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Submission date: 16-Aug-2022 03:05PM (UTC+0700)

Submission ID: 1883125943

File name: Lecturers_Performance_JESTP_EkoH.terbit2021.pdf (499.88K)

Word count: 8911

Character count: 51222

Received: 28 June 2021

Revision received: 2 October 2021

Accepted: 20 November 2021

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www.jestp.com

DOI 10.12738/jestp.2021.3.009 ♦ December 2021 ♦ 21(4) ♦ 138-154

Article

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Abstract

The COVID-19 pandemic led to closure of all educational institutions globally, forcing the transition of teaching and learning process to go online. This transition required technological innovation and digitization. This study aimed to group lecturers' performance based on online pedagogical practices with the K-Means Clustering method at Universitas Negeri Semarang (UNNES) based on online pedagogical practices. The study used six variables namely course content, teaching design, video quality, teaching service, teaching evaluation, and learning effect, to measure the performance of lecturers in online learning practices in pandemic times. The data was obtained through a questionnaire from a sample of 278 lecturers at Universitas Negeri Semarang (UNNES) and analyzed using K-Means with SPSS 24.00 software. The results revealed that three lecturer performance clusters were formed during the COVID-19 pandemic based on the results of data clustering: 48 lecturers were placed in low-performance cluster (17%), 117 of them were in moderate-performance cluster (42%), and 113 of them were in the high-performance cluster (41%). The study recommends to improve lecturers' performance by joining the video-making workshops.

Keywords

Lecturer Performance • Online Pedagogical Practices • Clustering * course content

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Citation: Handoyo E., Mukhibad H., Tusyanah T., Ekaningsih L. (2021). Lecturers' Performance in Pandemic Era Based on Online Pedagogical Practices in Universitas Negeri Semarang (UNNES), Indonesia: A Cluster Analysis-Based Approach. *Educational Sciences: Theory and Practice*, 21(4), 138 - 154. <http://dx.doi.org/10.12738/jestp.2021.3.009>

The pandemic has resulted in extensive school closures in the education sector globally, forcing the transition of teaching and learning process to go online. This transition to online teaching implies the need for a faster and more diverse transformation of technological innovation and digitization (McFarlane, 2019). However, digitalization in schools is a crucial problem considering that many areas are left behind related to information and communication technology (Hermawan et al., 2018). Nneka Parsanalal (2020) stated that difference in income and household resources also hindered thousands of students from accessing education online. Besides, lecturer records reveal that online classes' participation tends to be low due to a lack of parental supervision, internet access, resources, and lecturer skills (Kalloo et al., 2020). The problem is that lecturers should use various digital tools and resources to solve existing problems and implement a new teaching and learning approach (Eickelmann & Gerick, 2020). Besides instructional purposes, lecturers also need to maintain relationships with their students.

The improvement of the competence and skills of lecturers is indispensable. One of the essential competencies today is digital competency and use technology to improve the quality of life, work, and learning. Hatlevik et al. (2018) also state that digital competence is a set of lecturers' capacity, ability, and knowledge to solve educational problems integrating information and communication technology (ICT). Tan (2013) adds that the rapid development of the internet has eroded the boundaries of space and time in education to continue the learning process with a distance learning system carried out with the help of technology. Thus, integrating technology efficiently in teaching should be considered.

Universitas Negeri Semarang (UNNES) has a vision of becoming a conservation-oriented and internationally reputed university (Rahmawati et al., 2020). There are three models of learning activities at UNNES: face-to-face, hybrid learning, or fully online (Cahyono & Munawar, 2020). During the COVID-19 pandemic, online teaching was necessary to reduce the spread of the virus attacking the world for almost a year.

UNNES uses various platforms to make it easier for lecturers and students to properly deliver and receive materials and responses. Internal UNNES has an Electronic Learning Aid system; ELENA, an online teaching system developed by UNNES based on MOODLE version 2.0 to support academic activities whose main purpose is to provide a space for lecturers and students to meet face to face without using a computer or smartphone-connected internet network (Rahmaningtyas et al., 2020). UNNES carried out online learning before the pandemic occurred with the hybrid system. Research by Cahyono and Asikin (2019) found that there are several predictors of the efficacy of hybrid learning at UNNES, which include the conformity of the material by utilizing the features of the learning management system, regulations, supporting facilities, the role of lecturers in facilitating courses, and students' perception of hybrid learning.

Besides ELENA, UNNES also uses several other platforms, such as Zoom cloud meeting, google meeting, google classroom, podcasts, or WhatsApp groups on the devices of lecturers and students. A challenge for lecturers in facing online learning because it certainly differs considerably from face-to-face learning as usual. Therefore, adjustments are needed both from the lecturer's and the student's sides. Lecturers should adapt to the current conditions and situations (Dhawan, 2020). They should master online teaching knowledge and skills to prepare themselves to teach well, such as mastery of IT and computers and mastery of software and hardware to support the creation of various learning media. Most UNNES lecturers have utilized ELENA as an e-learning platform well. They have been able to use some of the features available in ELENA to support online learning. The most commonly used features are absenteeism, files, links, labels, assignments, quizzes, discussions, pages, and video conferencing. The students also rated their lecturers as having good skills in online learning, and they can make online design learning (Nurkhin et al., 2021).

