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Improving Content Knowledge and Technological Skill of University Instructors: A Case Study for Online Learning Implementation during and after the COVID-19 Pandemic

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Abstract:

The objectives of this study were to investigate and improve the university instructor's content knowledge and technological skills relating to digital learning. The research participants involved 260 lecturers from eleven education departments that teach 260 subject matters at a private university in NTB Province, Indonesia. We verified the instructor's content knowledge through the availability of course materials suitable to students' competencies needed and their potential. Then, it identified the instructor's skill in using information and communications technology (ICT) devices and analyzed the data. Enforcing an online learning workshop for the instructors who still had low digital knowledge, we evaluated their efforts during workshop activities. This research found that in the online learning process during and post the COVID-19 pandemic, the lecturers' course material preparation was generally unsatisfactory, even though they had good competencies in the use of ICT tools. This study gave information that the instructors who had abilities to digital devices did not automatically provide good services in online learning and technology adaptation processing for students. Fortunately, by training lecturers in the e-learning platform, the institution's efforts have to be successful in solving this problem. The training approach appertained dealing with the content knowledge improvement could affect their productivity in creating the learning media based on ICT and the presentation to be interesting. The instructors could enrich the content quality. The simulation exercise of the e-learning platform improved the instructors' competency related to the benefits of e-learning devices, the arranging of course materials, and students' learning activities management. For future development, we suggest that the institution must provide progressive support and training to ensure the continuity of online learning in the university.

Keywords: content knowledge, COVID-19 pandemic, instructor, online learning, technological skill.

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提高大学教师的内容知识和技术技能：在新冠肺炎大流行期间和之后实施在线学习的案例研究

摘要：

本研究的目的是调查和提高大学教师与数字学习相关的内容知识和技术技能。研究参与者包括来自11个教育部门的260名讲师，他们在印度尼西亚西努沙登加拉省的一所私立大学教授260个主题。我们通过提供适合学生所需能力和潜力的课程材料来验证教师的内容知识。然后，它确定了教师使用信息和通信技术设备的技能并分析了数据。我们认为仍然缺乏数字知识的教师实施了在线学习研讨会，我们评估了他们在研讨会活动中的努力。这项研究发现，在新冠肺炎大流行期间和之后的在线学习过程中，尽管讲师在使用信息通信技术工具方面具有良好的能力，但他们的课程材料准备普遍不令人满意。这项研究表明，具有数字设备能力的教师并没有自动为学生提供在线学习和技术适应处理方面的良好服务。幸运的是，通过在电子学习平台上培训讲师，该机构的努力已经成功地解决了这个问题。处理内容知识改进的培训方法可能会影响他们创建基于信息通信技术的学习媒体的生产力和有趣的演示。教师可以丰富内容质量。电子学习平台的模拟练习提高了教师在电子学习设备的好处、课程材料的安排和学生学习活动管理方面的能力。对于未来的发展，我们建议该机构必须提供渐进的支持和培训，以确保大学在线学习的连续性。

关键词：内容知识、新冠肺炎 大流行、讲师、在线学习、技术技能。

1. Introduction

The readiness of lecturers in the challenging context of implementing online learning needs the aspects of technological knowledge, pedagogical knowledge, and content knowledge. As Mishra and Koehler stated that the effective instructional use of technology requires three essential linkages of teacher knowledge, i.e., technological knowledge, pedagogical knowledge, and content knowledge (cited in Morsink et al., 2010/2020). Furthermore, they defined that the technological knowledge (TK) is close to the fluency of information technology; Pedagogical knowledge (PK) is teachers' deep knowledge about the processes and practices or methods of teaching and learning. Content knowledge (CK) is the teachers' knowledge about the subject matter to be learned or taught (Koehler & Mishra, 2009). Finding research by Orlanda-Ventayen et al. (2021) suggested that teachers must accept the various technologies provided by different platforms to improve their knowledge and expertise in using technological tools in teaching. This competency includes the course designing ability and the managing time for contributing to online-teaching (Song et al., 2004). The other view stated that the primary aspect of e-learning had focused on teaching the course materials that learners must require in natural ways (Muthukrishnan et al., 2021). This view interpreted that, to implement online learning, the lecturers must dominate in using technological devices and managing the course.

