Delivering Blended Learning for Generation Z: When Will We be Ready?

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**Abstract**. Teaching and learning have shifted from synchronous meetings in the classroom and laboratory to virtual synchronous and asynchronous meetings. Teaching and learning can take place anytime and anywhere. The availability of ICT infrastructure is one of the supporting factors for teaching and learning in today's Education 4.0. This article describes the availability of ICT facilities to support blended learning. Accidental sampling was conducted on 56 lecturers of the Faculty of Engineering, Universitas Negeri Yogyakarta (UNY), who participated in a webinar and filled out polls. The polls revealed that nearly 72% of respondents had subscribed to Internet Service Providers and cellular data packages. Total respondents who own laptops or PCs with Intel Core i3 / AMD Ryzen 3 processor specifications were only 23%, yet a mere 4% still own lower processors specifications. Cloud-based software provided by UNY, such as Microsoft 365, was only used by 46% of respondents. The availability of facilities to support virtual synchronous meetings included headset 96%, Zoom educational license 86%, and interactive application 18%. In contrast, facilities to support asynchronous meetings were owned only by less than 60% of respondents, including condenser or clip-on microphone types, graphic pads, video editing software, screen recording software, and project management software. Facilities to support collaborative asynchronous activities such as Google Workspace were applied by 66% of respondents. The availability of ICT facilities supporting teaching and learning is an indicator of readiness for Education 4.0, and this study shows it needs to be improved.

**INTRODUCTION**

Generation Z, who was born between 1995-2010, is a digital native generation1. This generation is currently the undergraduates or graduates of higher education and has entered the workplace. They have different characteristics from the previous generations—they fancy interaction in the digital environment. Due to the overuse of digital technology, their social skills are not well developed, so they are prone to nervousness and depression. Their concentration on one subject is relatively short, and they become easily bored with repetition and monotonous things. The learning preferences of Generation Z are individual, fast, interesting, engaging, facilitated by technology, and based on visuals2.

The development of information and communication technology (ICT) has made human life more manageable. ICT also has an impact on teaching and learning in universities. Learning initially took place synchronously in the classroom. When ICT was integrated with education, teaching and learning can be performed anywhere and anytime. The use of ICT facilitates various types of meetings, namely virtual synchronous and asynchronous meetings. Virtual synchronous meetings are facilitated by video conference technology, while asynchronous meetings are facilitated by the learning management system (LMS).

Synchronous and virtual synchronous meetings are performed when lecturers and students meet at the same time. In synchronous meetings, lecturers and students meet in the classroom or laboratory. Meanwhile, meeting locations for virtual synchronous meetings are facilitated by video conference applications such as Zoom, Webex, Google Meet, Skype3, Microsoft Teams, Big Blue Button, and others. Activities carried out in synchronous and virtual synchronous meetings include discussions, simulations, and demonstrations. Lecturing is no longer expected at both synchronous meeting4.

Asynchronous meetings involve independent or collaborative student activities. Independent student activities include reading digital text2, listening to explanations in lecturers' podcasts, watching video recordings of lecturers' presentations1,2, animation videos, or demonstration videos5,6, conducting simulations2,7, completing game2, and submitting quizzes or assignments2,7. Meanwhile, collaborative activities in asynchronous meetings include discussions, group assignments, and peer assessments. All these activities are accommodated through LMS such as Moodle, Blackboard, Brightspace, and others. LMS also able to report all student activities.

Blended learning is a delivery method that combines synchronous and asynchronous meetings. The asynchronous meetings in blended learning cover 30-79% of the total meetings. The success of blended learning depends on many factors. Lecturers must have computer literacy, use ICT for teaching, educational technology, learning media, and technological tools, know the latest technology, and develop learning media 4,8. The ICT competence is the third main competency that lecturers must possess, besides pedagogical and subject knowledge8.

