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SMART for the Improvement of Primary School Teachers' Digital Competence in the 21st Century: An Action Research Study

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Abstract. Digital competency for teachers is required for learning implementation to address the challenges of teaching and learning in the 21st century. Therefore, this research was aimed at developing formulations to improve primary school teachers' digital competence in responding to today's learning demands. Specifically, it focused on developing stages through which to enhance primary school teachers' digital competence, expected to be re-implemented broadly and professionally in many cities in Indonesia. In attempting to achieve this goal, action research was employed by involving 30 primary school teachers from three regions in Sumedang Regency, West Java, Indonesia, consisting of 11 teachers from urban areas, 11 teachers from suburban areas, and eight teachers from rural areas. The data were obtained through instruments used, namely a survey and a semi-structured interview. The research results suggested five steps for improving school teachers' digital competence, namely Selection of subject matter, Management and implementation of training, Actualization, Reflection, and Training Assessment. These steps were organized under the acronym SMART. This research concluded that these steps could improve teachers' digital competence effectively. It is recommended that the findings of this research to be disseminated to the Board of Education, for it to recommend these steps to be implemented by many schools in different regions.

Keywords: action research; digital competence; primary school; teacher competence

1. Introduction

In the twenty-first century, it is essential to integrate technology into everyday life, especially for teachers who are responsible for carrying out learning practices (Maderick et al., 2016; Martzoukou et al., 2021). Nowadays, schools in various

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countries are actively participating in digital transformation (Håkansson Lindqvist & Pettersson, 2019). This fact necessitates that teachers continue to develop their competence in mastering information and communication technology (ICT) as an actual effort to respond to demands and challenges in the learning process in the twenty-first century. Since digital competence is one of the requirements for highly qualified teachers in the twenty-first century, it is necessary to make actual efforts to determine practical steps to improve teachers' skills to integrate technology in the learning process (Krumsvik, 2014; Maderick et al., 2016).

Several studies related to teachers' digital competency have been conducted. Yoon (2022) examined the pre-service teachers' digital competencies based on gender by involving 157 teachers at South Korean universities. The findings showed that male and female pre-service teachers scored differently on the sub-competences. Reflective practice, guidance, and assessment strategies are required of teachers of both genders. Galindo-Domínguez and Bezanilla (2021) mapped the digital competency profiles of 200 prospective early childhood and primary school teachers in Spain. The findings revealed that prospective teachers had mid-level digital competence, and they encountered difficulties in creating content. Calderón-Garrido et al. (2020) examined the digital competence of 93 music teachers from 45 different universities in Spain. The analysis focused on knowledge of digital resources, their use to prepare for and practise teaching, and how they learnt by utilizing these technologies. The findings showed that their technological knowledge was limited, which was indicated by lack of use of technology in preparing and teaching the class and almost non-existent teaching. As a comparison, similar research was conducted in Indonesia by Suherman et al. (2020). Their research aimed at enhancing the digital literacy skills of people at *Kampung Literasi* by emphasizing the implementation and media targeting digital literacy skills improvement.

The results of the research were intended to examine and map the profile of teachers' digital competency levels. There has been no research exploring practical steps in attempting to improve teachers' digital competence. Therefore, in contrast to existing research, the research sought to find practical steps in increasing primary school teachers' digital competence. The findings are expected to contribute to addressing gaps in existing research and to provide a basis for determining teacher education curriculum policies in an attempt to create professional teachers for the twenty-first century (Fernández-Batanero et al., 2020; Leach et al., 2004; Spiteri & Chang Rundgren, 2017).

2. Theoretical Framework

2.1. Digital Competence

At the conceptual level, digital competence (DC) is an individual's ability to utilize technology for development in all fields in effective ways (López-Meneses et al., 2020). In addition to being related to the use of digital technology (Farjon et al., 2019), DC is related to ethical knowledge and skills awareness (McGarr & McDonagh, 2021). Thus, in the context of the teacher, DC can be defined as skills, knowledge, and attitudes that are essential in the integration of technology (Casillas Martín et al., 2020) for the development of teaching and learning.