Several studies reported that students' perspectives increased the digital abilities of teachers and provided feedback during online lectures (Sulisworo et al., 2021;

Susilana, 2020). So training lecturers must deal with online learning and technological tools. Trying new experiences and developing various learning methods need to be also introduced to a reliable online learning platform (Shaharane et al., 2020). This effort supports the argument that achieving an optimal online learning process needs some instructors' skills. These competencies can encourage the students to be interested and willing to learn, interactive, democratic, and wise in using internet content and online tools (Lukas & Yunus, 2021; Babe, 2021; Fuad et al., 2020). For teachers, these reviews and information can be used as a reflection to improve their future online learning process.

Considering the participating lecturers from education departments and paying attention to the students' perspectives about the e-learning obstacles, this study focused on assessing and enhancing the content knowledge and digital skills for achieving effective online learning. For these reasons, we examined the competence of the instructors in producing some standard materials for preparing online teaching-learning activities (e-handout, student worksheets, e-module, e-books, PowerPoint, teaching-learning videos, and alike). After that, we investigated the teachers' online device skills. These abilities can be used to design online learning processes (WhatsApp, email, telegram, Youtube, blog, radio online, Moodle, Google Classroom, Zoom Meeting, Google Meet, Schoology, and alike). Then, from the finding results, it was used to take action to improve their CK and TK through training. The problems of this research are as

follows.

a. How were the lecturers' content knowledge and technological skills readiness to implement the online learning using e-learning platforms during and post-Covid-19 Disease pandemic?

b. How can the university's efforts and instructors' ICT knowledge improvement be optimal in the online learning process?

Contributions to the literature are as follows.

a. This study provides contributions of knowledge and information for the lecturers and departments about how e-learning design needs various aspects of competencies and supporting systems, including the readiness of the instructor's content knowledge, digital skills and devices, technology costs, stable internet, and connectivity.

b. The study shares the understanding of lectures' difficulties and the university's challenges for online learning that could design strategies and take action in online learning development.

2. Methods

In this study, we used a qualitative descriptive method to describe a phenomenon and its characteristics actually. The steps are as follows: gathering data, interpreting and analyzing data, and reporting the findings (Nassaji, 2015; Creswell, 2013). The focus of the research has emphasized the readiness of lecturers' ability to manage and prepare the learning material (content knowledge) and the lecturers' technological skills to establish online learning based on a more reliable e-learning platform. Besides, we evaluated both lectures' content knowledge improvements and online technological skills after they attended the e-learning workshop provided by the institution during and post the Covid-19 pandemic.

2.1. Participants and Times

The research was undertaken at an excellent private university, in NTB Province, Indonesia. The university has about five thousand students, three hundred lecturers, and five faculties. These faculties consisted of twelve education departments, and eight non-education departments. This study was held in the eleven education departments for the undergraduate program to prepare the teacher candidates for elementary, junior, and senior high school levels. The use of online learning in odd semesters of the eleven departments was implemented for the first, third, and fifth semesters with a total of 260 subject matters. The distribution of the 260 courses to the departments is presented as follows. It was the English Department of Education (D1) = 40 courses, Sport Education (D2) = 30 courses, Education's Information Technology (D3) = 14 courses, Mathematics Education (D4) = 13 courses, Chemistry Education (D5) = 18 courses, Physic Education (D6) = 21 courses, Biology Education (D7) = 15 courses, Technology Education (D8) = 24 courses, Administration Education (D9) = 27 courses, Guidance and Counseling (D10) = 34 courses, and Society

Education (D11) = 24 courses (Figure 1). Regarding the 260 subject matters, the participants of this research involved 260 lecturers who taught the 260 courses. The study was undertaken from March 2021 to February 2022.

