

## Application of Information and Communication Technology in Online Learning at the Department of Mathematics Education

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### Abstract

This research focuses on applying of Information and Communication Technology (ICT) to the Department of Mathematics Educations lecture activities. Researchers identified five different groups of teaching practices: the use of the most frequently used platforms; forms of lecture and assessment activities; student activities in finding and exploring information related to lecture materials; the ability of lecturers to utilize technology for lectures; and the ability of lecturers and students to create a conducive learning atmosphere in classes at the Department of Mathematics Education, by taking the student's point of view. This research is a quantitative study. The data in this study was obtained through a questionnaire distributed online through Google Forms. Studies related to the application of ICT in implementing online learning activities are described in graphs based on the analysis carried out and associated with several research results and articles by the research objectives. The result of this study indicates that ICT is the key to the mathematics education process, especially in conducting online mathematics learning, which is a challenge in the work of lecturers in various universities.

**Keywords:** ability, assignments, communication, survey research

### INTRODUCTION

Information and Communication Technologies (ICT) in teaching and learning has increased substantially over the last few years in most developed countries (see Comi, Argentin, Gui, Origo, & Pagani, 2017; Falck, Mang, & Woessmann, 2018). Indonesia started to be introduced computer technology in 1970. Today, the government has invested heavily in completing schools and higher institutions with various ICT supporting devices and tools that led to massive innovation and expansion over the last few decades (for example Hasyim, 2020; Hayati & Mulyaningsih, 2019; Perienen, 2020; Rahayu, Iskandar, & Abidin, 2022; Zhang, Zhao, & Zhou, 2021). (for example: Hasyim, 2020; Hayati & Mulyaningsih, 2019; Perienen, 2020; Rahayu, Iskandar, & Abidin, 2022; Zhang, Zhao, & Zhou, 2021). Thus, computer-based learning activities, e-mail, and websites in teaching practice have spread rapidly.

During the COVID-19 pandemic, stakeholders decided to conduct learning and lecture activities online. However, no research that shows a shred of clear evidence to support this ICT-based online learning activity (Fernández-Gutiérrez, Gimenez, & Calero, 2020). In this context, the impact of ICT on educational achievement has become controversial.

Theoretically, arguments support the positive effects of ICT adoption on educational attainment, suggesting that they can improve student learning outcomes by increasing access to information and a wider variety of resources for learning. For example, the research conducted by Zhang et al. (2021) showed that distance online learning could overcome this difficulty and increase interactivity for students instead of being taught passively by reading books or watching learning videos.

As the availability of information for two subjects for the same student, as in

previous contributions in the literature, (Comi et al., 2017) adopted an identification strategy that exploits variation between subjects in students. It aims to control unobserved ICT-based distance learning activities when estimating the effect of teaching practices on student achievement in schools by measuring teacher and student abilities using scores on detailed ICT performance tests. Another critical factor in the research is teachers' beliefs about how students experience attending ICT-based lectures.

Previous evidence at the school level, research conducted by Das (2019) shows that in Information and Communication Technologies (ICT)-based mathematics learning activities, teachers' beliefs about how student experiences affect the frequency of using ICT in schools. It is not only limited to the availability of infrastructure, but also students who teachers teach can master ICT in education. Therefore, this research focuses on ICT-related practices by lecturers in lecture activities at the Department of Mathematics Education.

This study considers a broader range of teaching methods on the use of ICT, covering a broader spectrum of teaching-related activities both synchronously and asynchronously with students, either at undergraduate or postgraduate levels. The main contribution of the research is built on detailed questions to students on how many courses are conducted face to face online (synchronous) and asynchronous (Learning Management System/LMS, WhatsApp Group/WAG, and others).

Based on the research questions, there are five different groups of teaching practices: the most frequently used platforms; the form of lecture activities and assessments; the students' activeness in finding and exploring information to lecture; the ability of lecturers to use technology; and the ability of lecturers and students to create a conducive learning atmosphere. The purpose of the research is to explore how ICT is applied in lectures at the

Department of Mathematics Education from a student's point of view.

## METHOD

The research was quantitative. The data were obtained from a questionnaire, distributed through Google Form to explore the application of ICT in online lectures at the Department of Mathematics Education, at one of the higher education institutions in the province of D.I. Yogyakarta. After that, the data were analyzed descriptively and quantitatively using SPSS. Stockemer (2019) explains the stages of survey research as presented in Figure 1.

