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Assessing Digital Attitude Competence of Prospective Chemistry Teacher in Indonesia: A Case of Lampung Univesity

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Abstract: Assessing Digital Attitude Competence of Prospective Chemistry Teacher in Indonesia: A Case of Lampung Univesity. Objective: This study aims to analyze the competence of digital attitudes of chemistry teacher candidates at the University of Lampung. **Methods:** A total of 200 chemistry teacher candidate students at the teacher training faculty, Universitas Lampung were randomly selected as research samples. The data obtained were analyzed using exploratory factor analysis techniques, reliability, correlation, average value, and variance. **Findings:** Analysis shows that the questionnaire items are grouped into five main factors with the Cronbach alpha coefficient and the percentage of variance as follows: attitudes towards digital content creation ($\alpha = 0.919$; $s^2 = 39.546\%$); attitudes towards digital information ($\alpha = 0.885$; $s^2 = 7.806\%$); attitudes towards digital security ($\alpha = 0.871$; $s^2 = 4.321\%$); attitudes towards digital problem solving ($\alpha = 0.755$; $s^2 = 3.410\%$); and attitudes towards digital information ($\alpha = 0.793$; $s^2 = 2.974\%$). **Conclusion:** The comparison of the mean and grand mean values shows that attitudes towards information and digital security are more dominant factors in how chemistry teacher students respond to digital devices that support learning.

Keywords: digital attitude competence, chemistry teacher candidates, factor analysis.

Abstrak: Menilai Kompetensi Sikap Digital Calon Guru Kimia di Indonesia: Suatu Kasus di Universitas Lampung. Tujuan: *Penelitian ini bertujuan untuk menganalisis kompetensi sikap digital calon guru kimia di Universitas Lampung.* ***Metode:*** *Sebanyak 200 calon mahasiswa calon guru kimia di FKIP Universitas Lampung dipilih secara acak sebagai sampel penelitian. Data yang diperoleh dianalisis dengan menggunakan teknik analisis faktor eksplorasi, reliabilitas, korelasi, nilai rata-rata, dan varians.* ***Temuan:*** *Hasil analisis menunjukkan bahwa item kuesioner dikelompokkan menjadi lima faktor utama dengan koefisien alpha Cronbach dan persentase varians sebagai berikut: sikap terhadap pembuatan konten digital ($\alpha = 0{,}919$; $s^2 = 39{,}546\%$); sikap terhadap informasi digital ($\alpha = 0.885$; $s^2 = 7{,}806\%$); sikap terhadap keamanan digital ($\alpha = 0.871$; $s^2 = 4{,}321\%$); sikap terhadap pemecahan masalah digital ($\alpha = 0{,}755$; $s^2 = 3{,}410\%$); dan sikap terhadap informasi digital ($\alpha = 0{,}793$; $s^2 = 2{,}974\%$).* ***Kesimpulan:*** *Perbandingan nilai mean dan grand mean menunjukkan bahwa sikap terhadap informasi dan keamanan digital merupakan faktor yang lebih dominan dalam respon siswa guru kimia terhadap perangkat digital yang mendukung pembelajaran.*

Kata kunci: *kompetensi sikap digital, calon guru kimia, analisis faktor.*

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INTRODUCTION

Digital technology plays an important role in developing skills for collaboration, social interaction, information retrieval, and community participation (Zhong, 2011). It is very important for students to master advanced digital competencies, especially when the world is currently entering the era of digitalization which is widely known as the Industrial Revolution 4.0 (Aesaert et al., 2013). The term Industrial Revolution 4.0 is used to represent the fourth revolution that has occurred in computer-based manufacturing and automation and enhances it with intelligent and autonomous systems based on data and machine learning. In this era of the Industrial Revolution 4.0, every individual is required to master adaptive 21st century skills to fill this era of digitalization.

In the context of the 21st century skills movement, the European Commission defines the use of digital technology as one of the eight main competencies for lifelong learning (i.e., the competencies people need for personal fulfillment, active citizenship, social cohesion and work in society (European Commission, 2008). Recent research has shown that variability in digital competence is related to the degree to which people benefit from computer use (Hargittai & Hinnant, 2008). For example, people with low digital competence tend to use online public services less frequently than those with competence. digital (van Deursen & van Dijk, 2009). Hargittai and Hinnant (2008) found that people with a higher level of knowledge about online terms were more likely to visit websites that could have a major influence on human and financial capital development. them. H This shows the importance of mastering digital competencies and achieving the target of the old curriculum towards a digital skills-based curriculum (Vanderlinde, van Braak, & Hermans, 2009).

