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Designing an Instrument to Measure Digital Literacy Competence Using the 4D Model

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This study aims to develop digital competency measurements, especially in junior high school, using a 4D model consisting of the following stages: definition, design, development, and dissemination. The research data source is the Central Java academic community consisting of 300 students, 5 teachers, and 3 digital literacy experts. The research data was obtained using a questionnaire and expert validation guidelines. The data obtained are qualitative and quantitative. The findings from this needs analysis include: 1) all respondents (100%) know the benefits and are actively using digital products; 2) there are (95%) of respondents know about digital competence but do not know the level of digital competence; 3) all respondents (100%) admit that they have never measured digital competence; 4) all respondents (100%) admitted that so far in measuring digital competence they have not used adequate and tested instrument; and 5) all respondents (100%) admit that information about the level of digital competence is needed as input to improve the quality of students digital competence. Seven instrument indicators test results are 52% for the strongly agreed category and 33% for the agreed category. Thus, this instrument is valid and expected to map the digital competencies of the academic community in junior high school, especially for students.

Keywords: digital literacy, measurement, instrument, 4D model

INTRODUCTION

The change in the learning paradigm from traditional to digital learning models has become one of the markers of the 21st century learning era. Learning characteristics are now open to all fundamental changes (Bagus & Arjaya, 2023; Wijaya et al., 2016). Technology is now overgrowing and is quite influential in various aspects, one of which

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is the world of education. Technology has now become an essential tool in the field of education (Sariyatun et al., 2021), especially in the process of teaching and learning activities (Lukitasari et al., 2022; Martin & Grudziecki, 2006). This condition demands the skills needed in the 21st century, which include learning and innovation skills as well as skills in using technology and information media (Wijaya et al., 2016). These skills are needed to overcome all the problems in the era of ease of information as it is today.

In the age of technology, we can quickly adapt and solve problems. In the field of education, now many educational policies have emphasized using digital technology to answer future needs (Benson & Kolsaker, 2015; Martin, 2006; Purnama et al., 2021; Saripudin et al., 2019; Wannapiroon et al., 2022). Students learning styles are now dominantly influenced by digital skills in learning (Arono et al., 2022; Coccoli et al., 2014; Tejedor et al., 2020). Future leaders, must prepare themselves to adapt to technological advances to support their activities, especially in classroom learning. Students must integrate technology into the school environment so that learning objectives can be achieved adequately. The frequent use of digital technology will improve students digital knowledge (Arono et al., 2022; Yustika & Iswati, 2020). The abilities needed by students in the fields of media, information, and ICT are summarized in a skill called digital literacy (Suryanti & Wijayanti, 2018). Digital literacy is very important for students as a basis for being able to compete in the world of work (Kaeophanuek et al., 2019; Lukitasari et al., 2022; Phuapan et al., 2016; Rini et al., 2022; Tang & Chaw, 2016). Digitally literate students will be able to use digital tools and content when they learn (Brata et al., 2022; Rini et al., 2022).

In Indonesia, various technical issues still haunt the development of digital competency (Smeru Research Institute et al., 2022; Werdiningsih, 2021). Despite the government's efforts to improve internet connectivity, many students need adequate connectivity, making it difficult for students to adjust to digital learning and for parents who cannot support them (UNICEF Indonesia, 2020). This result aligns with cross-country research conducted by Kuntadi et al., with Malaysian students digital skills slightly higher than Indonesian students digital skills (Kuntadi et al., 2022). There have been many measurements of understanding or digital literacy skills in Indonesia. One of the studies on measuring digital literacy was carried out by Rusydiyah, Purwati, and Prabowo. In her research, Rusdiyah et al. constructed digital literacy skills in four indicators, namely: essential ICT competencies, information skills, media awareness, and computational thinking (Fraillon et al., 2013; Siero, 2017). These four indicators have been proven in 22 statements that have been tested for validity and reliability (Rusydiyah et al., 2020). The results of Rusydiyah, Purwati, and Prabowo's research show that students have a good perception of utilizing digital literacy as a learning resource.