2.2. Digital Competence Urgency

DC is critical for exploring the digital technologies' potentials and overcoming the difficulties that these technologies can cause in modern society (Fraile et al., 2018). DC is also considered a prerequisite for a quality educational environment (Spiteri & Chang Rundgren, 2020; Voithofer et al., 2019). This logical consequence specifies that teacher education must reflect the demands of twenty-first century education, which integrates technology into learning practices (Suherman et al., 2020; Supriyadi, Julia et al., 2020). Furthermore, this emphasizes the significance of technology in teaching and education for teachers (Håkansson Lindqvist & Pettersson, 2019; Maderick et al., 2016). Moreover, it necessitates the teacher education curriculum to have a strong emphasis on the use of information and communication technologies (R. J. Krumsvik, 2014).

2.3. Digital Competence Standards and Indicators

Several standards and models exist for formulating teacher digital competence (DCs) in several countries and educational organizations, for example in Canada (Quebec, 2001), Australia (Department of Education, 2002), the United Nations' Educational, Scientific and Cultural Organization (Hooker et al., 2011; UNESCO, 2011), and those based on research conducted by J. Krumsvik, (2011; 2014). Since there are many standards and models in formulating teachers' digital competence, Casillas Martín et al. (2020) mentioned three elements related to teachers' digital competence, namely (i) basic digital competencies, such as utilizing ICT tools, gaining access to information, and communicating with others; (ii) teaching approach competence in the use of ICT; and (iii) learning strategies using ICT competencies.

2.4. Research Objective

Based on evaluations of literature reviews on teachers' digital competence and recommendations from the latest research, it was determined that studies that explore practical steps in improving digital competence for teachers, particularly primary school teachers, are urgently needed. This topic has not received special attention from academics. Therefore, this research was aimed at finding a formulation that can improve the digital competence of primary school teachers by formulating these research questions: 1) What is the digital competency profile of primary school teachers? 2) Based on the current digital competency profile, what steps are required to enhance primary school teachers' digital competence? and 3) How significant is the influence of the initiatives taken on developing primary school teachers' digital competence?

3. Method

3.1. Design

Action research was the most appropriate method to utilize in this case to support the main purpose of this research (Supriyadi et al., 2022; Supriyadi, Saptani et al., 2020; Supriyadi & Julia, 2019). The rationale behind studying the problem was to find a solution that would enhance primary school teachers' digital competence. This effort is in line with Creswell's (2012) action research aims, namely to create designs that explore practical problems to develop solutions. In addition, it is believed that the action research design can increase the enthusiasm and self-confidence of teachers (Cohen et al., 2017; Monem & Cramer, 2022; Pelton, 2010).

Procedurally, the design of action research demanded this study to be carried out in three stages, namely pre-action analysis, implementation of actions, and post-action analysis (Julia & Isrokatun, 2019; Supriyadi et al., 2019). The researchers identified and mapped the teachers' digital competencies during the pre-action analysis stage by asking the teachers several reflective questions. Furthermore, at the action research implementation stage, the researchers conducted follow-up actions based on the findings of the first stage to further implement numerous action steps that were considered having the ability to improve teachers' digital competence. Afterwards, in the post-action analysis stage, the researchers analysed the significance of the impact caused by the actions taken.

Collaboration is a key element in designing action research (Creswell, 2012; Jaipal & Figg, 2011). The method proposed by Heil (2005) was applied to establish collaboration by stating what was needed and who wanted to be involved. This method ensued in finding three individuals willing to participate in the research, namely a professor with expertise in educational technology, a lecturer in the field of curriculum development, and a school supervisor. The professor and lecturer participated in a series of actions and assessment processes in this research to improve teachers' digital competence. Meanwhile, the school supervisor was involved in developing teacher communication and consolidation.

Based on the results of team collaboration through FGD (Focus Group Discussion) in accordance with guidelines on competency levels according to the UNESCO ICT Competency Framework for Teacher and INTEF Common Digital Competence Framework for Teacher, digital competency indicators used in this research were the following:

Table 1. Teacher's Digital Competence Instrument

Level	Competency Indicator	Category
Level 1	<ol style="list-style-type: none"> 1. Being able to search data, information, and digital content for learning 2. Being able to evaluate data, information, and digital content for learning 3. Being able to manage data, information, and digital content for learning 	Digital competence is severely lacking
Level 2	<ol style="list-style-type: none"> 1. Having full ability at Level 1 Competency 2. Being able to interact through digital technology for learning 3. Being able to share information and digital content for learning 4. Being able to connect with students and other teacher communities through digital communication tools for learning 5. Being able to collaborate through digital tools for learning 6. Having ethics in communication and learning collaboration through digital tools 7. Having awareness in managing digital identity well 	Digital competence is lacking