Due to the COVID-19 pandemic, the education system should transform into online learning for all students and lecturers. It is essential because today, the world of education is entering a new era of building creativity, honing student skills, and improving ourselves' quality with changes in our systems, perspectives, and interaction patterns with technology. Therefore, performance and courage to intervene will make online learning an opportunity to transform education today. Bullen and Morgan (2011) suggests that there has been a change in educators' role; which requires them to master not only conventional learning techniques but also necessary to know ICT-based learning techniques.

Moreover, lecturers should create models and learning strategies to follow students' character in their schools. Several online learning applications can benefit lecturers in this learning process (Arnesti & Hamid, 2015). Lecturers should familiarize themselves with teaching by utilizing complex online media packages effectively, easily accessible, and understood by students. Lecturers may also design online learning by utilizing

the right tools or online media and appropriate materials. The online learning will provide a broader opportunity to explore the materials, lecturers therefore also need to limit the material's breadth and determine the proper application of the learning materials and methods used.

The occurrence of pandemics has made the adoption of technologies such as online education change widely, which will be very helpful in education in the future (Chakraborty et al., 2021). Integrating components such as students, lecturers, learning resources, and technologies is a determining component of learning success (Hermanto & Srimulyani, 2021). A lecturer must innovate in learning, especially in using the state and learning model to improve learning understanding and awareness among students (Silalahi & Hutaaruk, 2020). Creativity is the key to a lecturer's success to motivate his students to keep the spirit of online learning and not become a psychological burden. Therefore, the performance and provision of competent prospective lecturers need to be improved to be better prepared for any situation to achieve learning objectives adequately.

This study aims to group lecturers' performance based on online pedagogical practices with the K-Means Clustering method. Based on the formulation of the problem, the objectives in this study are to describe and cluster the lectures' performance at *Universitas Negeri Semarang* (UNNES) based on online pedagogical practices. The performance of lecturers during the pandemic with a fully online learning process is an interesting thing to research because many new skills need to be mastered by lecturers, especially in terms of the use of technology-based media. Lecturers must adapt quickly to carry out online learning creatively and innovatively and make online learning not an obstacle in the teaching process nor evaluating learning outcomes.

The study used six variables spelled out in several indicators in measuring lecturer performance. These variables include (1) Course Content; (2) Teaching Design; (3) Video Quality; (4) Teaching service; (5) Teaching evaluation; and (6) Learning effect. The use of these variables is essential for this study because the variables and indicators spelled out are very suitable to measure the performance of lecturers in online learning practices in pandemic times. The six variables are the adoption of a previous study by Hua and Ren (2020) entitled "Online + Offline" Course Teaching Based on Case Teaching Method: A Case Study of Entrepreneurship Education Course."

Previous researches have discussed the performance of lecturers with various measurement models. For instance, Utomo and Rachmawati (2021), using descriptive research methods of analysis, showed whether a lecturer's teaching performance during pandemics is at a good level or ready for teaching planning and evaluation. However, another study by Hidayat et al. (2021) with semi-structured interview methods found that lecturer performance is positive and negative. Positive lecturer appearance, such as lecturer trigger topics, positive lecturer interaction with students, lecturers providing feedback on student work, and positive expectations of lecturers to motivate students in learning English. The study also revealed negative lecturer performance, such as monotony in teaching methods and lack of lecturer involvement in the classroom.

The results of previous research on the performance of lecturers, especially in the online learning process, shows the research gap. Utomo and Rachmawati (2021) show that lecturer performance is at a good level; however, Hidayat et al. (2021) find that lecturer performance is both positive and negative. Due to this discrepancy and indecisiveness, the authors in the current study were interested in conducting further research on the performance of lecturers with online learning practices during pandemics using the Hua and Ren (2020) research model that is considered most relevant to the current conditions of online learning as well as with the purpose of this research.

Literature Review

Digital Transformation of the Education System

Digital transformation leads to many information technology activities to obtain efficiency and effectiveness. Some areas that have been transformed digitally includes education into e-learning, business into e-business, banking into e-banking, government into e-government, and others (Danuri, 2019). Jack Ma in (Surani, 2019) says education is the biggest challenge of this millennium. If it does not change how we educate and teach, we will have great difficulties in the next 30 years. Education and learning loaded with knowledge content override the content of attitudes and skills currently implemented. This will result in students being unable to compete with machines making it difficult for students to develop qualifications and competencies of qualified educators.

Azhari and Fajri (2021) mention that teachers cannot directly utilize various Information and Communication Technology (ICT) devices and online learning platforms that are widely available in support of remote implementation, either because of teacher ability, parental economic factors, limited internet access, or the absence of guidance. Many obstacles are found in the learning process online, especially on the character formation of learners who cannot be replaced by technology. Learners will still require face-to-face and time-span education patterns to form characters and learn ICT skills (Muskania & Zulela, 2021). ICT is indispensable in learning in this era. With the principle of using ICT effectively and efficiently, optimally, attractively, it stimulates the power of creativity. ICT has become one of the learning media widely used in various fields of education because it improves effectiveness and efficiency in the learning process (Rahim, 2011).

