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Investigating the Attitudes of Chemistry Students Towards Blended Learning: A Survey Cross Sectional

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Abstract: This study's main objective is to explore chemistry students' attitudes towards the learning policies implemented during the Covid-19 Pandemic. Method: This study used a quantitative approach with a cross-sectional survey method. Respondents were 201 students majoring in chemistry at a university in Surabaya, Indonesia. The data collection instrument was a questionnaire developed during the research and validated through a confirmatory factor analysis (CFA) test. Data analysis used is descriptive statistics and two-way ANOVA test to interpret differences in student perspectives based on two characteristics. Findings: 18 of the 21 questionnaire items fall into the valid and reliable category with a loading factor value greater than 0.50. From the two characteristics of the respondents who were analyzed through the two-way ANOVA test, there were significant differences in student perspectives on the implementation of learning based on learning intensity with significance levels of 0.031. Overall, 52% of students choose blended learning, 46% face-to-face, and 2% online learning. Implications for Research and Practice: Currently, blended learning is still relevant for chemistry students in Indonesia. With notes, face-to-face learning is carried out more than virtual (online) learning, and practical learning in the laboratory is carried out face-to-face in full.

Keywords: Blended learning; Chemistry students; Covid-19; Indonesia learning policy

Introduction

Over the past two years, many things have happened in the world of education due to the COVİD-19 pandemic. Restrictions on face-to-face learning are a real challenge in today's education world-moreover, the chemistry department has a laboratory-based practice component (Wijenayaka & Iqbal, 2021). Lecturers and students are required to maximize the use of technology so that learning can continue even without direct physical contact (Ali, 2020). It is not surprising that there are many challenges faced by lecturers and students, especially in terms of internet access, teaching materials, and technological resources (Macias et al., 2022). In addition, this challenge arises from students' lack of interest and involvement in online learning. Even though teachers at various universities have made many innovations, most students still do not want to continuously do online learning (Chung et al., 2020). Virtual learning caused student learning enthusiasm to decline during the COVİD-19 pandemic, especially for chemistry students who needed to do direct learning in the laboratory. Even though many learning technologies have been developed, students still consider social presence and involvement important elements of their lectures (Tan, 2020).

Technological development in university learning activities was massive during the COVİD-19 pandemic (Chick et al., 2020; Ferdig et al., 2020). Learning flexibility occurs at various levels of educational units. So, the terms "synchronous" and "asynchronous" are widely known in Indonesia as two online learning methods that are often applied (Fadhilah et al., 2021). Although both are carried out online, the implementation model is quite different. Asynchronous learning is carried out independently by students in their respective places with assignments, so guidance from the lecturer is lacking in this learning (Murphy et al., 2011; Xie et al.,

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2018). As a result, students feel a greater workload (Aristovnik et al., 2020). Due to a high workload and a lack of psychological support, many students experience mental disorders such as excessive stress, depression, and anxiety (Astutik et al., 2020). Not only are students stressed, but lecturers and teachers also experience stress and fatigue, not because of workload but because of uncertainty about information regarding learning policies that will be implemented later (Westphal et al., 2022).

Education policymakers are basically in a dilemma. National policy in Indonesia continues to place safety and health as a top priority (Djalante et al., 2020). This decision was taken even though it caused disparities between students in the learning process. (Ramadani et al., 2021). As a result, there is a decrease in student interaction, which spoils the learning experience (Hollister et al., 2022), especially in the chemistry department, which includes laboratory learning. They have the potential to lose the essence of learning chemistry itself. Therefore, national and university policymakers need to find out the perspectives and wishes of students towards the learning process because students are the main goal (raison d'être) for universities' existence (Chickering & Gamson, 1987). This study is intended to describe the attitudes and opinions of chemistry students towards the currently applicable learning policies. Facing student perspectives is the most appropriate step to determining learning policies in the current and post-COVID-19 pandemic. One of the most likely methods to be used is opinion polling through a survey of students, which is the focus of education. Surveys are one of the most appropriate methods for assessing attitudes, opinions, perspectives, beliefs, and current practices in education (Cresswell, 2015).