With the rapid development of technology in the last few decades, it has been widely recognized that teachers and prospective teachers must be ready to integrate Technology, Information and Communication (ICT) tools in their educational practice, including Chemistry teachers. Chemistry itself has the characteristics of abstract submicroscopic material content such as the concept of atoms, orbitals, molecular electrons, chemical bonds, interactions between molecules and so on which are not easy to explain conventionally. Chemistry teachers are required to present chemistry learning through visualization, computation, and animation to make chemistry easier for students to understand. Generally, a chemistry teacher is required to master simple computational chemistry software that can visualize molecules and their interactions between molecules. In other words, the digital competence of prospective chemistry teachers can be used as one of the main benchmarks for the professionalism of chemistry teachers (Kirschner, Wubbels, & Brekelmans, 2009).

Digital competence is related to 5 main competency areas (Ferrari, 2013), namely information processing, communication, content creation, safety, and problem solving. Digital competence as a transverse key competency that allows to acquire other key competencies (eg language, mathematics, cultural awareness). Undoubtedly, various technologies (for example, computers, interactive boards, software, internet and so on) that affect the lives of consumers and users around the world can be useful to support the teaching and learning process. This is because technological advances can increase access to more educational resources and reveal wider opportunities for collaboration and problem solving (Al Khateeb, 2017). Thus, knowledge, skills and attitudes are needed in mastering digital technology at this time. The interaction of the three dimensions will accelerate the process of adaptation to technology which is increasingly progressing rapidly.

It is widely understood that the attitude dimension plays an important role in increasing one's competence, including digital competence (Tømte, 2015; Avidov-Ungar & Eshet-Alkakay, 2011; Calvani, Fini, & Ranieri, 2009). The level of one's digital mastery and how to improve it can be determined by how well a person perceives his abilities or in other words how a person behaves towards digital technology that is being faced (Avidov-Ungar & Eshet-Alkakay, 2011). By studying a person's attitude towards digital technology, it can also be seen the factors that might affect their competence. For example, someone who has perceived himself will not be able to operate the formulas and logic in computational chemistry software even though he has never tried it, will face great difficulties in training the skills to operate these devices. Therefore, this research will be developed. a valid and reliable assessment instrument to measure the digital attitude competence of chemistry teacher candidates related to mastery of general computational chemistry software and must be mastered by a prospective teacher. In the next stage, the instruments developed will also be used to evaluate the readiness of these prospective teachers in facing the Industrial Revolution 4.0. This instrument is expected to be used more broadly for the purposes of competency analysis of digital attitudes of educators and students so that it is possible to understand weaknesses and be able to increase mastery of digital technology.

■ METHODS

The research sample was active students in odd semesters consisting of students in semesters 1, 3, 5, totaling 200 students. This study uses an assessment instrument that has been developed and standardized before at the instrument development stage. The questionnaire was constructed using a comprehensive analysis using exploratory and confirmatory factor analysis methods. The instrument design developed was adapted from the Digital Competence Framework for Citizens (DigComp) which was previously researched by the European Union (Europass). The instrument was transliterated into Indonesian, making it easier for research subjects to understand each item in the instrument and presented through one of the electronic survey platforms, namely Google Form. The data analysis in this study was carried out in several stages, namely grouping students' answers in each item in the instrument and coding according to the 5 level Likert scale, determining the construct validity of the instruments used using exploratory factor analysis (EFA) techniques, analyzing the validity of the instrument. In accordance with the validation criteria in the EFA analysis by Stevens (2002), items that are maintained in the instrument must have a loading factor of more than 0.40 so that items with a loading factor of less than 0.40 will automatically be eliminated in the analysis of each item in the instrument. The principle of main component extraction by orthogonal rotation is used in this study to estimate the number of possible factors, as well as to contribute to construct validity in the developed instrument. analyzing the reliability of each dimension in the instrument based on the calculation of Cronbach's alpha coefficient, calculating the average value and standard deviation for each dimension used to describe the level of competence mastery of students' digital attitudes (according to their respective perceptions), analyzing the correlation of each item and each dimension of attitude competence digital students using Pearson product moment.

