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Factors Affecting Teacher Digital Competence : An Exploratory Factor Analysis

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Abstract: This study aims to analyze the factor affecting the teacher competence in mastering digital technology in classroom learning during face-to-face learning in elementary schools in Lamongan district. This study used a quantitative approach using exploratory factor analysis (EFA) techniques. EFA is used to determine indicators related to teacher competence in mastering digital technology. The population of this study were teachers in Lamongan district. The sample of this research is 60 respondents with a cluster sampling method. The research stages include 1) instrument development, 2) instrument validation, 3) data collection, 4) data analysis, and 5) reporting. The results showed that there were 4 factors in mastering digital technology for teachers, namely collaboration, personal development, data literacy and information literacy. Collaboration and personal development in increasing digital competence influence on teacher performance in the teaching process. Teachers have numerous teaching materials due to collaboration using digital platforms.

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Introduction

Digital technology is a catalyst in the transformation of education in the 21st century. Rapid and sustainable innovation in educational technology in this digital era is increasingly encouraging the implementation of online learning. In recent years, technological developments and globalization have accelerated and digital competence has become very prominent in the context of education (Pozos Pérez & Tejada Fernández, 2018). However, the use of technology has become a daily necessity, on the other hand, because of the professional development of people dependent on the efficient and appropriate use of digital technology. In this regard, (Cabero-Almenara et al., 2022) suggest that digital competence is one of the main competencies that must be mastered by society in general, and teachers in particular.

Teachers are the key to the process of integrating and implementing digital technology in classroom learning, the transformation and improvement of education will depend on the learning process held. From an educational perspective, digital technology has transformed from simple supporting media into an integral part of the current pedagogical process (López-Belmonte et al., 2019) (Ladhari & Morales, 2011). Mastery of digital technology raises concerns for teachers today because teachers are required to be able to adapt and improve their competence in mastering digital technology, especially during the online learning period. Based on the results of a survey conducted by the Ministry of Education and Culture obtained data that one of the obstacles that play a role in the online learning process is the inability of teachers to optimize digital technology in classroom learning. Teacher competence in the aspect of digital mastery can still be categorized as low

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with data of approximately 28% as the main contributor to teacher barriers in the learning process. This can be seen in Figure 1 Below;

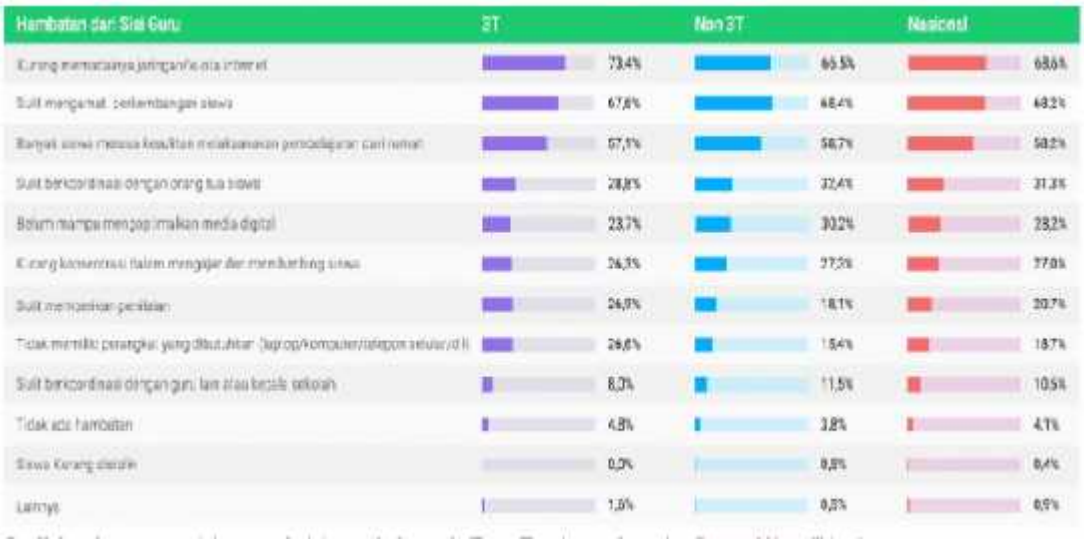

Figure 1 Teacher Barriers in Online Learning
Source: Ministry of Education and Culture Survey 2021

Online learning *encourages* teachers to be able to improve new skills and pedagogical strategies that allow teachers to integrate this digital technology into the learning process (Li et al., 2019). In this new normal era, the implementation of learning is held face-to-face. When learning online, teachers are required to be able to get out of their comfort zone by integrating the learning process using digital technology. In face-to-face learning, teachers also require for optimizing the use of digital technology, which is still a major need considering that the competence of students in the 21st century is technology literacy or literacy in mastering technology.