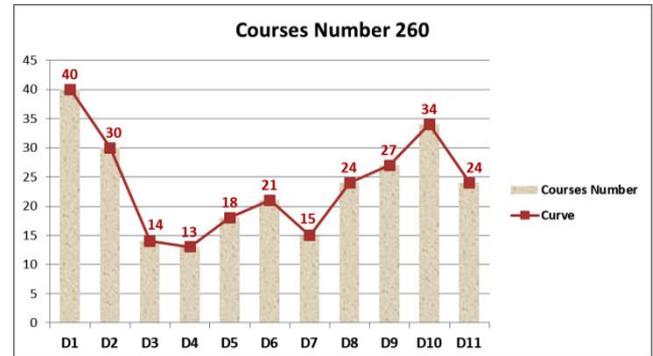


Figure 1. Online learning courses distribution of the eleven departments during the COVID-19 pandemic

2.2. Instruments and Procedure of Research

The research instruments used the instructional designs, course materials made by instructors, reported data on online media technology for each course meeting, and some e-learning platform courses on 260 subject matters. All these instruments were available in each department of the University.

In the initial step of the research, we verified that the lectures' content knowledge dealt with the availability of course materials based on instructional design. Besides, the course content that was created or uploaded from some resources by the lecturers had to be suitable for the students' needed competence. Additionally, the course materials can be implemented for student-centered learning approach. These consist of an e-handout, student worksheet, e-module, e-book, PowerPoint, and video learning-teaching. Based on these instructional designs, we assess the availability and compatibility of the course materials for each subject matter created by the instructors in the ten times course meetings in a semester. These criteria scored 1 to 3 with the codes as follows.

C1 = Score 1: No available digital learning course materials.

C2 = Score 2: Available digital learning course materials but incomplete or incompatible for online learning.

C3 = Score 3: Available course materials with satisfaction online learning content and good presentation.

The second step identified the lecturer's technological skills that dealt with the lecturer's skill in using information and communications technology (ICT) devices leading to employing these tools for designing the learning process. This was classified into three levels based on the usage complexity, i.e., social media tools, semi-academic media tools, and e-learning platforms. We assessed the use of various ICT tools by the instructors for every subject matter in ten courses meeting. Applying these indicators, we valued the use of the ICT tools from 1 to 3 with codes as follows.

T1 = Score 1: Social or non-academic media tools

(WhatsApp, email, telegram, Instagram, and alike).

T2 = Score 2: Semi-academic media tools (Youtube, blog, online radio, and alike).

T3 = Score 3: E-learning platform, academic or professional media tools (Moodle, Google Classroom, Zoom Meeting, Google Meet, Schoology, Edmodo, and alike).

The third step analyzed the result data of both steps to classify the level of the instructor's content knowledge and technology skill. Furthermore, using the assessment results of the first five meetings of each subject matter, we enforced an online learning workshop to improve the instructors' content knowledge and e-learning tools skills who still achieved low scores 1 and 2 in handling online courses.

3. Results and Discussion

Inspecting ten times classes at online meetings for each subject matter of the 260 courses was used to assess the lecturers' content knowledge in online learning during and post the Covid-19 pandemic. It found the scores category C1 = 121 courses (46,5%), C2 = 25 courses (9,6%), and C3 = 114 courses (43,9%) as shown in Figure 2a. Three departments that had many scores C1 were D10 = 27 courses of 34 courses (79,4 %), D9 = 24 courses of 27 courses (77,8 %), and D8 = 19 courses of 24 courses (79,1 %). Meanwhile, three departments with lots of scores C3 were D1 = 25 courses of 40 courses (62,5%), D7 = 13 courses of 15 courses (86,7%), and D3 = 10 courses of 14 courses (71,4 %).

On the other hand, investigating lecturers' technological skills, it reported the scores category T1= 60 courses (23%), T2 = 5 courses (2%), and T3 = 195 courses (75%) as presented in Figure 2b. Three departments had many scores T1 were D1=20 courses of 40 courses (50%), D6 = 13 courses of 21 courses (70%), and D5 = 8 courses of 18 courses (44,4%). In contrast, three departments with many scores T3 were D10 = 34 courses of 34 courses (100%), D2 = 29 courses of 30 courses (97%), and D8 = D11 = 24 courses of 24 courses (100 %).