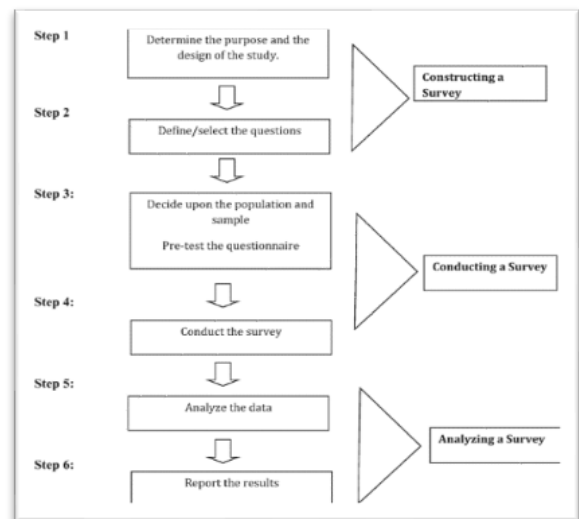


Figure 1. Different steps in survey research

The first step was, determining the objectives and research design. The second stage chooses questions whose purpose is to build a survey to answer research problems.

The focus of the research is to find out what platforms are most used by lecturers in online learning, forms of learning activities, and forms of learning assessment. Then, the student's perception of online learning which consists of: the clarity of the learning contract, the role of the lecturer in providing services to facilitate students in the learning process, students' initiatives in finding and exploring information for learning, the ability of lecturers to use technology, the ability of students to use technology to find sources of information,

students understanding of how to learn, students' ability to build attitudes, knowledge, and skills for lifelong learning, and interaction and collaboration with other students and/or lecturers.

The third and fourth stages are determining the population and conducting a survey. The total respondents/samples were 109 students.

The respondents consisted of 49 undergraduate students from the Mathematics Study Program, 34 undergraduate students from the Mathematics Education Study Program, and 26 post-graduate students from the Mathematics Education Study Program in the Even Semester of the 2020/2021 Academic Year. Furthermore, the fifth and sixth stages are conducting data analysis and reporting the results.

## RESULTS AND DISCUSSION

Studies related to the application of ICT during online learning activities at the Department of Mathematics Education at Universitas Negeri Yogyakarta are described in graphical form, based on the survey of students and analysis conducted on several studies and articles, following the research objectives.

Various works of literature show a gap between students and teachers who are used to using mobile phones, tablets, or laptops will find it easier to adapt to the use of ICT. Furthermore, these students are more able to achieve higher math scores compared to their peers (eg: Das, 2020; Eickelmann & Vennemann, 2017; Juul-Kristensen et al., 2020; Saal, Graham, & van Ryneveld, 2020). The use of ICT provides new solutions in the world of education, especially during the COVID-19 pandemic with various technological innovations, such as software and hardware (Oranburg, 2020).

The hardware consists of computers, laptops, webcams, microphones, internet networks, and cellphones. While the software consists of applications supporting learning activities such as WhatsApp, Zoom, Google

Meet, and others (for example Enriquez, 2014; Iftakhar, 2016; Irvan, Damayanto, Jauhari, & Aqilah, 2021; Pratama, Azman, Kassymova, & Duisenbayeva, 2020; Sicat & Ed, 2015).

Online learning is assumed as alternative learning during the COVID-19 pandemic (Naciri, Baba, Achbani, & Kharbach, 2020). Today, online learning activities have generated various responses to the impacts and changes in the learning system that affect the teaching and learning process (for example Jaelani, Fauzi, Aisah, & Zaqiyah, 2020; Sukoco & Suharjo, 2019).

The impact and influence of online learning on the learning process, the article analyzes several aspects, as follows:

### The platform most used by lecturers

Synchronous lecture activities are usually implemented through video conferencing with the help of software such as MS Teams, Zoom, Google Meet, Skype, and others using Google Classroom or WhatsApp Group to overcome teacher limitations in direct interaction (Karimov, Kuzmenko, & Radchenko, 2020). Figure 2 shows the most used applications are Zoom and Google Meet 99.1%, while Webex is the lowest with 0%.