■ RESULTS AND DISCUSSION

The digital attitude competency instrument developed in this study uses 42 statement items where each statement is expected to represent the 5 dimensions of digital competence. Furthermore, the 42 items of the questionnaire statement were analyzed using exploratory factor analysis to reveal how the tendency of the statement items to cluster on latent factors that were not yet known. Exploratory factor analysis (EFA) is a statistical technique used to reduce data to a smaller set of summary variables and to explore the theoretical structure underlying the phenomenon. It is used to identify the structure of the relationship between variables and respondents.

Exploratory Factor Analysis

Before an EFA analysis is carried out, it is necessary to identify the items made whether they are suitable for EFA analysis or not. This can be done by tracing the value of the Kayser-Mayer-Olkin sampling adequacy test (KMO) and the Bartlett sphericity test. The KMO test is a statistic that shows the proportion of variance in your variables that may be due to underlying factors. High values (close to 1.0) generally indicate that factor analysis might be useful with your data. If the value is less than 0.50, the results of the factor analysis may not be very useful. Meanwhile, Bartlett's Test for variance homogeneity was used to test that the variance was the same for all samples. It checks that the equal variance assumption is correct before running certain statistical tests. This is used when you are reasonably sure your data comes from a normal distribution. In this study, the KMO and Bartlett chi-square (x^2) test values were, respectively, 912 and 3548.843 ($p < 0.05$). This value indicates that the data set is suitable for analysis by EFA and will provide valid results.

After it is known that the data is suitable for use for EFA analysis, the results of the varimax rotation show that all items have an extraction value of more than 0.40 so that all items in the instrument do not have to be removed because they are thought to have contributed to each structural factor (latent factor). In this study, the extraction communalities ranged from 0.595 to 0.826, so it was assumed that each item had a contribution and was able to represent the latent factor. The EFA analysis was then continued by applying the principle of main component extraction with a minimum eigenvalue 1, orthogonal rotation of varimax and limiting the loading factor to a minimum of 0.45. The limitation of the loading factor value is based on the validation criteria in the EFA analysis by Stevens (2002). According to Stevens (2002), items that are maintained in the instrument must have a loading factor of more than 0.40 so that items with a loading factor of less than 0.40 will automatically be eliminated in the analysis of each item in the instrument. The principle of main component extraction with orthogonal rotation is used in this study to estimate the number of possible factors, as well as to contribute to the validity of the constructs in the developed digital attitude competency instrument.

After the EFA analysis is carried out, information is obtained that items No. 7 and 17 have a loading factor below 0.45 so that in this case it will be excluded in the EFA analysis. The loading factor value of the questionnaire items ranged from 0.470 to 0.930. The results of the EFA analysis then showed that the 40 items used in the analysis resulted in 8 latent factors with a total variance of 67.096%. The percentage of this variance indicates that the 8 latent factors that have not been labeled can explain the competence of digital attitudes of prospective chemistry teachers by 67.096%. Furthermore, the reliability test with Pearson product moment analysis shows that the total Cronbach á is 0.893 which indicates that the items in the instrument have high internal consistency and are reliable. Information related to the loading factor of each item and the percentage of variance for each factor is presented in table 4.3. However, the analysis will result in a weak judgment if it only has 1-2 items. In other words, only those factors that had more than 3 items and those that were less were considered were eliminated from the factor analysis. This is because the factor that only has less than 3 items is considered to be very weak or unstable; On the other hand, a factor consisting of 5 or more items with a loading value (0.50 or more) is preferred and indicates a solid factor (Osborne & Costello, 2009). It is possible to maintain a factor with only two items if the items are highly correlated (r > 0.70) and relatively uncorrelated with other variables (Yong & Pearce, 2013). Researchers must maintain a factor only if they are able to interpret it in meaningful ways, no matter how strong the evidence is to maintain it based on empirical criteria (Worthington & Whittaker, 2006). Therefore in this case the factors 6, 7 and 8 will be omitted and will not be used for further analysis. The factors in digital attitude competence are (a) attitudes towards digital content creation (á = 0.919; s2 = 39.546%) consisting of 10 items; (b) attitudes towards digital information (á = 0.885; s2 = 7.806%) consisting of 8 items; (c) attitudes towards digital security (á = 0.871; s2 = 4.321%) consisting of 8 items; (d) attitudes towards digital problem solving (á = 0.755; s2 = 3.410%), consisting of 4 items; and (e) attitudes towards digital information (á = 0.793; s2 = 2.974%), consisting of 4 items.