In the current era, teachers need a fairly high digital competence and also the increasing complexity in implementing education in schools (Pettersson, 2018). (Krumsvik, 2014) argues that digital competence is more complex in the teaching profession compared to other work professions because in the teaching profession there are two dimensions of digital competence. The first competency dimension relates to the teacher's ability to use technology in a good way to encourage students to imitate using the technology in daily activities. The second dimension is pedagogical where the teacher continuously makes pedagogical didactic assessments that focus on how ICT can expand learning possibilities for students in the learning process (Krumsvik, 2008).

The centrality of teachers in encouraging the use of technology in schools, digital competence is now a key element of teacher education worldwide (Guðmundsdóttir & Hatlevik, 2017). At present, the concept of 'professional digital competence' does not only focus on teaching and learning skills. (Instefjord & Munthe, 2017) argues that professional digital competence requires the ability to integrate and use technology for educational purposes as well as possessing more general skills that are suitable for all situations, both personal and professional.

As teachers who educate and teach millennials, teachers must always improve their competence in mastering technology and be able to answer students' needs. Pedagogic competence is the aspect most related to technological advances, in order to support the smoothness and quality of learning. It is supported by previous research (Antonietti et al., 2022) that teacher digital competence has a relationship to support in teaching and learning.

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Learning in the digital era is expected to apply advanced technology or digital. This study aims to analyze the indicators related to teacher competence in mastering digital technology during face-to-face learning in elementary schools in Lamongan district.

Research Method

This study used a quantitative approach using exploratory factor analysis test data analysis techniques. Exploratory factor analysis (EFA) classify as one of multivariate statistical methods that the function is to identify the factors of hypothetical constructs (Watkins, 2018). This method is used to identify factors related to the digital competence of teachers in mastering digital technology. Bartlett test (p = .000) and Kaiser-Meyer-Olkin index (0.886), are the standards used for the application of factor analysis. This research questionnaire consists of two parts. Part I was developed to identify the condition of the respondents' demographic data. Containing information on gender, age and position, part II is developed from a literature review and conceptual framework on teacher digital competence. The measurement scale uses a 5 point Likert scale. 1=strongly disagree, 2=disagree, 3=disagree, 4=agree and 5=strongly agree. Data collection is done by collecting primary data.

In this study, the data collection method used a questionnaire. Respondents were given an online questionnaire consisting of an open and closed questionnaire. The prepared questionnaires were distributed by teachers in Lamongan district. The population of this study was 180 teachers, moreover the sample in this study was 60 teachers using cluster sampling. Sampling adequacy will be seen in the KMO coefficient. Bartlett's test was used to test the normality of the data. The data are normally distributed if 2 count < 2 table or the specified significance level is smaller than the calculated significance level limit. The next analysis is presenting a correlation matrix, determining analytical procedures, extracting Factors, Rotates factors and data interpretation.

Results and Discussion

Based on the data that has been collected, the demographic conditions of the respondents are described as shown below:

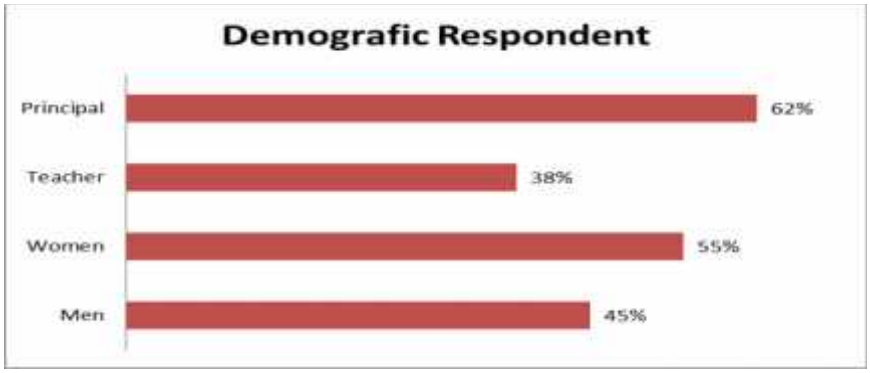

Figure 2. Demografic Respondent

The picture above shows that 62% of respondents are principals and 38% are teachers in terms of gender, 55% were female and 45% were male.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.874
Bartlett's Test of Sphericity	Approx. Chi-Square	1326.620
	df	276
	Sig.	.000

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Based on the results of the analysis, testing the assumption of factor analysis using KMO-MSA obtained a value of 0.804 > 0.5, which means that the factor analysis data is appropriate. The KMO value obtained is 0.806 (greater than 0.5) indicating that the number of samples (respondents) is sufficient. Figures Sig. (significance) which is 0.000 or can be read as 0.0001.