Chandra also carried out research related to measuring the level of digital literacy in high school students research subject. The measurement results show that the digital literacy index of Pramita High School students is included in the relatively good and good category. The highest dimension index is the dimension of computer literacy and technological literacy. This result is understandable by looking at their average age of 16.1 years, known as the digital native generation (Chandra, 2021). Furthermore,

Irhandayaningsih also carried out similar measurements on students at Diponegoro University by referencing the Bawden Conception, which consists of four main components: basic digital literacy skills, background knowledge of information, and critical competencies in the ICT field, and attitudes and perspectives of information users. This study shows that respondents have a high level of digital literacy when measured using the Bawden Conception (Irhandayaningsih, 2020).

Tzafilkou, Perifanou, and Economides have also released the results of their development of the digital competency measurement scale in Europe. As a result, 28 items and six components of digital competence were obtained. The components in question are (1) search, find, access (SFA); (2) develop, apply, modify (DAM); (3) communicative, collaborative, share (CCS); (4) save, manage, delete (SMD); (5) evaluate (EV); and (6) protect (PR) (Tzafilkou et al., 2022). All items are measured on a Likert Scale with a range of 5 points with details; 1 which means strongly disagree to 5 which means strongly agree. Related to some of the research findings, the authors feel the need to develop digital competency measurement instrument, especially in junior high school (Divayana et al., 2021), by referring to previous instruments, which were quite complex and varied.

Definitions of literacy have undergone a transformation or expansion along with innovations and research that redefines it (Martin & Grudziecki, 2006). Digital literacy is an umbrella framework for several complex and integrated subdisciplines or "literacy" comprising skills, knowledge, ethics, and creative products in a digitally networked environment (Calvani et al., 2008). Digital literacy means more than just having the technical skills to operate digital devices properly. Digital literacy is the ability of users to operate technological devices and information from digital and communication devices, and think more critically, creatively, and inspiringly to filter content and information received to create innovation through the use of digital tools (Bell, 2021; Khlaisang & Yoshida, 2022; Lukitasari et al., 2022). Digital literacy is not only a person's ability to use technology but also various other thinking skills. Paul Gilster first put forward digital literacy in 1997 (Riel et al., 2012). He stated that the ability to operate digital devices effectively and efficiently for purposes such as career, study/academic, and daily life is called digital literacy (Riel et al., 2012).

Furthermore, the Onderwijs 2032 Platform defines digital literacy as the competence to work on computers to collect, process, and share information in a safe and conscious way (Schnabel et al., 2016). Fraillon et al. define digital literacy more concisely as all digital-based efforts that can be used as learning resources (Fraillon et al., 2013). Gapski describes digital literacy as having subjective interpretations across various global cultural systems, suggesting that values used in assessment should consider a range of socially based strategies for measurement (Gapski, 2007). Aviram and Eshet-Alkalai distinguish digital literacy as the integration of five separate but interrelated literacy skills: (a) photo-visual literacy; (b) reproductive literacy; (c) information literacy; (d) branched literacy; and (e) socio-emotional literacy. These skills are presented as culturally distinct epistemological expressions, with a set of skills shaping different learning styles and personality types (Aviram & Eshet-Alkalai, 2006).

Digital literacy is divided into four competency areas: essential competencies of ICT, information skills, media awareness, and computational thinking (Fraillon et al., 2013; Rusydiyah et al., 2020; Siero, 2017). First, the essential ICT competencies are the knowledge and skills needed to understand the operation of computers and networks. These skills are necessary for mastery of various types of technology and for understanding the limitations of technology. Students are not only required to know the names and functions of computer components but also to master many applications. The term computer refers not only to a desktop or laptop computer but also to smartphones, tablets, and other devices that use a microprocessor. To succeed in modern society, it is essential for students to know the basic concepts of ICT and use technology effectively.