The general description of the assessment results is that the online learning materials were structured by the instructors as being unsatisfactory. The investigation found that more than 50% of the course material is not available or incomplete notes for online learning services. From the eleven departments, there are six departments (D2, D6, D8, D9, D10, D11) that at least thirteen subject matters have no course material. In contrast, there were 195 instructors, or 75% of the lecturers' number, who had the competencies for designing e-learning platforms (Figure 2b). Five departments (D10, D2, D8, D11, D9) dominated it with at least nineteen lecturers per department. The others were in position less than fifteen lecturers per department. In this COVID pandemic case, the sudden

shift from face-to-face to distance learning might cause a distressed person and unstable internet signal. Due to these unanticipated condition, lecture costs are high for students, internet access infrastructure limited and disrupted academic management (Stadtlander & Sickel, 2021; Burkholder & Krauskopf, 2021; Tran et al., 2021; Hammoumi & Youssfi, 2020; Moralista & Oducado, 2020). Solving the problems of distance learning process' limitations is necessary emphasized to develop the instructors' content knowledge and technological skills. It is to improve the quality of the lecture materials and the use of online learning tools with a more reliable e-learning platform.

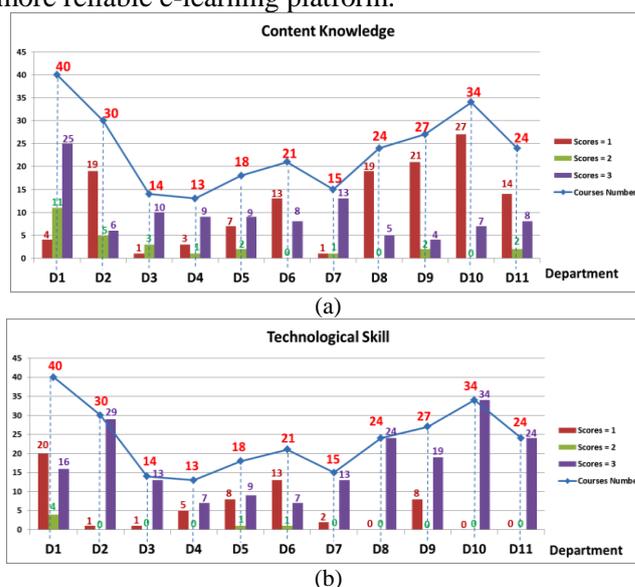


Figure 2. Content knowledge and technological skill of the instructors in online learning

Considering the academic atmosphere in the COVID-19 pandemic situation, the university tried upgrading the learning quality for the first five online meetings of the 260 courses in the semester. From these 260 courses, it was found that the score categories C1 = 94 courses, C2 = 32 courses, C3 = 134 courses (Figure 3a), T1 = 50 courses, T2 = 7 courses, and T3 = 203 courses (Figure 3b). In detail data, Figure 3 shows that there are five departments in low performance of category C1, i.e., D10, D9, D8, D11, D6 in Figure 3a, and three departments in the skill of the weak device of category T1, i.e., D1, D6, and D9 in Figure 3b. Because there were many scores of C1, C2, T1, and T2, the 126-course materials had to be upgraded into level C3 and about 57 instructors to be improved into level T3. Based on the lack of online course materials and the low competency in the e-learning platform of the lecturers, thus, it needs, as soon as possible, to enforce a workshop to develop the distance learning services in the university.