The implementation of blended learning requires ICT facilities, such as networks, hardware, software, and ICT equipment to support blended learning. In Indonesia, the Internet Service Providers (ISP) and cellular operators offer internet access services. Access to ICT-based learning is performed using laptops, PCs, tablets, or smartphones4. Applications can be used to bolster discussions and interactions during synchronous or virtual-synchronous meetings, such as Padlet, Miro, Kahoot, Quizziz, Mentimeter, Slido, and others. These applications will increase student engagement2. Digital whiteboard applications such as Padlet or Miro will prevent discussions that involve only certain students3. Video conferencing requires laptops or PCs with high-speed processors and a stable internet connection. Additional tools are also essential to maintain student engagement, such as high-quality microphones, webcams, and lighting. The facilities to support asynchronous meetings are more complex than virtual synchronous meetings. Producing a simple video presentation requires software for presentation, screen recording, video editing, and hardware like a microphone, webcam, and lighting. Furthermore, making high-quality videos requires at minimum HD video cameras, good quality lighting, green screens, and noise-canceling microphones. Collaborative work among students can be facilitated with cloud-based applications, such as Microsoft 365 or Google Workplace4,7.

Several lecturers of the Faculty of Engineering in UNY have been conducting blended learning since 2015. The university's policy permits the implementation of blended learning with asynchronous meetings of a maximum of 50%. Lecturer's preparation to conduct asynchronous meetings is longer than synchronous meetings. Therefore, shifting from synchronous meetings to asynchronous meetings runs slowly. The COVID-19 pandemic has contributed to speeding up the shifting process. Lecturers are forced to facilitate learning from home so that teaching and learning facilities must be provided personally at home. However, the availability of ICT facilities for blended learning by the lecturers has not been identified.

This article portrays the availability of ICT facilities, which includes network, hardware, software, and other ICT supporting tools, that are accessible, either through ownership or other means, by the lecturers of the Faculty of Engineering UNY. The availability and accessibility of ICT facilities indicate lecturers' readiness to facilitate the shifting of teaching and learning towards blended learning for today's generation.

## METHOD

### Research Method

This qualitative study described the availability of ICT facilities to support blended learning. The samples were lecturers who participated in the Lecturer Capacity Improvement Webinar of the Faculty of Engineering UNY on August 25, 2021. The sample was taken accidentally. Data were collected using real-time online polls launched during the webinar, and 56 respondents filled out the poll.

### Instrument

The instrument was prepared based on the recommendations of Chicca et al. and Bhute et al. on the facilities needed to support blended learning2,7. These facilities include internet access, hardware, institutional software and applications (provided by UNY), and supporting ICT equipment. The choice of internet access includes subscription to ISP and cellular data plan. Essential hardware for blended learning is laptop or PC processors equipped with Intel Core i7 or AMD Ryzen 7, Intel Core i5 or AMD Ryzen 5, Intel Core i3 or AMD Ryzen 3, and below Intel Core i3 or AMD Ryzen 3 processors. Institutional software and applications from UNY include Microsoft 365, Google Workspace collaborative application, and licensed Zoom Meeting (education). ICT equipment supporting blended learning includes extra hardware and software. The hardware is microphones (condenser or clip-on microphones), headsets (over-ear or on-ear), lighting, external webcams with HD quality, extended desktops, and graphic pads, or tablets. Meanwhile, the software includes interactive applications for the virtual synchronous meeting (Padlet, Miro, Kahoot, Quizziz, Mentimeter, Slido, and others), project management (Trello), video-audio editing (Camtasia, Filmora, Adobe Premiere, and others), and screen recording software (Camtasia, Filmora, Snagit, and others).

### Data Analysis

Respondents gave one answer for the 'internet access' and 'hardware' questions of the polls. Respondents can provide one or more answers to the questions of 'software or application provided by UNY' and 'ICT facilities supporting blended learning.' Data were analyzed quantitatively by calculating the percentage of respondents who chose an answer to the total number of respondents in the poll.