Many studies have been conducted to determine students' opinions and attitudes towards learning during the COVID-19 pandemic. Post-COVID-19 education rearrangement can be done with blended learning strategies, which are more successful than online learning (Masturin & Zaman, 2022). In several other countries, such as India, the blended learning needs much consideration because of the problems of students with very diverse backgrounds (Bordoloi et al., 2021). The biggest challenges are the use of technology and the digital literacy gap. This is important because it involves the quality of teaching. According to Singh et al. (2021), Students' social and cognitive presence is important when considering the considerations of implementing blended learning.. However, many findings from other studies are contradictory, as in one of the medical universities in Kazakhstan, which states that the level of academic motivation is higher when implementing blended learning. It is said that the learning transition from online to a blended learning model benefits students (Bolatov et al., 2022). In Malaysia, blended learning and flipped classrooms have proven practical in implementing a multidisciplinary curriculum, even though the implementation is not yet mature. Effectiveness depends on the collaborative efforts of educators, institutions, students, parents, and stakeholders (Soon Tan et al., 2022). In Singapore, new normal learning is designed with the support of digital technology so that the younger generation is more agile and flexible in dealing with the post-pandemic world (Ng, 2021). Hybrid curriculum development combining traditional and online learning is also carried out in Australia. Student preferences are divided into two groups: one tends toward a blended learning approach, and the other prefers online learning only (Brown et al., 2022). Similarly, the country of Brunei Darussalam has adopted blended learning significantly, even though there are pedagogical challenges that affect the learning experiences of teachers and students (Ibrahim et al., 2022). Blended learning is also being implemented in Vietnam, despite numerous challenges such as technical, financial, community, and internet access. So, it needs good preparation from the university staff, lecturers, and students (Kang & Duong, 2021). In essence, the sudden attack of COVID-19 created serious problems in more than 150 countries and affected 1.6 billion learners, including university students. Blended learning is important because long-distance online learning is not enough. Therefore, digital literacy and the availability of technology are mandatory requirements that educators and students need to implement (Munoz-Najar et al., 2021).

In Indonesia, blended learning, which is carried out using the Project-Based Learning (PjBL) model, is said to increase the average score of students' critical thinking (Yustina et al., 2020). The implication is that blended learning is effectively implemented in several educational institutions in Indonesia. Almost all schools and universities in Indonesia have implemented online learning and blended learning during the COVID-19 pandemic. One of the most recent forms of learning to be adopted and implemented is hybrid learning, also known as the "baur" system, implemented at Surabaya State University and Yogyakarta State University. The scheme applied to the system is an odd-even system of student identification numbers and a face-to-face sharing system at the beginning or end of the week. Until now, university policymakers have worked hard to develop the most appropriate schemes to ensure that education and health can go hand in hand during the learning process.

Previous studies have focused more on student perspectives in general. Several studies have also focused on social science faculty students who do not include learning in the laboratory at all. This research specifically tries to reveal the different perspectives of chemistry students on learning policies during the

COVID-19 pandemic. Several universities in Indonesia have implemented blended learning for a year or more. However, many studies state that blended learning benefits students (Watrianthos et al., 2021). There is an interesting issue where many chemistry students are bored with the current blended learning system. This certainly necessitates a re-evaluation of university policies. Moreover, the science faculty contains practice-based lessons in the laboratory also requires special attention. The effectiveness of learning with the blended learning model must be reviewed and questioned (Watrianthos et al., 2021). One of the most appropriate ways is to look at the students' points of view. Probably most students choose face-to-face learning over blended learning, which is currently implemented in many universities. Research conducted by Atwa et al. (2022) stated that at one particular university, more than half of its students chose face-to-face learning over blended learning. However, many other studies reveal otherwise. As the results of research from Nasution et al. (2021) state that most students tend to choose a blended learning system rather than an online or face-to-face one. Therefore, it is important to study chemistry students' attitudes and opinions towards learning policies in Indonesia. Not only as a consideration for policy makers but also as evaluation material for lecturers and universities to improve future learning implementation.