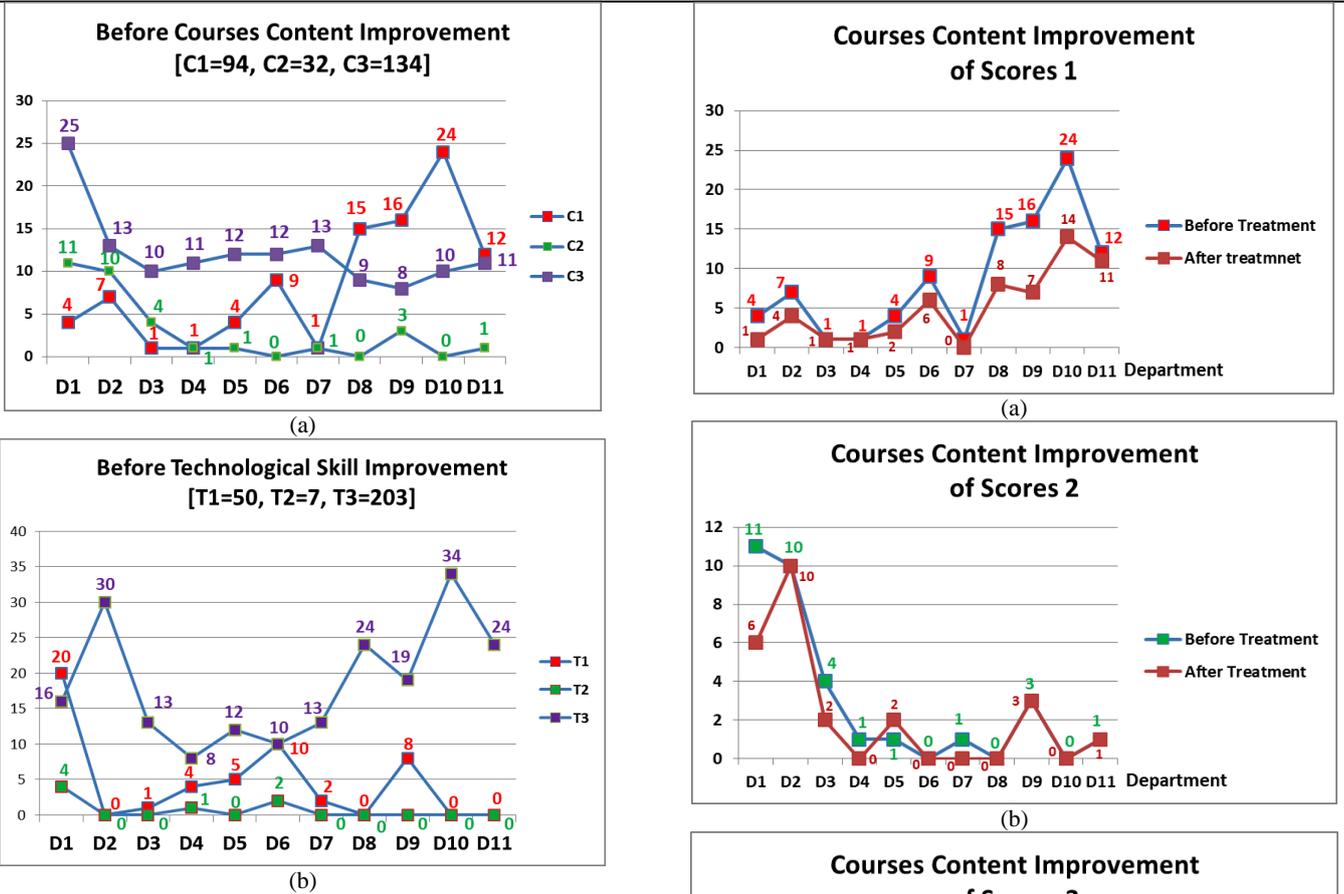


Figure 3. Instructor profiles of the content knowledge and technological skill before improvement

Conducting workshop focused on the treatment of the C1 lecturers' category of five departments ordered from the lowest performances, i.e., D10, D9, D8, D12, and D6 (Figure 4a). Besides, it handled to upgrade the C2 lecturers' category from the departments D1, D2, and D3 (Figure 4b). The intervention materials included a simulating create-account, menu, and features, making e-modules, teaching-learning videos, e-attendances, e-assignments, and e-assessments, creating student worksheets, online forum, and discussions. Among these eleven departments, the most ready-in-courses material aspect for implementing online learning were only two departments, i.e., D4, and D7 (Figure 4a,b). The ending workshop activity reported that in almost all departments, the score category C1 can decline sharply. Except for the D3 and D4 departments, they were in constant condition (Figure 4a). The treatment results for score category C2 were also in stable condition (Figure 4b). In contrast, the number of category C3 significantly increased for all departments, i.e., the average of course content improvement increased by four courses per department (Figure 4c).

Generally, the serious institution efforts were quite successful in reducing the scores of category C1 and C2 to C3. They could decline from a total of C1 = 94 to be C1 = 55, and C2 = 32 to be C2 = 24. As a positive result, the scores C3 could be significantly increased from C3=134 to C3 = 181 (Figure 4d). This means that 70 % of the 260 courses were ready to be implemented for online learning by using an e-learning platform.