## RESULT AND DISCUSSION

One of the essential competencies in Education 4.0 is that lecturers must possess ICT competence. To be able to master these competencies, lecturers must be accustomed to using ICT facilities. Shifting teaching and learning from the on-campus environment to the home environment caused by the Covid-19 pandemic has forced lecturers to obtain access to ICT facilities.

### Internet Access

The central facility in blended learning is internet access. Internet access owned by the respondent in their home is presented in Figure 1(a). 28% of respondents have cellular data packages only and have not subscribed to an ISP. Virtual synchronous meeting by video conferencing requires high-speed and stable internet connection. When many of the participants turn their videos on, the need for data access increases. The ISPs provide solutions for high data needs for video conferencing activities as they usually have more bandwidth. However, there are still some areas in Indonesia that do not have ISP facilities yet. Therefore, ownership of cellular data plans becomes a reasonable alternative. Because cellular data are expensive and often unstable, some lecturers would carry out virtual synchronous activities from the on-campus internet connection. Related to this finding, lecturers at the University of California even reported difficulty facilitating video conferences due to poor internet connection3.

In providing resources or activities in asynchronous meetings, lecturers often need to upload them to an online sharing platform like YouTube or Google Drive. It requires a high-speed internet connection. The need for this high-speed internet access can be circumvented by selecting screen recording software capable of producing HD video with minimal file size and reducing the video resolution to 720p. Anything below 720p is not recommended because Generation Z likes learning media with an attractive visual appearance2.

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| (a) |  | (b) |

**FIGURE 1.** Internet access (a) and laptop or PC's processor specification (b).

### Hardware

Developing learning media for asynchronous and synchronous meetings requires a laptop or PC with high-end specifications, emphasizing the processors. Video audio editing requires a processor of at least Intel Core i5 or AMD Ryzen 5. In developing simulations, augmented reality, and virtual reality, a minimum of Intel Core i7 or AMD Ryzen 7 processors are required. Figure 1(b) shows the respondent's ownership of a laptop or PC. 23% of respondents own a laptop or PC with an Intel Core i3 or AMD Ryzen 3 processor, and 4% with a processor specification below Intel Core i3. These two processors can only support making simple and basic video presentations, like using Microsoft PowerPoint.

### Cloud-Based Productivity Tools and Application Services

Today, many education systems integrated themselves with cloud-based productivity tools, applications, and services, such as Microsoft 365, Google Workspace, and the like7. The use of cloud technology will make it easier for lecturers to store files and documents, communicate effectively, and brings portability to learning media. Many lecturers have used this technology to support their teaching and learning activities. These cloud-based productivity tools also promote collaboration in a blended learning setup9,10. Students can use cloud-based software and services to do collaborative work, such as compiling lab reports in groups, sharing photos of practical activities, and the like7. Lecturers can also provide feedback on students' collaborative work. Other advantages of cloud-based applications and services are mobility, ease of access, cost-effectiveness, better means of communication, wide usage, and time saving4.

UNY has provided cloud-based productivity tools and applications for lecturers and students, namely Google Workspace and Microsoft 365. Despite these provisions, responses show that the use of these facilities still lacks, at 66% and 46%, respectively (see Figure 2). Adoption of Microsoft 365 is lower than Google Workspace for respondents as the former's subscription came way after the latter. Moreover, Google Workspace is a cloud-native service integrated with the institution's email accounts and Single Sign-on (SSO) into the university's ICT portal. These do not necessarily show that many lecturers are adapt to cloud-based productivity tools. They may not be aware of the traits of cloud-based collaborative work.

