conclusions [22]. After the synthesizing of knowledge stage is over, then students will be given evaluation questions by teacher which are done individually to find out the abilities of students each meeting.

Teachers do not use the lecture method in class because direct activities begin by watching learning videos given to students independently [5]. After watching the learning video, students have group discussions. Group discussions are aimed to students

who have watched learning videos and have positive influence on students in working on worksheets given by teacher. Implementation of Flex model can improve student learning outcomes, this is an agreement with research conducted by Ariawan et al [17] the implementation of Flex model has positive effect and is able to improve science learning outcomes. Learning using the Flex model is more flexible and adaptive to the needs of students making learn more focused on the abilities of student. This is impact on improving learning outcomes [18].

The learning process in the control class is different from the experimental class. The control class implement scientific approach. Teacher provides lesson for each meeting in the form of powerpoint to students to learn the problem in the lesson. The lesson that has been given by teacher, will be written by students. Students will discuss with their group about lesson that has been given and the work on activity sheets. Activity sheets that have been done will be presented and discussed together in class. After the lesson given to students each meeting is over, then posttest is given.

The purpose of giving posttest is to find out the knowledge of students after getting the lessons that have been taught. Posttest scores obtained by students, then will be tested together with pretest scores. The test carried out is an Independent sample T-test using N-Gain data. The following are the pretest and posttest scores obtained by both classes.

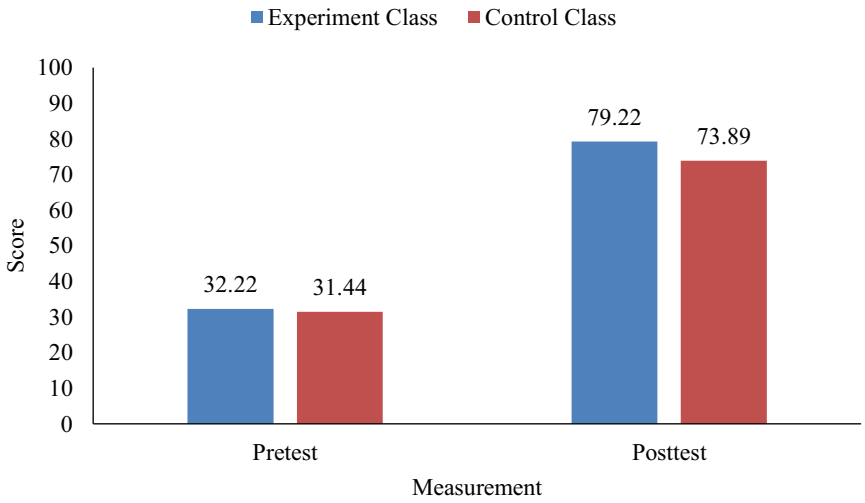

Fig 3. Learning videos for experimental class

The Figure 3, shows an increase in learning outcomes after applying the Flex model to the experimental class. While the posttest score for experimental class was greater than control class. Improve learning outcomes due to good understanding of student concepts. This is in accordance with the research of Ariawan et all.[17] the Flex model can improve learning outcomes because the learning presented by teachers is in the form of videos that can make students understand learning concretely, as if students can

be directly involved in the learning presented by teacher. Learning with Flex model provides understanding to students in a simple but meaningful way. Flex model is included from the Blended Learning parts. Based on Sidiq's [25] research, blended learning model has positive influence on students' understanding of concepts. Because the model combines positive aspects of face to face and online learning. Positive aspect of online is that learning is not limited by space and time which allows students to do more effective learning, while positive aspect of face to face is that teachers more easily to control the class. This model explains the online system is an inseparable part of overall learning process [26]. Blended Learning can encourage students to learn more actively (student centered) and teachers function more as facilitators to create fun learning. The implementation of 32.22 79.22 31.44 73.89 0 20 40 60 80 100 Pretest Posttest Value Class Experiment Class Control Class Blended Learning model can be used as an organizing strategy both in terms of delivery and quality of learning, because it can accommodate technological developments without having to leave face to face learning [27].

The implementation of the Flex model experienced several obstacles in the form of few students responding to other students' presentations at the first meeting. Based on this problem, teachers need to train the courage of students by doing questions and answers to the results of group presentations.

4 Conclusion

Based on the results and discussion, it can be concluded that the implementation of the Flex Blended Learning model can improve chemistry learning outcomes in acid and base of class XI MIPA SMA Negeri 4 Pekanbaru with a significance value (2-tailed) obtained is 0.004. The value (0.004) is less than (0.05), the value indicates that H_a is accepted. If H_a is accepted, there will be increase in chemistry learning outcomes after the implementation of the Blended Learning model Flex at class XI MIPA SMAN 4 Pekanbaru.