Level	Competency Indicator	Category
Level 3	1. Having full ability at Level 2 Competency	Digital competence is substandard
	2. Being able to develop digital content for learning	
	3. Being able to integrate and re-elaborate digital content for learning	
	4. Understanding copyright and license of digital content development for learning	
Level 4	1. Having full ability at Level 3 Competence	Digital competence is good
	2. Having an awareness of protecting digital devices	
	3. Having an awareness of protecting personal information and data	
	4. Having an awareness of health protection for the use of digital devices	
	5. Having an awareness of protecting the environment through the use of digital tools	
Level 5	1. Having full ability at Level 4 Competency	Digital competence is very good
	2. Being able to solve technical issues in the usage of digital learning tools	
	3. Being able to identify learning needs and responses through technology	
	4. Being able to make innovations in creative digital content development	
	5. Being able to identify gaps in digital competency for learning	

3.2. Participants and Research Sites

This research involved 30 teachers from three areas in Sumedang Regency, West Java, which included 11 teachers (36.66%) in urban areas, 11 teachers (36.66%) in rural areas, and eight teachers (26.66%) in suburban areas. They had attained various educational levels and had considerable experience as a teacher. In addition, based on their age, they are categorized in the digital native group. According to M. Prensky (2001), digital natives are the generation born in the 1980s and after, namely the generation born in a digital technology environment. The demographic profile of the participants in this study is presented in Table 2:

Table 2. Participant Demographics

Aspect	Frequency	%
Gender		
Male	15	50.00%
Female	15	50.00%
Teaching Experience		
1-5 Years	9	30.00%
6-10 Years	6	20.00%
11-15 Years	6	20.00%
16-20 Years	5	16.66%
Over 20 Years	4	13.33%
Level of Education		

Bachelor's degree	24	80.00%
Master's degree	6	20.00%

3.3. Data Collection

Surveys and semi-structured interviews were the techniques used in collecting data. The researchers used Google Forms to conduct surveys because it is known for being a useful and user-friendly survey tool (Brigham, 2014; Chiu et al., 2016; Lin et al., 2016). The survey was conducted by sending a link to colleagues granting access to teachers. The links were distributed using the WhatsApp messaging feature. After collecting the survey results, interviews were conducted to collect data in the second stage. For conducting the interviews, the researchers compiled a list of questions based on three main categories, namely the teacher's insights, attitudes, and skills related to the five aspects of digital competence. In addition, interviews were conducted to obtain additional information about the problems that the survey did not cover. To uphold ethical norms in the field of research, all participants were informed of the objectives, procedures, and potential benefits and risks. Then, they were given some time to consider if they would be willing to participate in this research voluntarily.

3.4. Data Analysis

Quantitative techniques were used to collect data in the form of numbers. Meanwhile, qualitative techniques with thematic inductive methods were used to examine the data from the interviews. The researchers used the NVivo 12 Plus software to code the qualitative data when analysing it. Triangulation between researchers was used by asking three researchers to get involved at all research stages through regular conferences or focus group discussions to enhance research dependencies (Patton, 2014). Triangulation among researchers also helped in the reduction of bias, since it allowed for the cross-checking of the integrity of participants' responses (Anney, 2014).

4. Result

4.1. Pre-Action Analysis

The researcher sought to identify the digital competence of the subjects in three stages. The first stage involved an exploration of information regarding their insights, experiences and perceptions of digital competence from a self-perspective view - this stage involved 30 teachers who participated in surveys and semi-structured interviews. The second stage was to prove findings of the first stage by carrying out a number of tests in order to map the teachers' digital competence based on the indicators listed in Table 1. This identification step was crucial to carry out so that the competency improvement programme given to teachers could be based on identified needs (Casillas Martín et al., 2020).

The subject experiences were analysed based on two questions: (1) Have you got training in the use of computer information technology (ICT) for learning? (2) Are you used to using the internet to create instructional materials and learning media, as well as to facilitate the learning process? Twenty-seven teachers (90%) stated that they had attended training regarding the use of ICT for learning. Their participation in the training was supported and facilitated by the schools where they worked. This was stated by several teachers during interviews with them.