Online Learning Policy during the Pandemic in Indonesia

The Indonesian government has enacted several policies to stop the spread of COVID-19. One of the policies is vested in the circular of the Ministry of Education and Culture (*Kemendikbud*) Directorate of Higher Education No.1 the Year 2020 on preventing the spread of COVID-19 in education. The Kemendikbud ordered distance learning and proposed that all students learn from their homes. Distance learning was implemented in March 2020. The government also issued various other policies and took initiatives to deal with the COVID-19 pandemic. Schools and universities were given flexibility in choosing the curriculum according to the students' needs. The Ministry of Education and Culture (MOEC) and the Ministry of Religious Affairs (MORA) need to consider distance learning approaches adjusted to regional characteristics. Distance learning exacerbates barriers of vulnerable students to access education, so diversification of the delivery medium beyond the internet should be considered. Options may include radio programs or postal services for regions with low connectivity (Nadia Fairuza, 2020).

Achmad Dicky and Dwi Cahyono (2021) stated that several applications could also help teaching and learning activities, for example, WhatsApp, Zoom, web blog, Edmodo, and others for facilitating Online Learning During Covid-19 Pandemic. In addition, the central government distributed aid and support funds, and the local government should be responsible for meeting all school needs. Local governments can also meet schools' needs that have implemented face-to-face learning, such as sanitation or hygiene facilities, body temperature gauges, and masks.

Lecturer Performance

Performance can be interpreted as actual behavior in everyone as a work performance produced following its role in an organization or company (Veithzal & Sagala, 2004). According to Sukirno and Siengthai (2011), lecturer performance is a major and strategic factor determining student performance and university performance in higher education. Assessment of lecturer performance is a process in which the institution evaluates or gives its assessment of lecturers' performance or work that has been achieved. The purpose of lecturer performance, according to Blazey et al. (2003), (1) improving performance, capabilities, and output in education, (2) facilitate communication and exchange information about educational practices, (3) as a tool to understand and improve performance and guidelines in education strategic planning. Ayun (2011) also stated that the purpose of the assessment could be in the form of general objectives and specific objectives. The general purpose is used to assess employee performance regularly.

One of three pillars of Higher Education is implementing education which is mandatory for higher education (Law No.12 of 2012, Article 1 Paragraph 9). The first point is Education and Development, so the learning process in higher education has a vital role in creating a superior generation. This excellent generation can bring the nation and country in a more advanced direction.

The Importance of Online Learning Skills for Lecturers

One of the efforts to improve the quality of the process and student learning outcomes includes increasing teachers' ability to use technology applications in the learning process and assessment of learning outcomes, also known as Technology Literacy (Astini, 2019). Technological literacy is the ability to effectively and efficiently use technology and information applications in various contexts, such as academia and education, learning and teaching, learning assessment, careers, and everyday life. The industrial revolution 4.0 or the digital era is a tough challenge for Indonesian educators. The essential thing that educators should consider to face the challenges of the digital era is that he should be technologically literate. The quality of educators who are devoid of technology does not instill "critical power" in students to become revolutionary human beings so that they are hampered

from exploring their potential. Professional lecturers are the spearhead of implementing classroom learning who are now required to use and take advantage of developments in information and communication technology to support the learning process. Lecturers should not be technologically illiterate. Furthermore, lecturers should always try to motivate themselves in technology, without showing tardiness to access information technology.

Developing a learning framework in the 21st Century requires students to have skills, knowledge, and abilities in technology, media, information, learning and innovation skills, and life and career skills. The explanation regarding the 21st-century learning framework according to (BSNP: 2010 in Astini (2019) is as follows: (a) Critical Thinking and Problem-Solving Skills, able to think critically, laterally, and systemic, especially in the context of problem-solving; (b) Ability to communicate and collaborate effectively with various parties; (c) Ability to create and renew and develop their creativity to produce various innovative breakthroughs; (d) Information and Communications Technology Literacy, (e) Contextual Learning Skills, being able to undergo contextual independent learning activities as part of personal development, and (f) Information and media literacy skills, able to understand and use various communication media to convey various ideas and carry out collaborative activities and interactions with various parties.

Research Variables

The COVID-19 pandemic requires educational elements to do online learning. Current conditions urge educators to make innovations and adaptations related to available technology to support learning. Therefore, educators need to learn various strategies, practice online teaching systems, and have supportive online learning skills. Hua and Ren (2020) proposed six indicators of online pedagogical practices;

- i. *Course Content*: The course content has an important position in the curriculum that should be prepared so that the implementation of learning can achieve goals following competency standards. The material specified for learning activities should support competency standards and learning indicators (Agustina, 2018). Course content indicators contain teaching goals (teaching objectives), time mismatch (consistency between content and objectives), content preparation, scientificity, and knowledge.
- ii. *Teaching Design*: According to Sagala (2005), teaching design is a systematic development of teaching that is explicitly used with learning theories to ensure the quality of learning. This statement implies that the preparation of learning planning should be following the concepts of education and learning adopted in the curriculum used. The teaching design indicator includes interest stimulation, teaching method, example display, and exercise design.
- iii. *Video Quality*: Video quality is one of the critical factors used in the online learning process; the excellent video quality will make the material presented easy to understand. When online learning is implemented, an educator is required to have the ability to make learning videos that are creative, innovative, and of good quality. It makes lecturers still carry out online learning well, and students are not easily bored with online learning. The video quality indicator contains video quality dimensions, including clarity, text expression, and teachers' teaching attitude.
- iv. *Teaching service*: Teaching service is one of the critical factors during the learning process; an educator should have professionalism in teaching by providing services to students. The service transfers their knowledge and educates students and is expected to achieve the learning objectives conveyed. The teaching service indicator contains dimensions of communication and question answering.
- v. *Teaching evaluation*: Teaching evaluation can be interpreted as a process assessment because it is carried out when the teaching and learning process occurs. The assessment focuses on the effectiveness of teaching and learning activities to achieve teaching goals. It involves assessing teacher activities, student activities, teacher-student interaction patterns, and implementing the teaching and learning process. The teaching evaluation indicators are class practice and final exam.
- vi. *Learning effect*: The learning effect is the cost-saving effect that comes from learning while working. It is usually associated with job specialization, which makes workers more proficient. This learning effect in learning activities can be obtained by evaluating the teaching-learning process results that have been carried out in the long term. An educator can determine the learning effect through how far students master the material presented, student participation in learning, and the pass rate of students' exams. The learning effect indicator includes dimensions of the rationality of the frequency of questions, the level of homework participation, homework completion, and passing the exam.