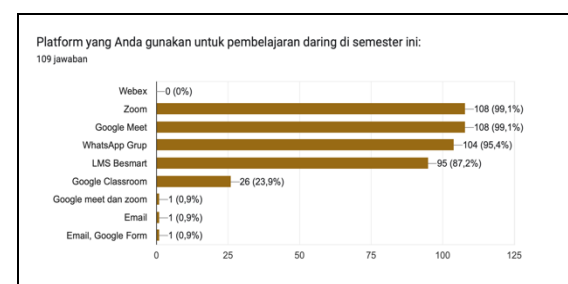


Figure 2. The platform used in online learning activities

### Forms of lectures and lecture assessments

It is a learning activity, both face-to-face, and non-face-to-face. Based on Figure 3, the most of form of learning activity that is used by lecturers to students is assignments with a total of 98.2% of respondents who choose.

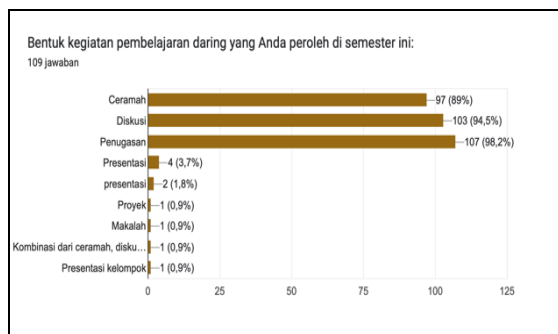


Figure 3. Forms of learning activities

Furthermore, Figure 4 shows the form of assessment carried out by lecturers in online lectures. Attendance, assignments (individual and group), and exams predominate. While assessments are conducted in the form of quizzes, activities, projects, presentations, and combinations of assessments are only slightly carried out by lecturers.

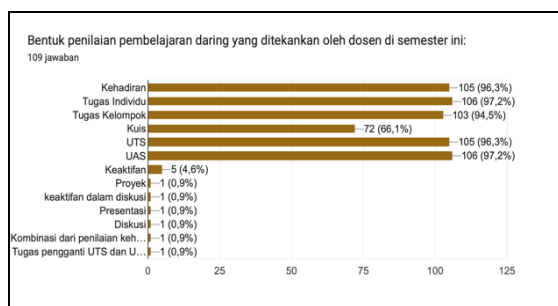


Figure 4. Forms of learning assessment

Active, cooperative, and project-based learning with innovations in online learning activities tends to develop better concepts than traditional face-to-face learning concepts (Pallavi, Ramachandran, & Sathiyaraj, 2022). In addition, the study follows the previous research conducted by Jaggars dan Xu (2013) serta Nguyen (2015), stating that most of the main objectives of online learning are to transfer information from lecturers to students who access information and expect them to be able to prove their understanding of the learning material which they understand in assignments and exams.

Furthermore, of course, it needs to understand how students perceive online learning, including, the clarity of the lecture contract (Figure 5); the role of lecturers in assisting in facilitate students in the learning process (Figure 6, Figure 7, and Figure 8);

student initiatives in finding and exploring information for learning (Figure 9); the ability of lecturers to use the technology described by students (Figure 10); how students assess their ability to use technology to find sources of information (Figure 11); students' understanding of how the learning on self-assessment (Figure 12); students' ability to build attitudes, knowledge, and skills for lifelong learning (Figure 13); and interaction and collaboration with other students and/or lecturers (Figure 14).

Learning activities must promote reflection and help students understand the flow of lectures in the future (Ayu, 2020; Kolbe et al., 2020). The goal is to provide students with a sense of psychological security to build reflective learning communications and make it easier to transfer learning materials (Frazier, Fainshmidt, Klinger, Pezeshkan, & Vracheva, 2017; LeBlanc, 2019; Roussin, Larraz, Jamieson, & Maestre, 2018).

Based on Figure 5, out of 109 students, 36 students stated that the lecture contract was very clear. On the other hand, 15 students answered that the lecture contract was still unclear.