H0 : There is no relationship between the tested variables

H1 : There is a relationship between the variables being tested

Based on the data that has been processed, the Sig number is 0.000, which is below 0.05 so reject H0. The conclusion is "there is a relationship between the variables being tested". This means that exploratory factor analysis can be carried out.

The second step is to calculate the variable correlation matrix or anti-image matrices. The results of the analysis show that the anti-image correlation in the data shows a number above 0.5 so that it can be continued in the next stage.

Anti-image Correlation	
X1	.864[a]
X2	.857[a]
X3	.831[a]
X4	.831[a]
X5	.831[a]
X6	.831[a]
X7	.879[a]
X8	.852[a]
X9	.899[a]
X10	.852[a]
X11	.909[a]
X12	.901[a]
X13	.882[a]
X14	.889[a]
X15	.831[a]
X16	.819[a]
X17	.838[a]
X18	.937[a]
X19	.852[a]
X20	.883[a]
X21	.851[a]
X22	.903[a]
X23	.860[a]
X24	.902[a]

The next step calculates the rotated component matrix. This step determines which variables will be included in the same factor. Determination of the incoming variable on which factor is determined by looking at the largest correlation value. In the table below, it has been sorted from the largest to the smallest value per factor.

Rotated Component Matrix[a]

	Component			
	1	2	3	4
X1	.286	.266	.846	-.034
X2	.169	.213	.839	.192

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X3	.265	.037	.757	.362
X4	.201	.248	.476	.607
X5	.496	.276	.193	.674
X6	.417	.374	.184	.705
X7	.764	.240	.204	.229
X8	.703	.283	-.022	.222
X9	.669	.281	.244	.269
X10	.683	.135	.286	.478
X11	.652	.382	.327	.317
X12	.779	.292	.269	.278
X13	.775	.193	.295	.266
X14	.590	.233	.296	.460
X15	.621	.594	.267	-.190
X16	.253	.708	.254	.372
X17	.204	.802	.305	.270
X18	.583	.415	.183	.419
X19	.467	.547	-.036	.465
X20	.558	.575	.118	.349
X21	.490	.648	.207	.223
X22	.748	.187	.270	.225
X23	.736	.284	.295	.184
X24	.610	.507	.124	.109

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 8 iterations.

The data from the rotation of factor analysis is shown in the table below:

Table 1 Description of Rotation Factor

Item	Description	Factor
X7	Interact for educational purposes through applications and web spaces with students and teachers by publishing news and information about education	Collaboration
X8	Regularly distributes and publishes relevant educational information.	
X9	Collaborate with members of the education community and use ICT responsibly and effectively	
X10	Uses the online space to share educational content that I find relevant to my community and provide feedback and recommendations	
X11	It is easy to access and participate in online spaces or share documents online	
X12	Feels confident in using online applications and collaborative spaces for my future work as a teacher	
X13	Creates, shares and comments online with educational content	

Item	Description	Factor
	that can help my coworkers	
X14	Knows and understands the concepts of digital identity and digital reputation	
X15	Provides my personal data only on secure network sites and easily identifies deceptive and/or fraudulent messages	
X18	Keeps resources or files in an organized way on my device which can be useful for teaching process	
X22	Solved technical problems related to my digital device through online communication	
X23	Knows several tasks that can be done by using technology to improve the teaching and learning process	
X24	Takes online courses and participates in various types of virtual training rooms that promote self-learning	
X16	Generates a key or password which I change regularly as a protection protocol	Personal development
X17	Uses online tutorials to learn how to use apps to create digital educational content	
X19	Knows the difference between types of licenses, and properly cite the sources of all the digital content that I use in compiling teaching materials	
X20	Seeks information on how to properly cite copyrighted content to ensure it is used properly	
X21	Tries to solve common technical problems related to my digital device individually with tutorial support	
X1	Searches the internet for various sources and information that will be used for learning materials in the classroom	Information literacy
X2	Selects and adapts various types of digital resources and information that I find on the internet to prepare for classroom learning	
X3	Meet and quality of resources and information that I found on the internet for learning materials in the classroom	
X4	Critically finds resources and information that I find on the internet and use in learning	Data literacy
X5	Has a cloud or external storage device where I can store and share resources and files that may be of interest	
X6	Compress files and keep backups of the materials I use to optimize the storage space I have on my device.	