The author believes that blended learning should be studied more deeply because it is directly related to the success of learning after the COVID-19 pandemic. There are indications that the experience and intensity of students' learning influence their attitudes toward the learning process. Learning experiences in this case are online, offline, and blended. Students who have experienced online learning may tend to choose an online system. While the intensity of learning can be interpreted as the number of hours a student learns outside of school hours, Students with high learning intensity may tend to prefer offline learning to online or blended learning.

The purpose of this study is to describe the attitudes and opinions of chemistry students toward the recently changing policies of education implementation in Indonesia. Therefore, this perspective can be one of the directions for policymakers to decide how learning in Indonesia should go forward. This study will answer the following problem formulation using the cross-sectional survey method: (1) Are there significant differences in the attitudes of chemistry students towards blended learning based on learning experience and intensity? (2) Is blended learning, as it is currently implemented in Indonesia, still relevant for chemistry students? (3) What are the preferences of chemistry students for lectures that might be implemented in Indonesia in the future?

Method

This research was designed with a quantitative approach based on survey methods. The type of survey used in this research is a cross-sectional survey, one of the most popular forms of survey design in the world of education (Creswell, 2012). This type of cross-sectional survey was chosen because it fits the research objectives to focus on studying, comparing, and describing the participants' attitudes, beliefs, opinions, and behaviours (Kerlinger, 1979) with the research flow as shown in Figure 1.

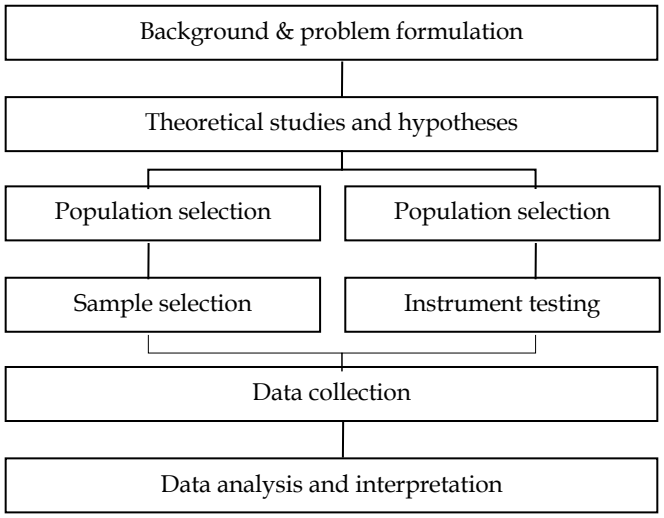

Figure 1. Research flow chart

This research also assesses and provides recommendations on policies for implementing online, face-to-face, or blended learning in Indonesia from the perspective of chemistry students. The sample for this study was made up of 201 chemistry students at one of the state universities in Surabaya, Indonesia. Participants were randomly selected (simple random sampling) but limited to first-semester students believed to have truly felt the impact of changes to various learning policies during the COVID-19 pandemic. The study participants were distributed among 167 famale (83.1%) and 34 male (16.9%), with the demographics shown in Table 1.

Data from this study was collected through valid questionnaires developed during the research. This questionnaire was compiled from various references to similar studies, such as research from Owston et al. (2013), Atwa et al. (2022), and several other studies regarding surveys of lecture implementation during the COVID-19 pandemic. The questionnaire is used to collect participant data through Google Forms. Fill in the online form using a Likert scale of 5 answer points (strongly disagree, disagree, neutral, agree, and strongly agree). The developed questionnaire consists of 21 questions. Participants also chose preferences between

online, face-to-face, and blended learning regarding discussion and lecture implementation. The instrument concludes with suggestions for universities for the future and an open-ended answer model that will be presented as is.