Second, information skills refer to the ability to formulate and analyze information from sources and use a critical and systematic approach to find and use that information. Ability to identify whether the information is relevant and reliable or not. As the internet infrastructure improves rapidly and the amount of information available increases, it becomes more difficult to distinguish between reliable and unreliable information. It is essential to teach students to determine whether the information is accurate. Third, media awareness is the knowledge, skills, and attitudes that people need to behave consciously, critically, and actively. This ability includes skills such as finding a job or connecting with friends using social media, including the ability to understand the impact of media on society. In this way, students can be aware of social media's opportunities and threats.

Fourth, computational thinking is a skill to solve problems that require much information, variables, and computations. Students are expected to be able to think step by step, understand algorithms, and write computer programs. These skills can help students understand the development of information to optimize computer systems. As the student population grows and their respective digital literacy skills – as does the network system in which they operate – it is hoped that digital literacy assessment instruments can continue to develop to measure the competencies needed to achieve success following educational goals (Covello & Lei, 2010). Conducting digital literacy assessments at the school level offers a starting point for classifying learners and establishing practical teaching entry points. In addition, digital literacy assessment can also be used as a longitudinal tracking throughout students academic careers (O'Connor, 2005).

The selection of the best digital literacy assessment instrument involves considering many factors, including approach, feasibility, implementation, scope, reporting structure, and costs, as well as consideration of output needs and social context (Covello & Lei, 2010). Katz explains the urgency of integrating digital literacy assessment into the educational framework, namely to; support institutional ICT literacy initiatives, guide curriculum innovation and evaluate curriculum changes, guide individual learning, and establish clear definitions of skills and knowledge (Katz, 2005).

Lynch and Swing (2006) describe the key features of an ideal digital literacy assessment instrument, including: (1) the validity of the assessment approach; (2) the reliability of the data collected; (3) feasibility of implementation (time and training required for

implementation); (4) conformity to the context of the assessment; (5) the use of information; (6) consistency with curriculum/program objectives; (7) proper representation of key knowledge/skill areas; (8) multiple assessments approaches to measure competence in various dimensions; (9) some observations to improve reliability; (10) multiple observers to increase precision; (11) fairness in the opportunities for participants to perform; (12) assessment according to predetermined standards or criteria (Lynch & Swing, 2006).

In this research, we designed a digital literacy competency measurement instrument by collaborating on the theories proposed by Tzafilkou, Perifanou, Econimides, and Siero (Perifanou & Economides, 2019; Siero, 2017; Tzafilkou et al., 2022) using the 4D development model consisting of (1) define, (2) design, (3) develop and (4) disseminate (Thiagarajan et al., 1974). The 4D development model has been widely used by researchers and is effective in conducting simple development research. This development model does not require a long time because the stages are relatively not too complex. The weakness of the 4D model is that the 4D model only reaches the dissemination stage, and there is no evaluation, where the intended evaluation is to measure the quality of the product that has been tested.

The theoretical framework built on digital literacy competence refers to the definition of digital competence as a person's knowledge, skills, and attitudes to 'efficiently' access, use, create and share digital resources, as well as communicate and collaborate (Perifanou & Economides, 2019). With others using digital technology to achieve specific goals. Some examples of digital competencies, include: (a) the ability to find legally open learning resources, (b) the ability to collaborate creatively with colleagues to solve math problems, (c) the ability to leave a network as a social skill safely so as not to become addicted, (d) the ability to install smartphone applications to manage schedule, and (e) the ability to use and control 3D printers effectively to develop homework artifacts (Perifanou & Economides, 2019). Tzafilkou, Perifanou, and Econimides define six dimensions of measuring digital literacy competence, which include: (a) searching, finding, and accessing; (b) developing, applying, and modifying; (c) communicating, collaborating, and sharing; (d) saving, managing, and deleting; (e) evaluating; and (f) protecting (Perifanou & Economides, 2019; Tzafilkou et al., 2022).