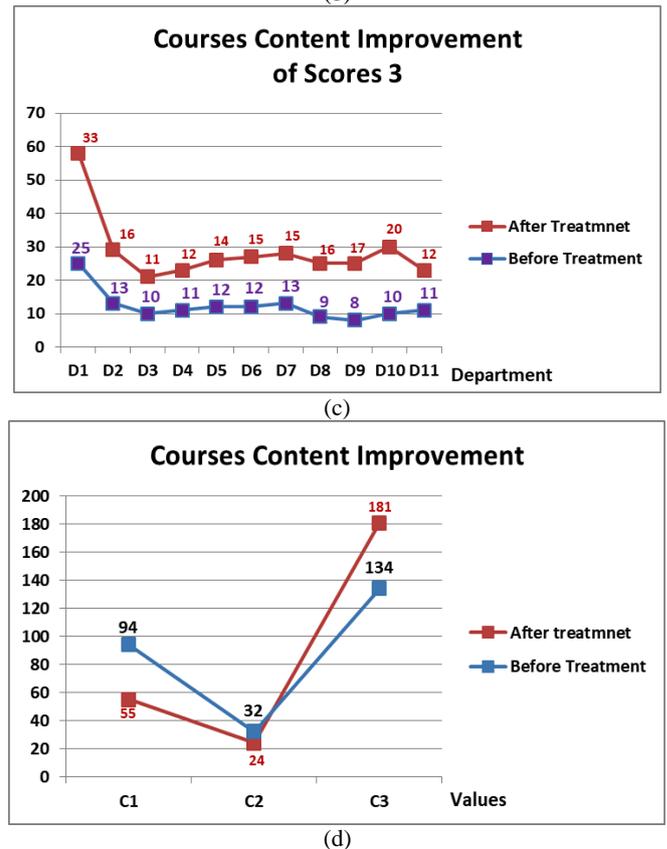


Figure 4. Content knowledge improvement of the instructors of the eleven departments

The training can add 47 new online course materials for the 260 courses of the eleven departments (Tabel 4d). This training could affect the instructor productivity in producing the e-handouts, the student worksheets, the e-modules, the e-books, and the PowerPoint displays. They have referred to and linked some teaching-learning videos and Youtube displays to

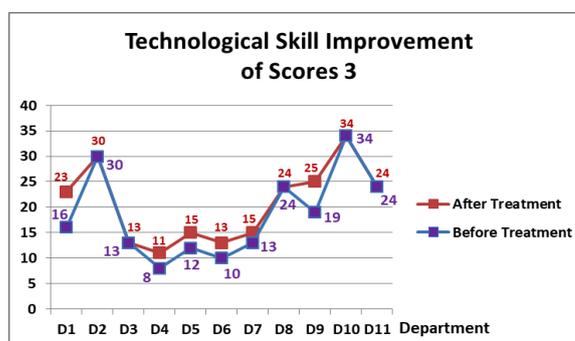
make their presentation more interesting. To enrich the content quality, some topics of courses were linked using e-book, Youtube, and e-library. The content development results made by the instructors are

respectively presented in Table 1, i.e., the material availability: e-handout = 65%, the student worksheet = 60%, e-module = 80%, e-book = 70%, PowerPoint = 95%, video teaching-learning = 60%.

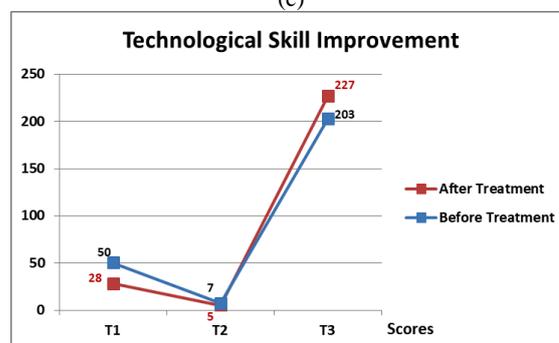
Table 1. Course material availability in the online learning implementation

Number	E-learning Contents Preparation	Materials Availability	Activities Remarks
1	E-handout	65%	Arrange and download e-handout from the Web, delivering materials, upload, and share-link to URL
2	Student worksheet (SW)	60%	Create and share SW with students
3	E-module	80%	Create and download e-handout from the Web, delivering materials, upload, and share-link to URL
4	E-book	70%	Compile and download e-handout from the Web, delivering materials, upload, and share-link to URL
5	PowerPoint (PP)	95%	Create and share the PP with students
6	Video teaching-learning	60%	Arrange, link Youtube, and share with students