References

1. Untari and Millatussa'adiyyah. Implementation Of Blended Learning Through Google Classroom. In: Generation Z. 1st International Multidisciplinary Conference on Education, Technology, And Engineering (2020).
2. Purnomo, A., Ratnawati, N. Aristin, N. F. Pengembangan Pembelajaran Blended Learning Pada Generasi Z. Jurnal Teori Dan Praksis Pembelajaran IPS, **1**(1), 70–76 (2016).
3. Samala, A. D., Fajri, B. R., Ranuharja, F., Darni, R. Pembelajaran Blended Learning bagi Generasi Z di Era 4.0. Jurnal Teknologi Informasi dan Pendidikan, **13**(1) (2020).
4. Koehler M.J., Mishra, P. What is Technology Pedagogy Content Knowledge. Contemporary Issues in Technology and Teacher Education **9**(1) 60-70 (2009).
5. Yuliani. Penerapan Model Flex Blanded Learning Pada Sistem Pendidikan Jarak Jauh. Jurnal Perspektif (2021).
6. Oxtoby, D., Gillis, Nachtrieb. Prinsip-Prinsip Kimia Modern Edisi Keempat Jilid I. Erlangga, Jakarta (2008)

7. Margaret, M., Sumari. Pengembangan Media Pelajaran Kelas Flipped Berbasis Animasi untuk Meningkatkan Pemahaman Konsep Kimia. Jurnal Pendidikan, **3**(3) (2020).
8. Sukemi. Model Pembelajaran Discovery Secara Blended Learning Untuk Meningkatkan Hasil Belajar Materi Asam Dan Basa. SCIENCE: Jurnal Inovasi Pendidikan Matematika dan IPA, **2**(1), 86–97 (2022).
9. Febriani. Meningkatkan Kemandirian Belajar Siswa melalui Metode Blended Learning berbantuan Google Classroom pada Materi Kesetimbangan Kimia. Jurnal Pendidikan Kimia Indonesia, **5**(1), 9–15 (2021).
10. Holden, S. Penerapan Blended Learning Berbasis Moodle Untuk Meningkatkan Hasil Belajar Mahasiswa. Jurnal Informatika Dan Teknologi Pendidikan, **2**(1), 1–5 (2022).
11. Astriyanti, G., Susilaningsih, E., Supartono. Model Blended Learning Berbasis Task dengan Penilaian Jurnal Belajar Terkait Pencapaian Kompetensi Dasar. Chemistry in Education, **6** (1), 15-19 (2017).
12. Isti'anah. The Effect of Blended Learning to The Students' Achievement In Grammar Class. IJEE: Indonesian Journal of English Education, **4**(1), 16-30 (2017).
13. Sya'idah, F.A.N., Wijayati, N., Nuswowati, M., Haryani, S. Pengaruh Model Blended Learning Berbantuan E-LKPD Materi Hidrolisis garam Terhadap Hasil Belajar Peserta Didik. Chemistry in Education, **9**(1), 1–8 (2020).
14. Bili, A. M., Mustaji, M.S. B., Bachri, B. Pengaruh Blended Learning Terhadap Hasil Belajar Mata Pelajaran Kimia Pada Siswa SMA Negeri 1 Waikabubak Sumba Barat-Ntt. Jurnal Ilmiah Mandala Education, **9**(1), 326–331 (2023).
15. Hidayat, M.T., Junaidi, T., Yakob, M. Pengembangan Model Pembelajaran Blended Learning dalam Meningkatkan Pemahaman Siswa Terhadap Tradisi Lisan Aceh. Jurnal Mimbar Ilmu, **25**(3), 401-410 (2020).
16. Staker, H., Horn, M. Classifying K-12 Blended Learning. Harvard: Innosight Institute (2012).
17. Ariawan, S., Tawil, Bintang, A. Pengaruh Blended Learning Flex Model Berbantuan Media Video terhadap Hasil Belajar IPA Materi Ekosistem. Borobudur Educational Review, **1**(1) (2021).
18. Rahmadani, R. Penerepan Flex Blended Learning pada SMKS Imelda. Jurnal Teknologi Pendidikan (JTP), **15**(02) (2022).
19. Siyamta. Strategi Blended Learning Flex Model pada Pembelajaran Administrasi Jaringan Komputer untuk Meningkatkan Pengalaman Belajar. Jurnal Inovasi Dan Teknologi Pembelajaran, **1**(1.) (2014)
20. Ananda, R., Fadli. Statistik Pendidikan. Widya Puspita: Medan (2018).
21. Jakni. Metodologi Penelitian Elsperimen Bidang Pendidikan. Alfabeta: Bandung (2016).
22. Cahya, D., Indah, C., Priyanto, Dwi, S. Blended Learning Konsep dan Implementasi pada Pendidikan Tinggi Vokasi. Swasta Nulus: Denpasar (2019).
23. Erna M., Susilawati, Haryati, S., Alodia, F. The colloid labyrinth media to improve students motivation and learning achievement on chemistry lessons. Journal of Physics: Conference Series. **1563** (2020).
24. Talenggoran, E. M., Karundeng, M. Efektivitas Model Pembelajaran Blended Learning Dalam Meningkatkan Hasil Belajar Siswa Pada Materi Asam Basa di SMA Negeri 1 Ratahan. Oxygenius, **3**(2), 92–96 (2021)
25. Sidiq. Penerapan Model Blended Learning untuk Meningkatkan Pemahaman Konsep Termokimia Siswa. Jurnal Pendidikan Kimia, **1**(1) (2019).
26. Siti and Kuntum. Implementasi Blended Learning Berbasis Moodle Pada Jurusan Pendidikan Teknologi dan Informasi. Jurnal Petik, **4**(2), 106–113 (2018).

27. Maryam. Pengaruh Blended Learning Berbantuan Microsoft Mathematic terhadap Kemampuan Berpikir Kreatif. Jurnal Pendidikan Surya Edukasi, **4**(2), 23–24 (2018)