Meanwhile, Manzo sets the assessment standards for digital literacy, including (1) creativity and innovation; (2) communication and collaboration; (3) research and information fluency; (4) critical thinking, problem-solving, and decision making; (5) digital citizenship knowledge; and (6) operation and mastery of technology concepts (Manzo, 2009). These categories are spelled out in detailed descriptions of actions and goals and serve as a starting point for creating items in assessment instruments used in several countries (Manzo, 2009). First is creativity and innovation. Students demonstrate creative thinking, build knowledge, and develop innovative products and processes using technology. Students are expected to be able to; apply existing knowledge to generate new ideas, products, or processes; create original works as a means of personal or group expression; use models and simulations to explore complex systems and problems; identify trends and possible forecasts.

Second is communication and collaboration. Students use digital media and environments to communicate and work collaboratively, including remotely, to support individual learning and contribute to the learning of others. Students are expected to be able to; interact, collaborate and publish with colleagues, experts, or others using various digital environments and media; communicate information and ideas effectively to multiple audiences using a variety of media and formats; develop cultural understanding and global awareness by involving students from other cultures; contribute to the project team to produce original work or solve problems. Third is the fluency in research and information. Students apply digital tools to collect, evaluate, and use information. Students are expected to be able to; plan strategies to guide investigations; find, organize, analyze, evaluate, synthesize, and use information ethically from various sources and media; evaluate and select digital sources of information and tools based on their suitability for specific tasks; processing data and reporting results.

Fourth is critical thinking, problem-solving, and decision making. Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources. Students are expected to be able to identify and define authentic problems and essential questions for investigation, plan and manage activities to develop solutions or complete projects, collect and analyze data to identify solutions and make appropriate decisions, and use multiple processes and diverse perspectives to explore alternative solutions. Fifth is digital citizenship knowledge. Students understand human technology's, cultural, and social issues and practice legal and ethical behavior. Students are expected to be able to; advocate for and practice the safe, legal, and responsible use of information and technology; demonstrate a positive attitude towards the use of technology that supports collaboration, learning, and productivity; demonstrate personal responsibility for lifelong learning; demonstrate leadership for digital citizenship. Sixth is the operation and mastery of technology concepts. Students demonstrate a good understanding of technology, systems, and operations concepts. Students are expected to be able to; understand and use technology systems, select and use applications effectively and productively, solve system and application problems, and transfer current knowledge to learn new technologies. For this research, we identified dimensions that have similarities between the two theories and then designed a modified digital literacy competency measurement instrument with seven dimensions that other researchers have not previously used. The proposed dimensions include: (a) searching, finding, and accessing; (b) developing, applying, and modifying; (c) communicating, collaborating, and sharing; (d) saving, managing, and deleting; (e) evaluating; (f) protecting; and (g) computational thinking.

METHOD

This research is developed by the 4D model (Thiagarajan et al., 1974), consisting of four stages: defining, designing, developing, and disseminating. The definition stage is related to the analysis of product needs, namely the measurement of digital competence. At this stage, an initial analysis of the availability of digital competency measurement

instrument is carried out. The design stage relates to the formulation of digital competency measurement instrument, which includes seven aspects, namely (a) searching, finding, and accessing; (b) developing, applying, and modifying; (c) communicating, collaborating, and sharing; (d) saving, managing, and deleting; (e) evaluating; (f) protecting; and (g) computational thinking. The development phase relates to testing digital competency measurement instrument. The dissemination phase includes the publication of the findings and testing results. The data sources in this study were students and teachers in Central Java and digital literacy experts from Sebelas Maret University. The respondents of this research were 300 students, 5 teachers, and 2 digital literacy experts.