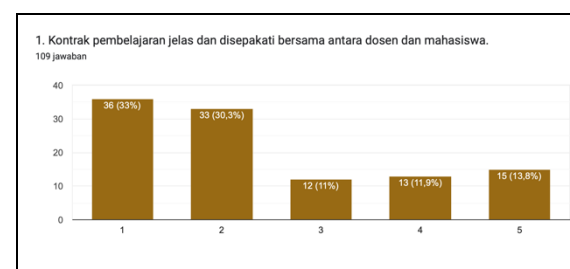


Figure 5. The clarity of learning contract

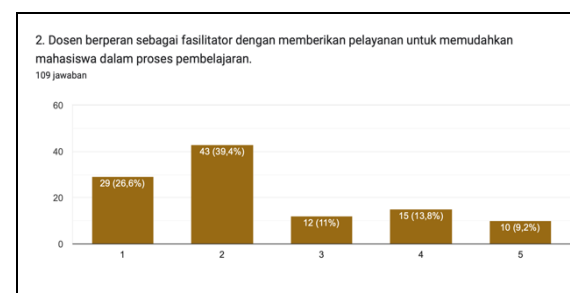


Figure 6. The role of the lecturer as a facilitator

Furthermore, Figure 6 shows that 72 students (66%) stated the lecturers act as facilitators well in online lecture activities. In line with research conducted by Aksit (2016) dan Vithayaporn, Katekaew, & Vorapanya (2020), lecturers can act as facilitators in teaching and fostering students. So, they have prioritized a strategic, innovative, and creative learning culture.

Because the form of assignment dominates lecture and assessment activities, apart from being a facilitator, the lecturer should also review and/or summarize the results of each assignment. Based on Figure 7, 61.4% of students stated that the lecturer had done well in this role. In addition, 65.2% of students assume that the lecturers had allowed students to take remedial on each task/assignment. And, it could be done at any time (more than 1 time), as presented in Figure 8. In other words, this result strengthens the role of the lecturer in lectures online as a good facilitator.

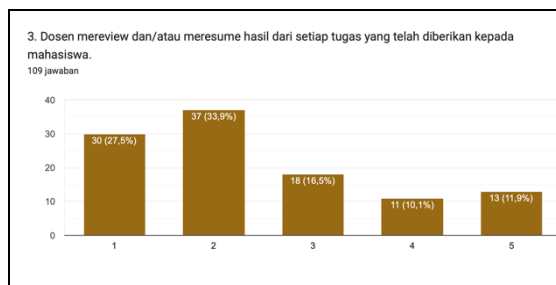


Figure 7. The role of the lecturer in reviewing and/or summarizing each assignment



Figure 8. The role of the lecturer gives students the opportunity to take remedial on each assignment/task

## The activeness of students in finding and Exploring information

The activeness of students in finding and exploring information about learning is presented in Figure 9. The abilities of students related to how they learn are presented in Figure 10. And, the ability to build attitudes, knowledge, and skills has shown very good numbers in Figure 11. This proves that students can process to plan, understand, and solve various kinds of information, problems, and curious things in learning activities (for example: Nastiti & Kaltsum, 2022; Zahroh, Hadi, Fatra, & In'am, 2022).



Figure 9. The activeness of student in finding and exploring information



Figure 10. The ability of students to understand how to learn

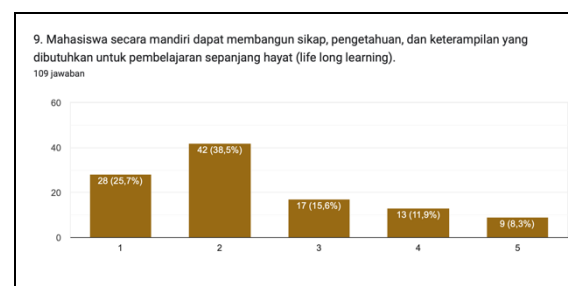


Figure 11. The ability of students to build attitudes, knowledge, and skills

### The ability of lecturers to use technology for lectures

Based on Figure 12 and Figure 13, the ability of lecturers and students to use ICT is very good. In line with research by Thomsen & Olsen (2019), the teacher's ability to use ICT and students' experimental activities in using ICT support their understanding in understanding the original source. Furthermore, various student activities in using an understanding of original sources will support the development and build awareness of mathematics that might not be appeared (for example Chen & Wu, 2020; Das, 2021; Dhika, Destiawati, Surajiyo, & Jaya, 2021; Karimov et al., 2020; Saal et al., 2020). (for example Chen & Wu, 2020; Das, 2021; Dhika, Destiawati, Surajiyo, & Jaya, 2021; Karimov et al., 2020; Saal et al., 2020).