The COVID-19 pandemic requires educational elements available online learning. Current conditions urge educators to make innovations and adaptations related to the use of available technology to support the learning process, so educators need to learn various strategies, practice online teaching systems, and have supportive skills for online learning.

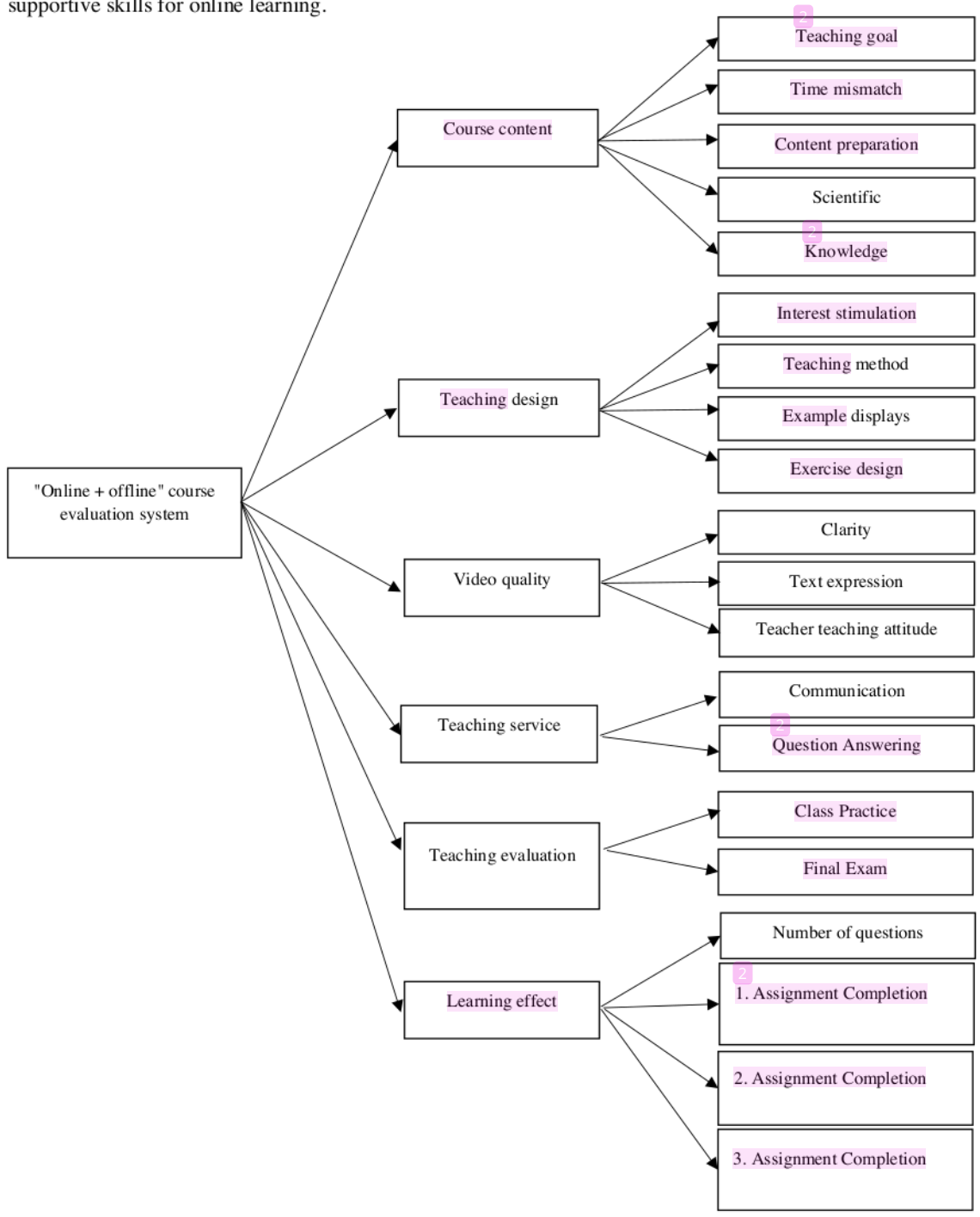


Figure 1. Online Research Variable Indicators Pedagogical Practices Adopted from Hua and Ren (2020)

Methods

Research Design

It is a quantitative study. Clustering is an analysis method, often termed as a data mining method. The purpose is to group data with the same characteristics into a "region" and data with different attributes to another "region."