Table 1. Participant Profile

Characteristics	Category	f	%
Gender	Male	34	16.9
	Famale	167	83.1
	Total	201	100
School Origin	Public school	138	68.7
	Private school	61	30.3
	Other	2	1.0
	Total	201	100
Majors of study	Non-educational chemistry	105	52.2
	programs	96	47.8
	Chemistry education	201	100
	program		
	Total		
Online learning	Once	193	96
experiences	Never	8	4.0
	Total	201	100
Study intensity	Never studied	10	5.0
	1-9 hours a week	85	42.3
	10-19 hours a week	60	29.9
	20-29 hours a week	31	15.4
	30-39 hours a week	9	4.5
	≥ 40 hours a week	6	3.0
	Total	201	100

Statistical calculations were carried out using SPSS version 26. Average calculations were calculated to determine the standard deviation of students' attitudes towards the current learning policy. Instrument validity was measured through Cronbach's alpha and Pearson correlations. Different tests for two characteristics of the participants were analyzed and seen in their interactions through the calculation of the two-way ANOVA test. A significance value of ≤ 0.5 indicates a difference between the two populations. In addition, descriptive analysis was also carried out to interpret the results of calculating the proportion of students' choices of the learning system they wanted. They also described some of the students' suggestions regarding the learning scheme they want during the COVID-19 recovery period. Additional data from honest answers will be analyzed descriptively as additional data in this study.

Resultt and Discussion

This section contains each research result that answers the research questions posed. This study's findings include a questionnaire on differences in student attitudes toward the implementation of learning policies in Indonesia, as well as recommendations for universities and policymakers on future learning schemes.

Validity and Reliability of Instruments

The quality of an instrument is determined by its validity and reliability. Validity is a measure of the extent to which the results of an instrument can be reproduced in other studies under the same conditions. While reliability is a measure of the instrument's ability to measure what the proposed variable should be measuring (Taherdoost, 2018). Before being used as a tool to collect data, the questionnaire instrument was tested on 20 participants with the same characteristics as those in this study. The results of these trials were used for exploratory factor analysis. The categorization results obtained identified three latent variables measured in this questionnaire, namely: social presence and interaction, collaborative learning, and satisfaction.

Confirmatory Factor Analysis (CFA)

The questionnaire instrument was used directly on the main participants of this study after it was declared valid in the trial. Factor analysis can only be performed when the instrument reaches the Cronbach Alpha reliability threshold above 0.7, the KMO is above 0.5, and Bartlett's Test is significant ($p<0.05$). This instrument has reached the park limit with a value as shown in table 2.

Table 2. Instrument Factor Analysis Prerequisites

Instrument	Valid Items	Kaiser Mayer-Olkin	Bartlett's Test	Cronbach Alpha
Attitudes of Chemistry Students Towards Blended Learning	18	0.863	X2= 1530.452 p=0.000	0.745

Table 3. Goodness of fit Confirmatory Factor Analysis

Goodness of Fit Indices	Result	Minimum*	Information
Chisq/df	1.496	1-3	Fit
RMSEA	0.050	≤ 0.08	Fit
GFI	0.91	≤ 0.90	Fit
NFI	0.95	≤ 0.95	Fit
CFI	0.98	≤ 0.95	Fit
AGFI	0.87	≤ 0.80	Fit

*The minimum requirements for the goodness of fit index criteria are according to suggestions from Hu & Bentler (1999) and Hair et al. (2010) and included in research by Anwar et al. (2020).

Verifying the instrument's validity was carried out through a confirmatory factor analysis test using Lisrel 8.8 software. In a fit model, the goodness of fit criteria is obtained, shown in Table 3.