Competency Level of Digital Attitude

The level of attitude of MIPA teacher candidates towards digital attitude competence is based on the comparison of the mean of each latent factor to the grandmean value (Suprapto, 2016). If the mean value of each latent factor is greater than the grandmean, it is indicated as the dominant preference for digital attitude competence possessed by chemistry teacher candidate students. The results of the degree of attitude analysis can be observed in table 1

Tabel 1. Descriptive statistics

	Mean	Std. Deviation	Ranking*
Factor 1	3.48	.690	5
Factor 2	4.10	.587	2
Factor 3	4.13	.570	1
Factor 4	4.06	.608	3
Factor 5	3.92	.568	4

Note: *Grandmean = 3.94

Interrelationship Between Factors

The relationship between factors in the competence of digital attitudes is studied based on the analysis of the Pearson product moment correlation coefficient. The results of the Pearson correlation analysis can be observed in table 2.

Table 2. Correlation analysis

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Factor 1	1	.608**	.613**	.602**	.704**
Factor 2		1	.758**	.657**	.561**
Factor 3			1	.668**	.576**
Factor 4				1	.557**
Factor 5					1

(**significant at the level 0.01)

The initial design of the instrument developed in this study was based on consideration of the author's justification and review of related literature related to digital attitude competency instruments. The next stage, the prototype of the instrument was validated by experts. From the results of expert validation, several recommendations were obtained regarding instrument items that could be added or reduced or improved on the item statement. The content validated instruments are then distributed (survey method) to students in semesters 1, 3, and 5 in the Chemistry, Biology, Physics, and Mathematics Study Programs. Furthermore, the data obtained will be used to determine the validity of the construct, as well as evaluate how the competence of digital attitudes of prospective chemistry teacher students. In general, the findings in this study reveal that the instruments developed are valid and reliable. This can be observed based on the Cronbach alpha value of 0.893 which indicates a high scale of internal reliability and consistency. Therefore, this instrument can be used for further research to analyze students' digital attitudes. Based on the results of exploratory factor analysis, it is known that the statement items (variables) can be grouped into 5 main factors, namely Factor 1 ($\alpha = 0.919$), consisting of 10 items; Factor 2 ($\alpha = 0.885$), consisting of 8 items; Factor 3 ($\alpha = 0.871$), consisting of 8 items; Factor 4 ($\alpha = 0.755$), consisting of 4 items; Factor 5 ($\alpha = 0.793$), consisting of 4 items. The five factors have a high enough Cronbach alpha value so that they are believed to be reliable and consistent to be used in the analysis of future student digital attitudes.

From this analysis also obtained information about the percentage of variance of each factor, it can be understood that Factor 1 (s2 = 39.546%) is able to explain most of the digital attitudes of prospective chemistry teacher students because the variance is much greater than other factors, then it can be followed that Factor 2 explains 7,806%, Factor 3 explains 4,321%, Factor 4 explains 3,410% and Factor 5 explains 2,974% the variance of the variables in the instrument. Besides that, the total variance explained 67,096% revealed that the instrument could explain a fairly large variance of each variable in the statement item to reveal the competence of digital attitude of chemistry teacher candidates.

The analysis was continued with the analysis of the degree of attitude of the chemistry teacher candidates by using the mean and grand mean comparison. The results of the analysis show that Factor 2 (Mean = 4.10; SD =, 587), Factor 3 (Mean = 4.13; SD =, 570), and Factor 4 (Mean = 4.06; SD =, 608) the mean value is greater than the grandmean value so that in this case these factors dominate how chemistry teacher student students respond to digital devices that support learning. These results also represent how the knowledge, skills, and experiences of chemistry teacher prospective students interact with digital devices in learning. Next is the bivariate correlation analysis which obtains an interrelated relationship between structural factors where each factor correlates significantly at the 0.01 level. Each factor in the digital attitude competency affects each other. This means that every effort made to improve one factor of digital attitude will lead to an increase in other factors.

■ CONCLUSIONS

The digital attitude competencies of chemistry teacher candidates are classified into five factors where these factors are able to explain 67.096% of all digital attitude competences. Furthermore, the digital attitude competence instrument developed was declared valid and reliable based on the construct validation criteria and Cronbach alpha coefficient analysis. The Cronbach alpha value obtained is 0.893, indicating that the instrument has high internal consistency. Each Factor correlates with each other with a confidence level of 99%.

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