Research Sample

This study clustered lecturers in UNNES, Indonesia. The strength of lecturers at UNNES is 909 academic staff spread across eight faculties and postgraduate degrees. Table 1 shows population comprising 909 faculty members, out of which 278 lecturers were taken as a sample using the Slovin formula with a margin of error of 5%.

Table 1. *The Respondents*

Faculties	Populations	Samples
FIP	125	38
FBS	157	48
FIS	93	28
FMIPA	167	51
FT	140	43
FIK	100	31
FE	87	27
FH	40	12
Total	909	278

Research Instrument

Data was collected by distributing the questionnaires via *Google form* to lecturers who have used ICT in their teaching at *Universitas Negeri Semarang*. Data on online pedagogical practices and online teaching behavior was revealed using instruments based on a *Likert* scale. A questionnaire containing items of research instruments in the form of statements and scoring using four (4) alternative answers for each positive information, was prepared. Table 2 presents the variables, their definitions and indicators:

Table 2. *The Research Instrument*

No	Variables	Definitions	Indicators
1	Course content	The course content has an important position in the curriculum that should be prepared so that the implementation of learning can achieve goals following competency standards. The material specified for learning activities should support competency standards and learning indicators (Agustina, 2018).	Teaching Goals (Teaching Objectives), Time Mismatch (Consistency between Content and Objectives) Content Preparation Scientificity Knowledge.
2	Teaching Design	Teaching design is a systematic development of teaching that is explicitly used with learning theories to ensure the quality of learning. This statement implies that the preparation of learning planning should be following the concepts of education and learning adopted in the curriculum used (Sagala, 2005)	Interest Stimulation, Teaching Method Example Display Exercise Design
3.	Video Quality	Video quality is one of the critical factors used in the online learning process, and the excellent video quality will make the material presented easy to understand. When online learning is	Clarity Text expression, Teachers' teaching attitude

	implemented, an educator is required to have the ability to make learning videos that are creative, innovative, and of good quality. It makes lecturers still carry out online learning well, and students are not easily bored with online learning.	
4. Teaching service	Teaching service is one of the critical factors during the learning process; an educator should have professionalism in teaching by providing services to students. The service transfers their knowledge and educates students and is expected to achieve the learning objectives conveyed.	Communication Question answering
5. Teaching evaluation	Teaching evaluation can be interpreted as a process assessment because it is carried out when the teaching and learning process occurs. Process assessment focuses on the effectiveness of teaching and learning activities to achieve teaching goals. It involves assessing teacher activities, student activities, teacher-student interaction patterns, and implementing the teaching and learning process.	Class practice Final exam.
6. Learning effect	The learning effect is the cost-saving effect that comes from learning while working. It is usually associated with job specialization, which makes workers more proficient. This learning effect in learning activities can be obtained by evaluating the teaching-learning process results that have been carried out in the long term. An educator can determine the learning effect through how far students master the material presented, student participation in learning, and the pass rate of students' exams.	The rationality of the frequency of questions The level of homework participation The level of homework completion Passing the exam

Data Analysis

This study used Partitional clustering with the K-Means method, one of the clustering algorithms with the partitioning method based on the center point (centroid), and the object-based k-Medoids algorithm (Madhulatha, 2011). In its application, the K-Means algorithm requires three entirely user-defined parameters, i.e., the number of K- clusters, cluster initialization, and system distance. The K-Means calculation process is also carried out through the SPSS software application, from which the data obtained is processed to form clusters. The SPSS calculation results show the cluster (grouping) according to the entered data.

The K-means algorithm defines the centroid or cluster center of a cluster as the cluster's average point. In the application of the K-Means algorithm, if given a set of data $X = \{ x_1, x_2, \dots, x_n \}$ where $x_i = (x_{i1}, x_{i2}, \dots, x_{in})$ is the system in real space R_n , then the k-Means algorithm will compile the X partition in some k clusters (a priori). Each cluster has a center point (centroid) which is the average (mean) value of the cluster's data. The K-Means algorithm's initial stage randomly selects k objects as centroids in the data. Then, the distance between the object and the centroid is calculated using the Euclidean distance. The K-Means algorithm iteratively increases the variation in values within each cluster. The next object is placed in the closest group, calculated from the center point of the cluster. The new center point is determined when all data has been placed in the closest cluster. Selecting the midpoint and placing the data in the cluster is repeated until the midpoint values of all the clusters formed do not change anymore (Han et al., 2012).

Results

Data collection and Respondents

The data collected came from teachers in eight faculties at *Universitas Negeri Semarang*. The study sample was calculated using the Slovin formula with a tolerance value of 0.05 to be as many as 278 respondents. Respondents received online questionnaires via broadcast from WhatsApp and email. Table 3 shows the results of demographic data. The 132 respondents consisted of 47.5% women and 146 or 52.2% men, ranging from 25 to <50 years.

Table 3. Demographic data of respondents

Attribute	Classification	%
Gender	Male	47.5
	Female	52.5
Age (year)	25 – 30	19.0
	31 – 40	39.0
	41 – 50	28.0
	> 50	14.0

The statement submitted that "I prefer to teach online rather than offline" found that 57% of respondents said they prefer to teach offline, and 43% said they preferred to teach online.

Validity and reliability of the instrument

A valid instrument can measure what it is supposed to measure. Reliable means that when the instrument is used several times to measure the same object, it will produce the same data. The validity test results using SPSS are presented in table 4 and reliability in table 5.