The data in this study were obtained using a questionnaire and expert validation guidelines. The questionnaire was used to test the construct validity of the developed instrument. The targets of this questionnaire are teachers and students. The expert validation guidelines are used to determine the validity of the contents of the instrument and to obtain feedback regarding the digital literacy competency measurement instrument in junior high school. The data obtained are qualitative and quantitative (Creswell & Creswell, 2018). Qualitative data in the form of observations and validity. Quantitative data in the form of digital competency measurement results. The data collected were analyzed and described. The qualitative description is based on the validity score of digital literacy experts in the form of criticism and suggestions for instrument improvement. The results of the analysis are used for product revision of the instrument. Quantitative description is used to process data as a digital competency questionnaire percentage. The formula for the percentage technique used in this study is as follows.

$$P = \frac{\sum p}{n} \; x \; 100$$

Information:
P = percentage size
$\sum p$ = answer frequency
n = total number of respondents (Moleong, 2018)

The results of calculating the overall percentage are adjusted according to the following table.

Table 1
Appropriateness of instrument validity

Achievement	Qualification	Description
80% - 100%	Very good	No revision
60% - 79%	Good	No revision
40% - 59%	Enough	Revision
20% - 39%	Not enough good	Revision
0% - 19%	Not good	Revision

(Moleong, 2018)

FINDINGS

The results of this study will be described based on research procedures that follow the stages of the 4D development model, which include the define, design, develop, and disseminate stages.

Define Stage

The defined stage of this study is focused on analyzing the need for developing digital competency measurement instrument in junior high school. This activity was carried out with a semi-structured interview technique with 5 teachers and 300 students. In the initial analysis, several findings related to the need to develop digital competency measurement instrument in high income. The findings produced in this needs analysis include: 1) all respondents (100%) recognized the benefits and were active in the use of digital products; 2) almost all respondents (95%) know about digital competencies but do not know their digital competency level; 3) all respondents (100%) claimed to have never measured digital competencies; 4) all teachers respondents (100%) admitted that so far in measuring digital competence, they had not used adequate and tested instrument, where assessments are only conducted with limited and less in-depth; and 5) all respondents (100%) admitted that information about digital competency levels is needed as input in order to improve the quality of students digital competencies. Based on the findings at the defined stage, it can be concluded that developing digital competency measurement instrument in junior high school needs to be implemented immediately.

Design Stage

The design stage aims to produce a design of a digital competency measurement instrument in middle education. The findings obtained at the define stage are used as a reference in developing digital competency measuring instrument in junior high school. The second stage, design, is carried out by researchers by compiling assessment instrument in 7 indicators of measuring digital literacy competencies, namely (a) searching, finding, and accessing; (b) developing, applying, and modifying; (c) communicating, collaborating, and sharing; (d) saving, managing, and deleting; (e) evaluating; (f) protecting; and (g) computational thinking (Perifanou & Economides, 2019; Siero, 2017; Tzafilkou et al., 2022).

First indicator is the ability to searching, finding, and accessing. This indicator can assess a person's ability to access, search, and find information using various search engines (google, yahoo, bing, etcetera) by entering the word lock through various intelligent devices; the advanced features it has. This ability can help users in meeting their needs. Second indicator is the ability to developing, applying, and modifying. This aspect can review the extent to which a person can design and develop various digital technological tools to be applied and modified to facilitate his needs. Third indicator is communicating, collaborating, and sharing. This ability is a crucial ability to have at this time. The development of increasingly complex technology and diverse life problems demands mastery of communicating, collaborating, and sharing capabilities. Today's digital world is not a single word but a very complex world. Therefore, a person who

can collaborate and share information with the unlimited outside world through social media, software, or other digital tools will have advantages. Fourth indicator is saving, managing, and deleting. The amount of information around us that continues to grow every day requires a person to have good information management skills. Saving, managing, and deleting skills are a necessity that today's digital generation must have. Fifth indicator is evaluating. The abundance of information from various sources allows the emergence of hoaxes or fake news that can cause losses. Therefore, the ability to evaluate the correctness of the information is necessary. Sixth indicator is protecting, which is the ability to protect privacy so that the data owned can be safe and avoid fraud. The last, seventh indicator is computational thinking, which is the ability to think critically and scientifically using data and information. This ability is necessary so that a person can solve problems in his daily life. The seven indicators are further outlined in the following specification table.