**FIGURE 2.** Use of cloud-based productivity tools and application

As a commitment to facilitate blended learning, UNY also provides applications for virtual synchronous meetings. These applications include Big Blue Button, which integrates into Moodle LMS, Google Meet integrated with Google Suite account, and Zoom Meeting with education license. Zoom is unarguably the most popular online meetings, with reported increase in participants of 300% over four months11. Due to its ease of access and exclusive features, almost all lecturers use Zoom for virtual synchronous meetings over others. Video conference activities can be recorded and stored in a cloud-based Zoom account that anyone can access3. Zoom has the highest adoption among cloud-based applications provided by UNY, with 86% of respondents activated the unlimited Zoom Meeting educational license (see Figure 2). Despite this, some lecturers, who could be seniors, still need technical assistance to set up virtual meeting schedules using Zoom. They may unknowingly use an unlicensed Zoom account and might need help from the administrative staff to set it properly. Alternatively, their students would set the virtual synchronous activities for their lecturers by using their Zoom account as part of the institution's educational account. The somewhat low utilization of cloud-based software and applications among respondents shows that they have not used the full potential of facilities provided by the institution for optimal blended learning implementation.

### ICT Equipment for Blended Learning

ICT equipment is needed to support an excellent blended learning delivery, so easy access to these tools is essential. Figure 3 shows the lecturers' polls response on the ownership of various equipment, software, and applications that support blended learning. Headsets are owned by 96% of respondents. A headset is essential for video conferencing as it can reduce nuisances to people around, caused by the sound volume from the computer speaker. Even a low level of background noise can interrupt the concentration of the meeting12. In the aviation industry, a headset is second nature and is proved to increase the pilot's performance12. In addition, the microphone quality of the headset is usually more reliable than the integrated laptop microphone.

**FIGURE 3.** Access to supporting equipment, software, and application

Human voice production using a microphone is greatly influenced by the selection of the type of transducer (dynamic, condenser, and the like), the distance from the microphone to the sound source, and the polar pattern13. Integrated microphones in laptops generally capture sound at a distance that is not ideal. Small size laptops and headsets microphones have an omnidirectional polar pattern that picks up sound from all directions. The ideal microphone for excellent human voice production is a condenser with a cardioid polar pattern that attenuates noise from the surroundings13. Condenser microphones are generally used to produce audio recordings or podcasts, make simple video presentations with Microsoft PowerPoint, or record videos with screen recording techniques. For virtual synchronous meetings, the use of a condenser microphone will also produce stable and noise-free sound. While the clip-on microphone is usually used for video recording using a video camera or cell phone. Several types of clip-on microphones are also equipped with noise-canceling facilities. Although condenser microphones and clip-on microphones are essential to produce good quality audio, it turns out that these facilities are only owned by 59% of respondents.

Nearly 57% of lecturer respondents have lighting equipment at their disposal. The choice of lighting in the home environment can be from simple ones, such as table lamps, ring lights, or LED video lights. The use of lighting in video conference activities is helpful to see the lecturer's face more clearly. Sometimes the lecturer also video-shared an item during a video conference that requires sufficient lighting. Lighting also helps when recording video with a webcam. An external webcam with HD quality should be used to produce good images, video conferencing, and video recording. An external webcam will offer flexibility if the lecturer wants to show an item or tool not positioned in front of the laptop. An HD quality of 720p will produce video recordings with good visual quality, which generation Z students like. Although an external webcam has its merit, this tool is only owned by 25% of the respondents. Most of the respondents still rely on the laptop's built-in webcam or convert their cell phones into cameras with the help of applications.

A second monitor for extended desktop is owned by only 16% of respondents. The use of an extended desktop can increase work effectiveness. An extended desktop is needed if the lecturer wants to open several applications on top14. Teaching using video conference technology usually requires several applications at once, such as Microsoft PowerPoint, video conferencing software, internet browsers, and others.

Whether in a classroom or a virtual setting, synchronous meetings should not be dominated by lectures. Synchronous and virtual synchronous meetings provide responsive feedback from the lecturer for discussion activities, student presentations, simulations, and demonstrations. If all participants turn their microphones on to express their opinion, a noisy atmosphere will disturb student's concentration12. Talking in the video conference room must be done in turns. When discussion activities are carried out in virtual synchronous meetings, a strategy is needed so that it is not only one person turning on the microphone, which can reduce other students' enggagement3. Therefore, lecturers need to master the skills to use interactive applications when hosting video conferences. Currently, there are many applications for collaborative and online discussions using digital whiteboards such as Padlet, Miro, Explain Everything, and others2. There are stand-alone poll applications such as Mentimeter, Slido, and Poll Everywhere, or integrated into the video conferencing software2,4. Assessment activities that promote exciting competition can be facilitated with Kahoot, Quizziz, and others2,4. Lecturers can choose one or several of these features according to the needs of the learning strategy. In this study, 18% of respondents have used those applications. It shows that video conferencing activities are still dominated by speaking activities involving only a few participants.