Table 4. Questionnaire's Validity

Variable	Questionnaire Item	Pearson Correlation	Sig. (2-tailed)	Description
Course Content	Item_1	.727**	.000	Valid
	Item_2	.714**	.000	Valid
	Item_3	.682**	.000	Valid
	Item_4	.733**	.000	Valid
	Item_5	.733**	.000	Valid
	Item_6	.700**	.000	Valid
	Item_7	.698**	.000	Valid
	Item_8	.475**	.000	Valid
	Item_9	.574**	.000	Valid
	Item_10	.638**	.000	Valid
	Item_11	.604**	.000	Valid
	Item_12	.575**	.000	Valid
	Item_13	.549**	.000	Valid
	Item_14	.645**	.000	Valid
	Item_15	.559**	.000	Valid
Teaching Design	Item_16	.642**	.000	Valid
	Item_17	.664**	.000	Valid
	Item_18	.704**	.000	Valid
	Item_19	.731**	.000	Valid
	Item_20	.662**	.000	Valid
	Item_21	.607**	.000	Valid
	Item_22	.666**	.000	Valid
	Item_23	.659**	.000	Valid
	Item_24	.627**	.000	Valid

2	4			
Video Quality	Item_25	.771**	.000	Valid
	Item_26	.837**	.000	Valid
	Item_27	.858**	.000	Valid
	Item_28	.777**	.000	Valid
	Item_29	.841**	.000	Valid
	Item_30	.647**	.000	Valid
	Item_31	.657**	.000	Valid
Teaching Service	Item_32	.673**	.000	Valid
	Item_33	.791**	.000	Valid
	Item_34	.759**	.000	Valid
	Item_35	.720**	.000	Valid
	Item_36	.683**	.000	Valid
	Item_37	.704**	.000	Valid
	Item_38	.748**	.000	Valid
Teaching Evaluation	Item_39	.549**	.000	Valid
	Item_40	.727**	.000	Valid
	Item_41	.744**	.000	Valid
	Item_42	.744**	.000	Valid
	Item_43	.734**	.000	Valid
	Item_44	.623**	.000	Valid
	Item_45	.710**	.000	Valid
Learning Effect	Item_46	.625**	.000	Valid
	Item_47	.644**	.000	Valid
	Item_48	.660**	.000	Valid
	Item_49	.556**	.000	Valid
	Item_50	.492**	.000	Valid
	Item_51	.673**	.000	Valid
	Item_52	.674**	.000	Valid
	Item_53	.738**	.000	Valid
	Item_54	.725**	.000	Valid
	Item_55	.562**	.000	Valid
	Item_56	.714**	.000	Valid
	Item_57	.625**	.000	Valid
	Item_58	.649**	.000	Valid
	Item_59	.696**	.000	Valid

An instrument based on statistics is valid if its significance level is less than the tolerance limit of Sig. (2-tailed) significance of 0.05 (Wahyudin, 2015). Based on the results of the analysis of the validity test in Table 4, all statement items are valid.

A questionnaire is reliable if the value of Cronbach's alpha > 0.60 (Abdillah & Hartono, 2015). Based on Table 5, the reliability test results on each research variable obtained a value above > 0.60. In line with these results, it can be concluded that all statements used in this study are reliable.

Table 5. Questionnaire Reliability

No	2 Variable	Cronbach's Alpha	Description
1.	Course Content	0,898	Reliable
2.	Teaching Design	0,838	Reliable
3.	Video Quality	0,886	Reliable
4.	Teaching Service	0,856	Reliable
5.	Teaching Evaluation	0,866	Reliable
6.	Learning Effect	0,851	Reliable

Multicollinearity

The results of the multicollinearity test in the form of tolerance values and Collinearity Tolerance values in each variable show more than > 0.10 . Ghozali (2014) states that the tolerance value should not be less than 0.10. The results of the multicollinearity test output are presented in table 6.

Table 6. Multicollinearity Test Results

Model	T	Sign.	Collinearity statistics	
			Tolerance	VIF
(Constant)	2.854	.005		
Course_content	-.985	.326	.363	2.756
Teaching_design	.319	.750	.288	3.475
Video_quality	-.050	.960	.427	2.342
Teaching_service	.877	.381	.359	2.785
Teaching_evaluation	-.530	.596	.504	1.986
Learning_effect	-.504	.615	.560	1.785

Outlier data

The outlier data test in this study showed that the scores of each of the tolerance values of all variables were above 0.10, and the VIF values of all independent variables were below 10. It is by the cut-off value used to indicate the existence of multicollinearity where tolerance ≤ 0.10 or equal to the value of VIF ≥ 10 . So, through these results, it can be concluded that there is no multicollinearity in the study. The results of the outlier data calculation are presented in table 7.

Table 7. Calculation of Outlier Data (N = 278)

	Min.	Max.	\bar{x}	SD
Zscore(Course_content)	36	64	51.44	6.798
Zscore(Teaching_design)	56	96	77.38	9.634
Zscore(Video_quality)	37	72	57.88	6.657
Zscore(Teaching_service)	28	48	38.33	4.143
Zscore(Teaching_evaluation)	33	68	52.73	6.163
Zscore(Learning_effect)	33	68	52.95	6.250
Valid N (listwise)	278			

Cluster Analysis: Data Centroid

At this stage, an analysis of educator data was conducted based on (Cluster 1), (Cluster 2), (Cluster 3). In applying the K-means algorithm, the midpoint or centroid value was generated from the data obtained because the desired clustering is 3. The data obtained was processed using questionnaires. There are 3 clusters, i.e., low-performance (c1), moderate performance (c2), and high performance (C3) clusters.