Table 2
Digital competency indicator specification

Indicators	Code	Statement Items	Number of Items
Searching, Finding, and Accessing;	SFA	1,2,3,4,5	5
Developing, Applying, and Modifying	DAM	6,7,8,9,10,11	6
Communicating, Collaborating, and Sharing	CCS	12,13,14	3
Saving, Managing, and Deleting	SMD	15,16,17,18,19	5
Evaluating	Ev	20,21,22,23,24,25	6
Protecting	Pr	26,27,28	3
Computational Thinking	CT	29,30,31,32,33,34	6
Total			34

The data from table 2 is then developed into statement points to measure digital competence in junior high school. The design shows seven essential digital competencies for the academic community to master in junior high school: students and teachers. Mastery of the seven components is expected to increase students digital literacy competencies.

Develop Stage

The third stage is development. At this stage, a digital competency measurement instrument was developed through two steps, namely expert appraisal and development testing. In the expert appraisal step, the instrument is assessed by the expert simultaneously to get suggestions and input on improvements. The experts involved in this assessment are in the field of digital literacy and experts in the field of assessment, each of which comes from Sebelas Maret University. Some inputs from linguists on digital competency measurement instrument include: (1) the use of numbering, please pay attention to it so that it is easier to read; (2) there are still errors in the use of punctuation; (3) language needs to be packaged more effectively; and (3) the diction chosen must be appropriately adjusted to the research target. The input from the evaluation expert includes: (1) the intensity of application of instrument number 3 and number 7 is still not following the title of the study; (2) the use of digital literacy in

learning activities has not been seen explicitly; (3) the amount and variety of reading materials for number 20 to number 22 is less narrowed down to digital literacy; (4) the amount of presentation of information about the use of digital literacy in everyday life has not been mentioned in the statement.

These inputs and suggestions are then used as a reference for improving digital competency measurement instrument. After revising and reassessing, the instrument was retested through the second step, namely development testing. Trials are carried out repeatedly to obtain adequate and consistent learning tools (Thiagarajan et al., 1974). The trial was conducted on respondents, teachers, and students. The trial involved 300 students and 5 teachers from Central Java. This trial is carried out to test the validity of the developed instrument. The trial results of the seven indicators of digital competency measurement instrument can be seen in figure 1 below.