For student-centered learning methods, project-based learning can be used. The project can be an individual or group assignment. Lecturers can provide feedback and monitor the progress of student projects through project management applications such as Trello, Zoho Projects, and others15. The use of project management software correlates with project performance16. However, only 20% of respondents use these types of applications. It shows that lecturers have not facilitated ICT-assisted student projects much.

Asynchronous meetings can promote more individualized learning. One of the activities that students can perform is to watch videos, either in the form of lecturing videos, animation videos, or demonstration videos. Lecturers are required to be able to make recordings of material explanations independently. However, only 27% of respondents use screen recording software, and 45% use video editing software. Video editing combines video recordings, captions, images, animations, audio, and back sound6. The addition of captions, pictures, animations, and back sounds is appreciated by generation Z5. One of the recommended learning videos to explain material in the STEM field is the style used by the Khan Academy video channel2 (see Figure 4). This hand-drawn video can mimic a natural activity that involves doodling with pencil and paper. Students liked the new experience when learning with digital scribble videos, and the experience can also reduce cognitive load17. The development of Khan Academy video type requires software to read digital scribbles. Making digital scribbles videos can be done conveniently if the lecturer has a graphic pad or tablet. However, this infrastructure is only owned by 25% of the respondents.



**FIGURE 4.** Video that refers to Khan Academy best practice.

This fact shows that most lecturers have not produced their original work of learning multimedia. Whereas, according to Wagiran et al., one of the teachers' competencies is using ICT to create learning media8. Barriers to the use of multimedia in teaching and learning are 1) fixed mindset and negative attitudes towards the use of ICT in education, 2) lack of confidence in using technology, 3) lack of basic knowledge and ICT skills in using multimedia, 4) lack of access to hardware and software, 5) lack of technical, administrative and financial support and 6) lack of environmental support and time to study new technology18.

### Traits of Synchronous and Asynchronous Meetings

Most respondents have equipment for virtual synchronous meetings, namely institutional Zoom educational license accounts (86%) and headsets (96%). Meanwhile, the availability of equipment for asynchronous meetings activities is only owned by some respondents, namely microphones (59%), drawing pads/tablets (25%), screen recording software (27%), video editing software (45%), and project management software (20%). This fact shows that respondents prioritize procurement and the use of tools to facilitate virtual synchronous meetings. This trend is similar to India, where lecturers often conduct video conferences rather than facilitating video recordings for asynchronous meetings19.

Shifting from synchronous meetings is easier to conduct using video conferencing technology. Video conferencing software such as Zoom provides screen sharing, file sharing, chat, polling, break-out rooms, and record session facilities that resemble synchronous meetings activities in the class. However, video conferencing activities turned out to be preferred by lecturers and less liked by students20. Students like online learning if there is an aspect of openness to new experiences. They love new experiences in learning. If lecturers constantly use video conferencing and only rely on it for online learning, students' engagement will decrease21.

The reluctance of lecturers to facilitate learning delivery by utilizing asynchronous meetings is caused by limited time and funds. Lecturers with high ICT skills need 6-8 hours to convert an hour of synchronous meetings to asynchronous meetings22. In contrast, lower ICT skills lecturers can allocate twice as long. However, Tuma et al. reported that activities in asynchronous meetings, including accessing learning media, doing assignments or quizzes, interaction in the form of discussions, and automatic feedbacks are effective for improving learning outcomes4. Therefore, lecturers face serious challenges to carry out blended learning, finding the balance between synchronous and asynchronous meetings.