There would be three midpoint values or centroids (Jeong et al., 2018). Cluster point determination is done by taking the smallest (minimum) value for a low-performance cluster (C1), the average performance score (C2), and the maximum largest value for a high-performance level (C3). The value of the data centroid point is shown in Table 8.

Table 8. Data Centroid Points (Final Cluster Centers)

	Cluster		
	1	2	3
Zscore(Course_content)	1.09083	.26109	-.73369
Zscore(Teaching_design)	1.52599	.16713	-.82125
Zscore(Video_quality)	1.45732	.18344	-.80898
Zscore(Teaching_service)	1.36757	.25348	-.84337
Zscore(Teaching_evaluation)	1.31089	.15414	-.71644
Zscore(Learning_effect)	.01139	-.06989	.06752

Data Clustering

Using the centroid, the data obtained by the cluster becomes 3 clusters. The clustering process takes the closest distance from each processed data. Clustering results can be seen in table 4. From Members for each cluster are presented in Table 9, which shows that clusters 1, 2, and 3 have 48 categories of low-performance levels, 117 moderate and 113 in high-performance categories, respectively.

Table 9. Total Cluster

Number of Cases in each Cluster		
Cluster	1	48.000
	2	117.000
	3	113.000
Valid		278.000
Missing		.000

After the clustering process was complete, it was advisable to check how high the clustering quality was by looking at the "capability" of the cluster. It aimed to distinguish existing data regarding the subject used for clustering, whether per variable or characteristic (Gudono, 2016). Table 10 shows that variables course content, teaching design, video quality, teaching service, and teaching evaluation can be used to distinguish each cluster. The significance value is below 0.05, or if the greater the value of F and (Sig < 0.05), the greater the difference in variables in the cluster formed. Table 10 shows K-means ANOVA, which can be used as a reference to test cluster capabilities specified by the K-Means method.

Table 10. K-Means ANOVA

	Cluster		Error		F	Sig.
	Mean Square	Df	Mean Square	df		
Zscore(Course_content)	62.959	2	.549	275	114.600	.000
Zscore(Teaching_design)	95.629	2	.312	275	306.706	.000
Zscore(Video_quality)	89.916	2	.353	275	254.472	.000
Zscore(Teaching_service)	88.832	2	.361	275	245.917	.000
Zscore(Teaching_evaluation)	71.633	2	.486	275	147.300	.000
Zscore(Learning_effect)	.546	2	1.003	275	.545	.581

In this study, it was found that three lecturer performance clusters were formed during the COVID-19 pandemic; 48 lecturers were in low-performance (17%), 117 of them were in moderate-performance (42%), and 113 of them were in the high-performance category (41%). These clusters are presented in Figure 3.

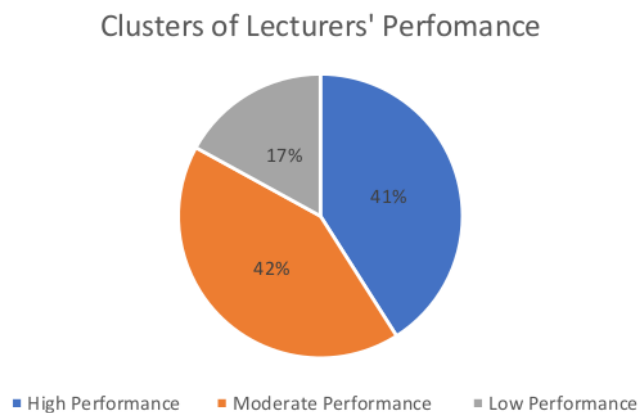


Figure 2. Clusters of Lecturers' Performance

Discussion

Lecturers should adapt to the changes nowadays due to online learning; they must manage the class well even without face-to-face learning. As it is known, starting March 2019, Indonesia was hit by the outbreak of COVID-19 and classroom learning was finally eliminated, and students studied at home with their families. By establishing this policy, schools must alter and conduct the activities based on online learning.

Online learning has its challenges due to its different characteristics from face-to-face learning (Watson, 2008). The teacher is demanded to have online teaching competencies, which are expected to support online teaching preparation. These online teaching competencies include indicators of learning material and evaluation questions, community, opportunities for collaboration, online and multimedia teachers. Furthermore, activity theory attempts to analyze cultural and technical aspects and the individual actions in their activities. The measurement of online learning activities is measured by indicators of technology level, individual level, and community level. It was found that three lecturer performance clusters existed during the COVID-19 pandemic based on the results of data clustering. Eliyana and Ma'arif (2019) stated that work performance was an achievement stage as a work accomplishment by an individual from the organization. Lecturers' performance was clustered in 48 lecturers who were in low-performance (17%), 117 of them were in moderate-performance (42%), and 113 of them were in the high-performance category (41%). In addition, 42% of lecturers had moderate performance. They had the competency in teaching and online learning activities; however, they were not very skilled. Thus, they needed time, opportunity, and encouragement to be ready for the changes.