Table 3 provides implications if the proposed model is fit and the questionnaire items are said to be valid and reliable in measuring what is to be measured in latent variables. The confirmatory factor analysis results show that the 18 items in the questionnaire are valid and significant with a loading factor above ≥ 0.5, so the questionnaire items can be used to measure

differences in student attitudes towards blended learning based on participant criteria. The fit model is developed in stages by eliminating invalid items. Items can only be included in one particular factor if the loading factor is > 0.4 (Azwar, 2021). In other sources, the minimum factor loading for each item is ≥ 0.5 (Hair et al., 2010).

Questionnaire items with a loading factor ≤ 0.5 were removed because they were considered invalid. The instrument development in this study eliminated three questionnaire items, so the data that could be analyzed could only be carried out on 18 questionnaire items. The resulting CFA fit model is composed of three factors (dimensional) with 18 questionnaire items, which can be seen in Table 4.

Table 4. Questionnaire Items

Code	Item	Mean	SD	Loading Factor	Sig.
SP1	Introductions between students and lecturers at the beginning of learning create a sense of togetherness.	3.52	0.75	0.51	0.000
SP2	Lecturers facilitate discussions in learning sessions.	3.84	0.80	0.53	0.000
SP3	One student's point of view is respected by other students in each learning session.	3.62	0.88	0.54	0.000
SP4	Blended learning systems can create a suitable environment for social interaction among students.	3.57	0.75	0.57	0.000
SP5	I feel comfortable interacting in every learning session.	3.55	0.73	0.53	0.000
SP6	The amount of interaction I have with other students in the session is appropriate or sufficient.	3.75	0.73	0.51	0.000
SP7	The quality of my interaction with other students in the session is appropriate or sufficient.	3.22	0.77	0.74	0.000
SP8	Social relations can be strengthened during the learning process.	3.28	0.77	0.75	0.000
CL1	I feel part of the learning community during the learning process.	3.36	0.84	0.74	0.000
CL2	I can develop new skills and knowledge from other members of the course.	3.19	0.81	0.55	0.000
CL3	I can develop problem-solving skills through peer collaboration during sessions.	3.31	0.95	0.76	0.000
CL4	Collaborative learning in this study has been effective.	3.24	0.93	0.69	0.000
CL5	I feel that I save more time with collaborative learning in this learning system.	3.39	0.83	0.79	0.000
CL6	Overall, the collaborative learning experience in the course is satisfactory.	3.14	0.77	0.71	0.000
SA1	The discussion in this lesson helps me understand other points of view.	2.25	0.84	0.65	0.000
SA2	I feel that the learning that is happening at this moment is of high quality.	3.16	0.82	0.65	0.000
SA3	The learning environment in each learning session motivates me.	2.70	0.88	0.64	0.000
SA4	Overall, this learning system meets my learning expectations.	3.01	0.86	0.63	0.000

Table 4 shows if the standard deviation of all items has a value greater than the mean. The implication is that there are differences in the participants' attitudes in this study. Meanwhile, the loading factor value for each instrument item is >0.5, which means the item is valid for measuring the construct we want to measure. The CFA test on this instrument has implications if the questionnaire is appropriate for use in other studies with similar participant characteristics in the future.

Two-way ANOVA

The hypothesis derived from this study is that experience factors and learning intensity influence chemistry students' attitudes towards blended learning. In addition, these two factors may have a special interaction. To see this, a two-way ANOVA test was used. The reason for selecting the two-way ANOVA test is to determine the interaction of the two factors. Where this certainly cannot be seen through the one-way ANOVA test (Kim, 2014), the obtained Likert scale data is used as the foundation for calculations. The requirements for data normality and homogeneity have been measured, and a value of > 0.05 ensures conformity. The results of two-way ANOVA calculations are shown in Table 5.