Reducing the number of score category T1 focuses on improving instructors' device skills for the e-learning platform, particularly, from the five departments, i.e., D1, D6, D9, D5, and D4 (Figure 5a). For the score category T2, only two departments needed the digital tools training, i.e., D1 and D6. In this treatment, the intervention materials consisted of simulating creating an account, menu and features, uploading materials, making attendance forms, online task assignments, creating online discussion forums, and evaluation. The ending of the workshop could reduce the number of categories T1 and T2 at almost all departments (Figure 5a,b). The score category T3 could increase in five departments, i.e., D1, D4, D5, D6, D7, and D9 (Figure 5c). In short, the university could decline the number of scores T1 and T2 from a total T1 = 50 to T1 = 28, and T2 = 7 to T2 = 5. Meanwhile, the score C3 significantly developed from T3 = 203 to T3 = 227 (Figure 5d). These results indicated that, in general, 87% of 260 instructors were competent in implementing online learning by using e-learning platform devices.

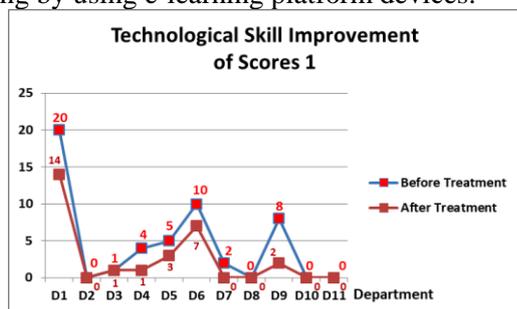


(c)

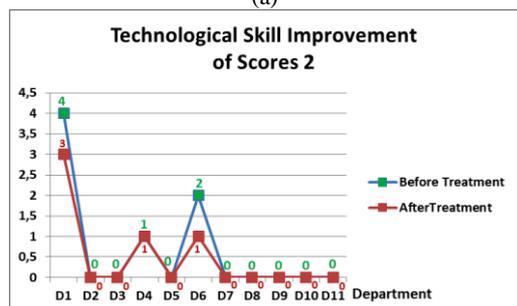


(d)

Figure 5. Technological skill improvement of the instructors of the eleven departments



(a)



(b)

Training the skills of the device for the e-learning platform can upgrade the competencies of the 24 lecturers (Figure 5d). These instructors can recognize the interface programs, the profits, and the benefits of some e-learning devices. They are capable of uploading the course materials, share and link with URLs. They can also add, edit, set, upload, save the contents, and create videos to present attractive teaching. Controlling students' learning activities manages students' attendance, students' tasks, and evaluation of students learning achievement. The digital skill development of the instructors led to the positive results as shown in Table 2, i.e., the understanding of menus and features = 75%, making e-modules = 60%, teaching-learning videos = 60%, e-attendance forms = 100%; e-assignments and e-assessments = 65%, creating student

worksheets = 70%, online forums, and discussions = 60%.

Table 2. Instructors' digital skills understanding

Number	E-learning Simulations	Achievements	Activities Remarks
1	Menu and features	75%	Recognize interface programs, profits, and benefits
2	Making e-modules	60%	Add, edit, set, upload, and save the content
3	Teaching-learning videos	60%	Create a video, upload and share-link the videos to the Youtube and URLs
4	E-attendance forms	100%	Manage attendance of students
5	E-assignments and e-assessments	65%	Manage the students' tasks and the evaluation of students learning achievement
6	Creating student worksheets	70%	Add, edit, set, and save the contents
7	Online forum and discussions	60%	Add, edit, set, and save the contents