Furthermore, 41% of respondents showed a high level of performance which implied that they were capable to conduct online learning. They were creative in designing learning media in videos or slides that were attractive to students as it is known that creating learning videos is not easy. Based on the preparation stage, they should be ready in terms of material and equipment and explain skills under the lesson plan that were prepared. They also had to do hours of editing to perfect the video, and upload and share it with the students concerned. In this regard, it requires IT skills as well as conscientiousness.

The respondents with a low level of performance were 17%; it implies that they were not ready for online teaching. They were still in the learning stage of creating videos or learning media with not many online learning activities. It is the basis for educational institutions to provide material and skills related to online teaching. Moreover, lecturers took the initiative to make learning videos, PPT media, manage Google Classrooms or GoogleMeet. However, various obstacles can emerge; one respondent argues that one of the obstacles in creating good online learning media is supporting devices/facilities (laptops and Wi-Fi)

Furthermore, this study consisted of six variables, including Course content, Teaching design, Video quality, Teaching service, Teaching Evaluation, and Learning effect. Descriptive statistical tests were conducted to determine the respondents' picture or profile from each variable in this study. Table 11 summarizes these statistics.

Table 11. Descriptive Statistics of Each Research Variable

Variable	N	Minimum	Maximum	Mean	Std. Deviation	Descriptive percentage
Course_content	278	45.00	60.00	56.1	4.33784	93%
Teaching_design	278	22.00	36.00	32.5	3.05027	91%
Video_quality	278	11.00	28.00	23.3	3.44075	83%
Teaching_service	278	22.00	33.00	29.6	2.67255	90%
Teaching_evaluation	278	28.00	40.00	38.0	2.81215	95%
Learning_effect	278	24.00	40.00	34.6	3.92101	87%
Valid N (listwise)	278					

Based on the table above, the skills of lecturers in very good positions included the skills of teaching evaluation, course design, teaching design, teaching service, learning effect. One skill that still needed improvement was video quality with 83%. The following are the descriptive results of statistics on Video Quality Variables in Table 12.

Table 12. Descriptive Statistics Variable Video Quality

Statement Items	N	Minimum	Maximum	Mean	Std. Deviation
X3.1	278	1.00	4.00	2.9065	.71993
X3.2	278	1.00	4.00	3.2122	.66495
X3.3	278	1.00	4.00	3.3201	.65958
X3.4	278	1.00	4.00	3.3921	.67515
X3.5	278	1.00	4.00	3.3849	.59425
X3.6	278	2.00	4.00	3.6115	.51701
X3.7	278	1.00	4.00	3.5504	.61508
Valid N (listwise)	278				

Table 12 shows the lowest statement was on X3.1; "I am skilled at making good and interesting learning videos," with a mean of 2,906 on a Likert scale of 1 – 4. It means that most respondents do not yet have the skills to make learning videos that should be interesting and easy for students to understand. Furthermore, the highest statement was contained in two statement items, X3.6, "I can operate online learning platforms well," with a mean of 3.611. It means that respondents should be skilled in using and operating the learning platform well. Most lecturers at UNNES organize learning and discussion through *Zoom/ GMeet*, ELENA (UNNES Learning platform), and social media applications such as WhatsApp and Blog. It is aligned with [Gunawan et al. \(2020\)](#), which found variations of models and learning platforms during the COVID-19 pandemic, such as WhatsApp and social media.

Moreover, the lecturers need to create videos to support learning optimization and improve lecturer performance. The use of good video for learning has advantages. According to [Aqib \(2013\)](#), learning videos can make learning clearer and more interesting. The teaching and learning process becomes more interactive; it can improve student learning outcomes and foster a positive attitude towards the material taught.

The results showed that most respondents did not yet have the skills to make learning videos that were interesting and easy for students to understand. One strategy to improve skills in making videos was an interesting learning video maker workshop. Applications or software used in learning video creation workshops was OBS Studio, Kine Master, and Power Director. They are open Broadcaster Software that makes video recording and video streaming. Many free and open-source applications ([Kumar & NCTEVA-DE, 2021](#)). At the same time, the open-source application was equipped with source code to contribute to development. Lecturers must always strive to improve their performance and adapt and manage online and offline classes. It is required for a better quality of education in Indonesia.

Conclusion and Suggestions

Lecturers should perform well in teaching. For encouraging the betterment of education, they need to prepare well in the online teaching-learning process. Some factors should be prepared in e-learning, i.e., course content, teaching design, video quality, teaching service, teaching evaluation, and learning effect. This study aimed to map respondents in which they were demanded to carry out effective and efficient online learning. It was found that three lecturer performance clusters were formed during the COVID-19 pandemic based on the results of data clustering. The first cluster of 48 lecturers was in low-performance (17%), 117 of them were in moderate-performance (42%), and 113 of them were in the high-performance category (41%).

In the end, therefore, the author recommends to improve lecturers' performance through a few recommendations: (1) Lecturers should improve competence in operationalizing technology-based media; (2) Lecturers must adjust the right learning design to online learning conditions so that the learning process becomes interactive and efficient; (3) Lecturers must be skilled in making good and interesting learning videos; (4) Lecturers should be able to establish intense communication with university students even though online learning; (5) Lecturers should be able to utilize technology-based media in the process of conducting learning evaluations; and (6) Lecturers should motivate university students to become more active in online learning.

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