## CONCLUSION

Technology has been integrated into various aspects of learning activities. The use of technology must be based on students' needs to improve their learning outcomes. ICT infrastructure can facilitate interaction, engagement, participation, collaboration, and communication in teaching and learning activities. Lecturers are required to master pedagogical competence, subject competence, and educational technology competence. Lecturers need to identify the suitable tools and technology for delivering blended learning, gain access (through ownership or other means) to educational technology facilities, and improve their ability to use equipment that supports technology in learning. The availability of ICT facilities is one indicator of lecturers' readiness in delivering Education 4.0. Spontaneous real-time online polls have portrayed this readiness, and there is much room for improvement.

## REFERENCES

1. C. Seemiller and M. Grace, About Campus **22**, 21 (2017).

2. J. Chicca and T. Shellenbarger, Teach. Learn. Nurs. **13**, 180 (2018).

3. R.C. Chick, G.T. Clifton, K.M. Peace, B.W. Propper, D.F. Hale, A.A. Alseidi, and T.J. Vreeland, J. Surg. Educ. **77**, 729 (2020).

4. F. Tuma, Ann. Med. Surg. **62**, 231 (2021).

5. A.A. Anggraeni and R.A. Surya, in *J. Phys. Conf. Ser.* (IOP Publishing, 2021), p. 012037.

6. W. Rinawati, P.M. Ghassani, and A.A. Anggraeni, in *J. Phys. Conf. Ser.* (IOP Publishing, 2021), p. 012043.

7. V.J. Bhute, P. Inguva, U. Shah, and C. Brechtelsbauer, Educ. Chem. Eng. **35**, 96 (2021).

8. Wagiran, Pardjono, W. Suyanto, H. Sofyan, S. Soenarto, and A. Yudantoko, Cakrawala Pendidik. **38**, 387 (2019).

9. H. Al-Samarraie and N. Saeed, Comput. Educ. **124**, 77 (2018).

10. A.E. Lackey, T. Pandey, M. Moshiri, N. Lalwani, C. Lall, and P. Bhargava, J. Am. Coll. Radiol. **11**, 580 (2014).

11. A. Aiken, Index Censorsh. **49**, 24 (2020).

12. R.S. Oeppen, G. Shaw, and P.A. Brennan, Br. J. Oral Maxillofac. Surg. **58**, 643 (2020).

13. J.G. Švec and S. Granqvist, Am. J. Speech-Language Pathol. **19**, 356 (2010).

14. A.R. Kumar, B.F. Ware, A. Subramanian, S. McClellan, E. Noriega, and J. Fernandez, in *Proc. 13th Annu. Int. Conf. Ind. Eng.* (Las Vegas, Nevada, 2008), pp. 351–355.

15. A.J.G. Silvius and C.M. Silvius, Procedia Comput. Sci. **64**, 343 (2015).

16. R. Pellerin, N. Perrier, X. Guillot, and P.-M. Léger, Procedia Technol. **9**, 857 (2013).

17. S. Oviatt, A. Arthur, Y. Brock, and J. Cohen, Comput. Collab. Learn. Conf. **8**, 569 (2007).

18. M.D. Abdulrahaman, N. Faruk, A.A. Oloyede, N.T. Surajudeen-Bakinde, L.A. Olawoyin, O. V. Mejabi, Y.O. Imam-Fulani, A.O. Fahm, and A.L. Azeez, Heliyon **6**, e05312 (2020).

19. A. Selvaraj, V. Radhin, N. KA, N. Benson, and A.J. Mathew, Int. J. Educ. Dev. **85**, 102444 (2021).

20. S. Vandenberg and M. Magnuson, Nurse Educ. Pract. **54**, 103138 (2021).

21. É.C. Audet, S.L. Levine, E. Metin, S. Koestner, and S. Barcan, Pers. Individ. Dif. **180**, (2021).

22. J.A. Phillips, C. Schumacher, and S. Arif, Am. J. Pharm. Educ. **80**, 102 (2016).