Table 5. Two-way ANOVA Test

Source	Type II Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	763.629[a]	8	95.454	2.442	0.015
Intercept	73276.1	1	73276	1874	0.000
Experience (ex)	114.058	1	114.058	2.918	0.089
Study intensity (ib)	492.774	5	98.555	2.521	0.031
ex*ib	27.584	2	13.792	0.353	0.703
error	7505.187	192	39.090		
Total	712441	201			
Corrected Total	8268.816	200			

a. R Squared = 0.092 (Adjusted R Squared = 0.055).

Table 5 shows that if the corrected coefficient model has a value of 0.015, the implication is that the model is valid. The significance value for the experience factor is 0.089, meaning that experience does not affect chemistry students' attitudes toward blended learning. In contrast to the learning intensity factor, which has a significant value of 0.031, the implication is that learning intensity significantly affects chemistry students' attitudes toward

blended learning. These factors (learning intensity and online learning experience) have an interaction significance value of 0.703. These two factors do not have an interaction that influences the chemistry students' attitude toward blended learning.

Student Perspectives on Blended Learning

One of the additional questions in this research instrument is a question related to the implementation of group discussions on the learning system that is currently implemented. There are three options: online discussions (via Zoom or other platforms), face-to-face discussions, or both (can be face-to-face and direct).

One of the interesting findings from this study is the preference among students for carrying out discussions or group work. Even though blended learning with lecturers is the most preferred choice, it differs from student discussion preferences. Most students (N = 133, 66.2%) chose face-to-face discussions over blended discussions (N = 49, 24%) or online discussions (N = 19, 10%), can be seen in Figure 2.

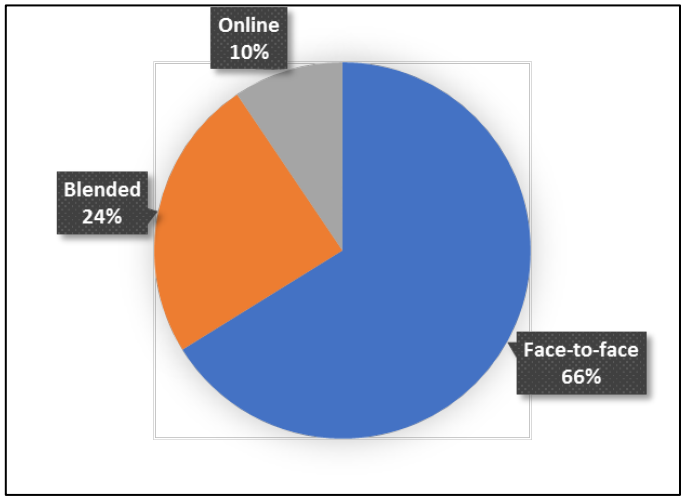

Figure 2. Discussion preferences

The implication is that students prefer face-to-face discussions with friends to lectures with lecturers. With the impact of virtual lectures, students want to continue interacting directly (face-to-face). This is also caused by asynchronous learning, which requires students to meet often for group work. This finding should be a positive input so that university policymakers pay more attention to student discussion facilities within the university environment, such as gazebos, gardens, canteens, open spaces, and others. Even though learning is carried out in a mixed manner, students can still interact actively with proper supporting facilities from the university (of course, while maintaining health protocols according to regulations). However, university institutions must also maximize online and mixed-mode discussion facilities through LMS or other learning support platforms (de Lima et al., 2019). Thus, face-to-face, and virtual learning in blended learning can go hand in hand according to student expectations.

Another finding from this research is that open-ended questions encourage students to make suggestions. Most of the student proposals lead to face-to-face lectures and blended learning. From these suggestions, an outline can be drawn if some students still choose blended learning but with certain notes. Three notes lead to suggestions for improving blended learning techniques. This is in accordance with the findings of (Muthuprasad et al., 2021) which states that the technicality of online learning (from the technology side and the provision of material) has an effect on its effectiveness. Another interesting thing is the subsidized student quota for online learning. According to "Surat Edaran Kemendikbud Indonesia nomor 821/E/E1/SP/2020", students have an internet quota. This note is possible because there are students who feel that the quota used is insufficient when learning is carried out virtually. In blended learning, universities do not need to provide quota subsidies; they only need to maximize the internet within the university by increasing access points and speed. Because, in blended learning, students do not have to study virtually all the time as a result, not a lot of quotas will be required.