Based on the data analysis, factors affecting teacher digital competence are classified into four aspects: Collaboration, personal development, data literacy and information literacy. The first construct or factor is collaboration, this aspect describes the teacher digital activities in sharing information and document with other colleagues. The second aspect is personal development, this aspect focuses on how teacher use digital tools and media for improving their competencies. The next factor is information literacy, this aspect explore about the teachers' ability to get the right information from internet. Moreover, the last aspect is data literacy, this area focuses on the teachers' ability to manage their digital data.

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Figure 3. Teacher Digital Competence Factor

From the analysis above we concluded that teachers digital competence consists of 4 factors. The first factor explained a description of several items that describe the collaboration factor. This can be identified from several statements such as the use of virtual spaces as collaborative media in teacher learning activities. This is in line with previous research that digital competence is defined as being able to be defined as the safe, critical, and creative use of ICTs to achieve objectives related to work, employment, learning, leisure, inclusion and/or participation in society (Janssen et al., 2013). Collaborating activities have the same meaning as actively participating in the community. This factor also supports the research of (van Laar et al., 2020) define DC as a combination of knowledge, skills and attitudes. They categorize digital skills into seven core and five contextual skills. The seven core skills are technical and information management, communication, collaboration, creativity, critical thinking and problem solving. Collaboration in virtual learning includes the sharing of ideas on e-learning implementation (Isoda et al., 2021).

The second factor is an indicator of personal development. The digital competence of teachers is formed from the aspect of self-development. This factor is formed from several statement items that describe teachers carry out self-development through online learning that is initiated independently. Develop yourself through citing references on the internet as the development of teaching materials and trying to understand the concept of digital development. This factor is also in line with (Torrance & Forde, 2017), which state that fundamental in the teaching profession it is closely connected to personal abilities such as communication, motivation, critical thinking, empathy, and personal safety. However, taking on the responsibility of being a reference or leader inevitably involves the ability to organize and manage digital technological resources, which implies being a source of inspiration for students (at the lowest level) and for colleagues (at a more advanced level), and is part of teachers' personal and professional development (Miguel-Revilla et al., 2020). Teacher ability to master digital tools can be indicated as one of country's long-term investments in professional development (Leino Lindell, 2020).

The third factor is information literacy. One of the factors that affect teacher digital competence is how teacher literacy to access and understand the information from digital media or digital learning. Teachers are more innovative use of digital learning and it has a positive impact to improve on the teaching practices (Mei et al., 2019). In this aspect,

teachers facilitate the student to use of the content, access to a variety of sources and enhance student critical thinking by encouraging students to reinterpret resources (Sanches, 2018). In the future, teachers are taught how to evaluate information, but lack instruction on fair use of information (Kokić, 2012). Teachers must be competent to teach students how to find information and ensure that the information sought is fact-based and reliable information so that it does not cause biased information. Moreover, information literacy has a positive effects on teaching effectiveness (Xu & Chen, 2016) .

The fourth factor is a factor that is formed in the aspect of data literacy. Data literacy is an important factor for teachers. During the learning process in the classroom, teachers need to look for information references or various materials needed so that teachers are expected to have the competence to seek, obtain, and process conclusions from the data. This is in line with previous research, digital tool use has often been associated with higher competence (Guðmundsdóttir & Hatlevik, 2017). Based on the assumption that competence improves with practice, teachers using digital tools in teaching often were more digitally competent (Ghomi & Redecker, 2019). (Miguel-Revilla et al., 2020) note that a variety of frameworks, models and literacies have been developed to guide teacher educators in their efforts to develop digital capabilities in their students that will help them use new and emerging technologies in their future classrooms.

Conclusion

The conclusion obtained from the results of this study are that the teacher digital competence is currently identified into four factors. Teacher digital competence classifies into several factor and each factor is mentioned in the discussion above describing that the teacher always be open minded and have the motivation to become a learner. Four factors in this study that contribute to master digital competence, can be used as a strategy for teacher to improve their competence. In the current digital era with the development of various digital-based learning media, teachers are required to be able to follow these developments by increasing their competence.

Recommendation

From this study, a recommendation to policy maker such as school principal that is crucial conduct training to improve teacher digital competence as one of the way to support teacher personal development. The training activities expected all of teacher to be literate from information and digital technology. However, school principal also facilitate the teacher for create collaboration with colleague from another institution//school.

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