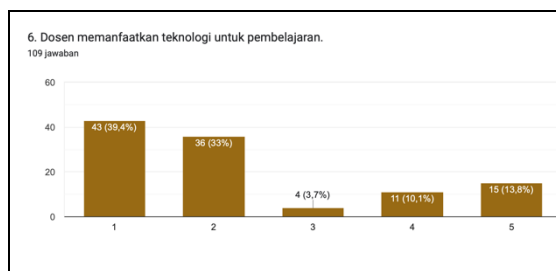


Figure 12. The ability of lecturer to use technology for learning

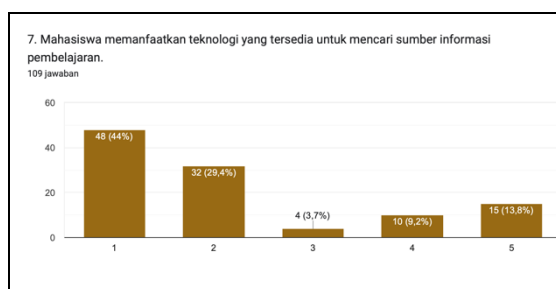


Figure 13. The ability of students to use technology to find sources of information

### The ability of lecturers and students to create a conducive learning atmosphere

Several current studies found that online learning activities using ICT components have a positive impact on students' acquisition and satisfaction with knowledge (for example Comi et al., 2017; Falck et al., 2018;

Fernández-Gutiérrez et al., 2020; Hasyim, 2020; Kruger, 2018; Mailizar & Fan, 2020; Supianti, Wahyudin, Kartasasmita, & Nurlaelah, 2019; Verschaffel, Schukajlow, Star, & Van Dooren, 2020).. Not only the ability to use ICT, but the conditions also occur if lecturers can encourage students to be active in collaborative activities, among lecturers during the course, lecturers of other subjects, and fellow students.

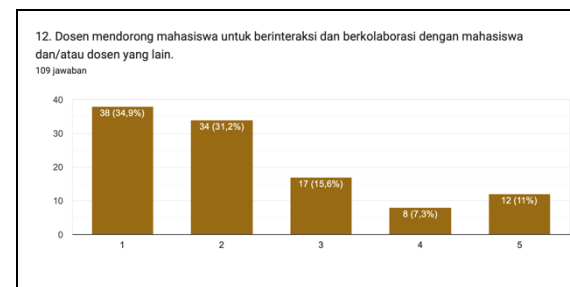


Figure 14. The ability of lecturers to encourage students to collaborate

Figure 14 shows that lecturers are very capable of encouraging students to collaborate. The role of communication and collaboration in online learning is proven by Wexner & Behrns, (2022) to be very effective in completing assignments and solving problems in learning.

### CONCLUSION

The use of Information and Communication Technologies (ICT) is key to the educational process, especially in online mathematics lectures. Lecturers must be able to help create a shared communication environment; forming various kinds of new activities in class to support and build students' awareness of education and mathematics; assist and guide students to have an awareness of independence in finding and exploring information about lecture content; and build a contextual environment and collaborate in solving problems and completing tasks more creatively and innovatively.

The use of ICT must be used maximally by lecturers in teaching. And, it is not only limited to asynchronous tools such as Google Classroom, email, and WhatsApp. But, it must



also contain tools for developing learning activities in which they have the skills to express their opinions, analyze the educational situation around them and reflect all other phenomena that occur in the implementation of mathematics learning, either at school or higher institutions.

It is also important for lecturers to involve students in collaborating in lectures to increase their knowledge by allowing them access to study materials allocated for independent work and learning. Finally, students must have initiative and self-discipline in the learning process, because in most cases, the material given to students for independent learning is ignored. Maximal use of ICT should improve this situation through tools that manage and lecturers who can motivate various student activities to be more independent.

The optimum use of ICT makes it possible to organize a more interactive communication process and online collaboration between lecturers and students, which is very much needed for distance education. However, the reality occurs is that online learning will never replace the process of direct communication between lecturers and students.

## ACKNOWLEDGMENT

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