According to the availability of paying quotas, respondents appear to prefer "ready to pay" (N = 83; 41.29%) over "neutral" (N = 66; 32.84%) or "not ready" (N = 52; 25.87%). Based on this data, universities do not need to provide other quota assistance besides the quota subsidy from the Ministry of Education and Culture. This is also a sign that students are not concerned about the quota assistance in the learning system that is currently implemented. This finding is supported by the analysis conducted by Asih et al. (2022), which states that quota assistance from the Ministry of Education and Culture tends to be received positively and is useful for students who get it.

Overall, students preferred face-to-face and blended learning, with or without notes. The most common reason students prefer face-to-face and blended learning is related to learning effectiveness. Many students feel they understand the material better if learning is carried out face-to-face or if there is an element of direct learning in class. In the current COVID-19 pandemic, online learning is still important, with a commitment to full student attendance (Alzahrani, 2022). However, face-to-face learning still tends to be chosen for various reasons. One of them is that students feel more involved in learning if it is done in a traditional system through face-to-face interaction in class directly (Sekhon & Patil, 2021). Some suggestions from these students also led to implementing blended learning, but with certain notes. If learning is still blended, the face-to-face elements must be more numerous than virtual learning.

Based on the answers analyzed, there are different perspectives depending on the intensity of student learning. Of all the respondents who filled out the questionnaire, only 2% tended to choose online lectures. This indicates that the online system is no longer considered relevant by students to be implemented at this time. Not only in Indonesia but also happens in other countries. Research from Giray et al. (2022) also mentioned students' negative views of online learning. One of the causes is stress levels that exceed the limit. Some students also feel that educational institutions only follow policymakers' rules and do not pay attention to students' educational needs. Another reason the online learning system is irrelevant today is that chemistry students must practice in laboratories. If students do not carry out practicums, they will feel they are not getting the essence of science in the chemistry department (Mitarlis et al., 2021). Students with low and moderate learning intensities dominate the participants. Most of them choose blended learning and face-to-face lectures. The two learning schemes are still relevant to implementation and following students' wishes. Several important factors that cause this are the experience of using learning technology and the teaching quality (Omar et al., 2021).

Another finding from this study is that the respondents who chose an online learning system were all those who had done online learning before. The implication is that they are already comfortable with the online learning system. The flexibility of online learning makes it much easier for students to attend lectures anywhere and anytime. In addition, students feel more free and independent with asynchronous learning (Mukhtar et al., 2020). Although several other studies have stated that online learning has a risk of negative student behaviour (Purnama et al., 2021). Meanwhile, all students who do not have experience with online learning choose blended learning or face-to-face learning systems. This is due to the limitations of technology and the internet, the lack of interaction in virtual learning, and the disruption of learning at home that students feel (Barrot et al., 2021). This statement is reinforced by the findings Muthuprasad et al. (2021), that student proficiency in using computers and the internet determine the effectiveness of online or blended classes. In addition, some students feel that blended learning or face-to-face learning is much more meaningful. Students learning experiences are decisive for their choice preferences. This experience can be found in the use of technology, learning interactions, and learning conditions (Yan et al., 2021). Students will certainly choose the learning system that is most comfortable for them. In Indonesia's current situation and conditions, the students in this study tend to choose blended learning over face-to-face, let alone online learning. In other words, until recently, blended learning was the most appropriate and desired by most students in this study.