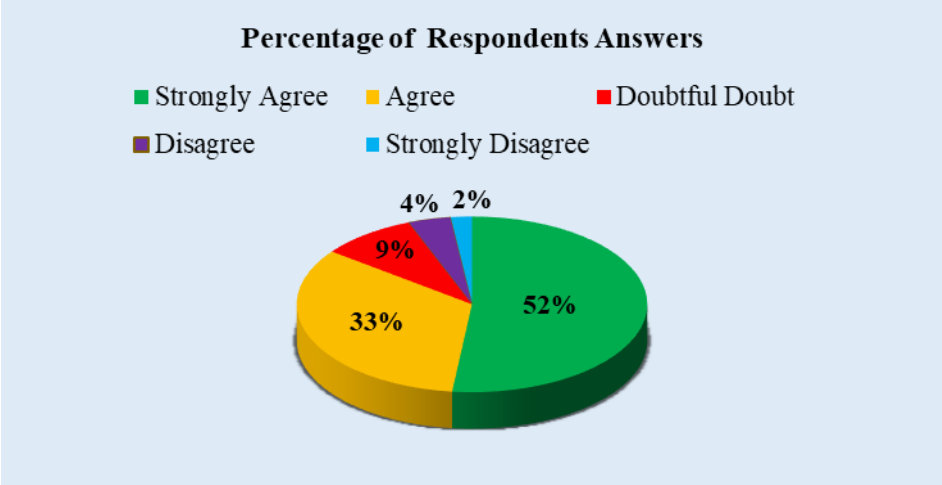

Figure 1
Percentage of respondents answers

Figure 1 shows that respondents who rated agreed by the indicators were 52% for the strongly agreed category and 33% for the agreed category. Thus, the percentage of achievement of the developed instrument is 85%. If referring to the table of the approximate instrument validity level according to Moleong (Moleong, 2018), then the points of statement in this digital competency measurement instrument can be declared excellent or valid. Thus, no longer a revision process is required.

Disseminate Stage

The final stage of this 4D development model is dissemination. Due to the limitations of researchers, this stage is not carried out massively. The dissemination process is limited according to the researcher relations. At this stage, the researcher still opens up opportunities to receive input and suggestions related to the instrument developed as a reference for the subsequent development of the instrument.

DISCUSSION

The digital competency measurement instrument developed in this study has seven indicators with specifications used, including the ability to (1) searching, finding, and accessing; (2) developing, applying, and modifying; (3) communicating, collaborating, and sharing; (4) saving, managing, and deleting; (5) evaluating; (6) protecting; and (7) computational thinking. The trial results showed that the digital competency measurement instrument developed was valid. This instrument is expected to map the digital competencies of the academic community in junior high school, especially for students.

Previous research also emphasized the importance of mastering digital competencies, which stated that several surveys show that critical thinking skills are abilities that need to be developed. Data show that adolescents score low when answering questions involving complex and critical thinking skills, such as comparing information, critically evaluating site reliability, or drawing conclusions from data (Eagleton et al., 2003; Katz & Macklin, 2007). This argument shows that someone using digital technology cannot necessarily think more complexly. It explains why in the instrument developed, the ability to think critically and evaluate is an indicator of determining digital competence.

As we know, lately, the focus of attention on digital competencies has experienced significant growth and achieved high popularity in the education world because today's students are a generation that was born and developed amid the unprecedented rapid development of computer networks and online media. The development of the internet, virtual reality, and artificial intelligence, coupled with the issue of the Covid-19 pandemic, has brought increased social attention to the need for digital skills (Iansiti & Richards, 2020). Many impacts will be felt from the development of the digital world today in various scientific fields, including education. Teachers are currently required to develop related capacities as part of teaching requirements; the use of new technologies is expanded, and they must be able to adapt to the new teaching environment. Teachers in the future are digital natives who use technology daily and will benefit significantly from this issue in teaching and learning (Guillén-Gámez et al., 2020). Thus, digital competence is an absolute must-have capability for the current generation, and its measurement needs to be carried out from the beginning.

CONCLUSION

Digital competence is an ability that needs to be mastered by everyone, especially the academic community in junior high school. This ability can support teachers and students in their work or studies. Therefore, it is essential to know the level of digital competence through measurement activities. Based on this, this study developed a digital competency measurement instrument using seven indicator criteria, including (1) searching, finding, and accessing; (2) developing, applying, and modifying; (3) communicating, collaborating, and sharing; (4) saving, managing, and deleting; (5) evaluating; (6) protecting; and (7) computational thinking. This instrument has passed two testing stages, expert appraisal and development testing. The results of the tests showed that this instrument was rated as excellent and usable. Thus, it is hoped that the

academic community in junior high school can utilize this instrument to measure their digital competence abilities. This research has limitations, namely the non-conduct of testing by utilizing statistics. Therefore, researchers recommend that subsequent studies use and test this instrument using statistical calculations. The test results are expected to add to the scientific characteristics of digital competency measurement theory. In addition, the dissemination process in this research is still limited to the researcher relations. Therefore, the researcher suggests that similar studies can conduct more massive and comprehensive dissemination.

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