When the data in Figure 2a,3a are respectively compared with the data in Figure 2b,3b, it can state that during the COVID-19 pandemic, instructors generally did not yet try to modify course materials to be suitable for digital learning. 50% of the 260 courses in course materials were not yet available for digital presentations and suitable for online learning. Although 75% of instructors are proficient in using ICT, as shown in the score T3 in Figures 2b and 3b, they are not automatically aware of preparing the representative online learning materials. Changing the habit to the use of technology for the instructors would be the departments' challenges to occur from face-to-face to online learning. Even some instructors might want to take the time. They also thought that after ending the pandemic, lectures would soon return to offline learning. They refused to recognize e-learning platform devices and change their habit from the training or practice methods to the distance learning method (Mohammed et al.; Allan et al., 2021; Shaharane et al., 2020; Nassaji, 2015). As a result, they were passive and less enthusiastic in training activities carried out by the university. They had almost no development (constant) in several departments, both in their ability to make lecture materials and mastery of e-learning tools. These facts are present in Figure 4a (D3, D4, D11), Figure 4b (D2, D9), Figure 5a (D3), and Figure 5b (D4). Therefore, the factor of changing the habits, awareness, perception, and individual resistance of lecturers is an important factor that must be the consideration in implementing digital distance learning during the COVID-19 pandemic (Samat et al., 2020).

Using the workshop treatment, it can develop the instructor quality from the category C1, C2, T1, and T2 to category C3 and T3, respectively, C3 = 181 courses (70%), and T3 = 227 courses (87%) of the 260 courses (Figure 4d and Figure 5d). In the future challenge, the departments should improve the course materials quality of the 79 courses (30%) and technology skills of the 33 courses (13%). In the context for improving departments' lecture services in future semesters, the departments must immediately give the interventions in course materials improvement and technological skills for the lecturers who have lacked performance. Based on the department's achievements as shown in Figures 4a,b, and Figure 5a,b, it emphasizes the lecture materials' intervention for eight departments: D2=14

courses, D10=14 courses, D11=12 courses, D9=10 courses, D8=8 courses, D1=7 courses, and D5=D6=7 courses. The intervention must develop digital skills in two departments, i.e., D1=17 courses and D6=8 courses. Thus, 8 of 11 departments still had to improve the instructors' knowledge in online learning course services, respectively: D2, D10, D11, D9, D8, D1, D5, and D6.

4. Conclusion and Future Directions

In the sudden shift from face-to-face to online distance learning in the university during and post the COVID-19 pandemic, the course material preparation was generally unsatisfactory, even though most lecturers had many good competencies in using ICT tools. Here, the instructors have been unable to adapt to online learning during the pandemic. Fortunately, training the instructors from the university helped solve these problems.

The study revealed that the training approach for the lecturers in the content knowledge improvement could affect their productivity in creating the learning media based on ICT. The instructors produced an e-handout, student worksheet, e-module, e-book, PowerPoint, and video teaching-learning. Besides, they could also enrich the content quality supported with blogs, websites, e-books, Youtube, and e-library. Consequently, the presentation of the materials would be exciting, various, and interactive. This research has also showed that the simulation exercise of the e-learning platform could increase the instructors' competency related to the interface programs and the benefits of e-learning devices. It consisted of the menu and features, making e-modules, and teaching-learning videos. On the other hand, the simulation training increased the instructors' skills in arranging the course materials and managing students' learning activities, e.g., the e-attendance forms, e-assignments, and e-assessments, and creating student worksheets. Implementing these instructors' skills in the online learning process can motivate the students to be interested and willing to learn, interact, and understand the material content. It will also meet what students need and their potential, wise in using internet content and online tools. Therefore, improving lectures' content knowledge and technological skills in digital learning are essential for the student learning services.

This study was conducted on lecturers of a private university in NTB Province, Indonesia. Thus, the generalization results have limitations. The research was also restricted to improving the content knowledge and technological skill of the lecturers.

With abilities in digital device competencies, the instructors have not automatically provided good services in online learning. It might be the impact of the COVID-19 stress, low awareness of lecturers, and unhabitual use of e-learning tools from the instructors. On the other hand, the training approach for the lecturers gave positive results in the digital learning process. Therefore, in the future, the institution must provide continued support and training to endeavor new technological tools and adapt to the disrupted teaching-learning activity.

Authors' Contributions

Kusno is responsible for the theme framework, data analysis, and writing evaluation; Sutarto: Literature search and data analysis; Muzanni: Data collector and analysis; Ahmad: Data analysis and discussion; Rahman: Literature search, writing, and editing; Hardiani: Literature search and discussion.

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