Even though many studies have shown the defects of blended learning during the Pandemic, of course, there are still many big challenges in its execution. Some of them are the lack of access to technology, limited internet in rural areas, and the lack of supporting devices (Brown et al., 2022). This certainly impacts the decrease in student involvement during blended learning (Flynn et al., 2021). The real challenge of the blended learning system is the difficulty of using technology by educators. This had even happened before the COVID-19 pandemic (Jumani et al., 2018). COVID-19 has brought various lines of life into contact with digital technology, including education and teaching (Vargo et al., 2021). Not surprisingly, digital literacy is crucial for supporting the virtual learning process and academic performance (Le et al., 2022). As mentioned earlier, blended learning in terms of interaction, social presence, and learning motivation is still inferior to traditional or face-to-face learning. This is important because it relates to the success of learning outcomes. Another big challenge comes from science faculty students, who need direct learning in practice-based laboratories. If face-to-face learning cannot be carried out, the practicum also cannot be carried out for reasons of preventing the transmission of the COVID-19 virus. Science faculty students who do not practice in the laboratory will certainly lose the essence of learning science itself. According to Kolil et al. (2020), currently many virtual laboratory platforms are being developed for science students. Starting from the use of AR, VR, NUI, and 3D desktop (Chan et al., 2021). Unfortunately, these platforms will not be able to replace meaningful learning from hands-on practice in laboratories, especially for students majoring in chemistry. The chemistry department is important in optimizing the quality of research and development of products and services in Indonesia. This role will not be optimally achieved if chemistry learning is not accompanied by hands-on laboratory practice. Undeniably, practice in the laboratory is important for learning chemistry (Bretz, 2019). This is a serious challenge in science faculties that university policymakers must pay special attention to during a COVID-19 pandemic.

During the COVID-19 pandemic, all learning was done remotely online. This creates a dilemma for chemistry students. Learning chemistry includes hands-on practice in the laboratory, practicum activities in chemistry learning are important so that students do not lose the meaning of learning chemistry itself (Mitarlis et al., 2021). Thus, several universities in Indonesia have implemented limited or hybrid practicum policies. At the beginning of the pandemic, several universities replaced practicum activities in laboratories with practicums on using natural materials in the

environment around the house. This step was taken by the lecturer because there was no other choice. Moreover, the virtual laboratory was still limited to general chemistry topics at that time. Online or virtual theoretical learning may emerge as a new avenue and prove effective in some countries (Ray & Srivastava, 2020), but the meaning is different from practical experience in the laboratory, which is important and needs to be done directly. In blended learning, this problem has been resolved. This is because practice in the laboratory is regulated face-to-face, with or without restrictions. It could be done for 50% or 100% of the students in one class. As a result, unlike at the start of the 2020 pandemic, most chemistry students are no longer experiencing this issue. The flexibility of blended learning seems to have a positive impression on the university academic community (Yılmaz & Malone, 2020). Although many students are getting bored with blended learning and prefer face-to-face learning.

Conclusion

This research reveals that although online learning during the pandemic is a definite policy, respondents prefer face-to-face or blended learning. As a note, blended learning is carried out by increasing face-to-face meetings rather than virtual ones. Learning general material can be done online, while special material and practice in the laboratory are carried out face-to-face. Through quantitative analysis of valid questionnaire data, there are differences in student attitudes towards the learning policies that are currently implemented based on learning intensity. The results of these findings can be used as a consideration for university policymakers to maximize online and offline learning support facilities. Starting from optimizing learning LMS and teleconference platforms to improving facilities to support face-to-face student discussions within the university environment. Blended learning and face-to-face learning are still the best choices for chemistry students. However, this research is limited to chemistry students at a university in Surabaya, Indonesia. Data from this study were collected through a questionnaire developed to determine chemistry students' attitudes towards blended learning. The questionnaire in this study is recommended for use in similar studies in the future. Increasing the number of survey participants in this study will make the data more accurate and complete. Thus, the research conclusions are stronger as data for policymakers' considerations in establishing university learning rules.

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