Our school, especially the principal, strongly supports teachers to master and apply ICT in the learning process. Therefore, whenever a training is held, I am always assigned to participate in the training. (Teacher 3)

The school where I work constantly provides ICT training so that, in the occurrence of a pandemic, our teachers are not technology stutterers. (Teacher 7)

As a teacher, I always have the opportunity to participate in training related to the use of ICT in the learning process, because the school where I work really supports the improvement of teacher competence. (Teacher 18)

However, the results of the training in which the teachers participated showed there were still a number of teachers who had not implemented the programme's outcomes. Only 16 teachers (53.33%) stated that they were used to using the internet in creating teaching materials and learning media, as well as in the learning process, while 14 teachers (56.67%) stated that they were not used to it. This result indicates that there were 56.67% of teachers who did not use ICT in learning because they were not used to it.

The subjects' insights regarding their understanding of ICT learning were analysed based on the following question: Is your current understanding of ICT adequate to support your professional responsibilities as a teacher? A total of 24 teachers (80%) maintained that their understanding of ICT during the survey was sufficient to support their opinion as a teacher. On the other hand, six teachers (20%) stated that it was insufficiently supported. The researchers sought to explore deeper by asking participants in semi-structured interviews what they already knew about ICT use in learning. The interview results are described in the concept map shown in Figure 1.

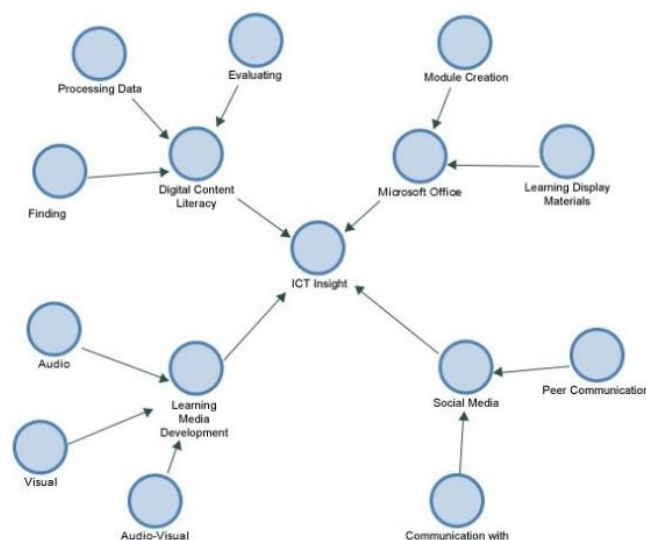


Figure 1. Teachers' ICT Insights

Figure 1 shows that four major factors were related to insights that teachers considered to have supported their professional work as a teacher. The first factor was digital content literacy. In this case, they stated that they knew and

understood how to search, manage data and evaluate digital learning content. This is in accordance with the statements of several teachers.

I know how to explore digital content that can be used to support the learning process for students. (Teacher 5)

I am highly familiar with the process of finding information that can be used as teaching materials for students, and I have re-evaluated the content in terms of its feasibility for learning. (Teacher 17)

I understand how to manage digital information that can be utilized for the learning process. (Teacher 19)

The second factor was Microsoft Office. The teachers knew how to utilize this widely used application. At the very least, they perceived two advantages: creating teaching materials in the form of books or modules, and presenting teaching materials, according to the statements of these teachers.

As a teacher, I am fairly familiar with Microsoft Office applications, which, in addition to being closely related to my primary work as a teacher, also help personnel administration (Teacher 9)

The teacher's work cannot be separated from Microsoft Office applications since they allow the creation of teaching materials, such as modules or display learning materials (Teacher 12)

The third factor was social media: Teachers stated that, in addition to expanding and developing networks with colleagues, they had become increasingly familiar with social media in their lives and social media facilitated communication with students during the learning process. Several teachers agreed.

Social media support teachers' works in facilitating communication with students and colleagues (Teacher 21)

Teachers can develop networks and exchange information in support of their teaching work by using social media platforms, such as WhatsApp, Facebook and Instagram (Teacher 27)

The fourth factor was the development of learning media. The teachers were aware of the use of ICT in creating visual, audio, and audio-visual learning materials. This finding is in accordance with the statements of several teachers.

Teachers need to understand the applications used to create today's learning media (Teacher 24)

In the current digital era, it is important for teachers to understand and master the development of ICT-based learning media so that learning will be interesting because the media used is auditory or visual. (Teacher 30)

The interview results showed that the teachers' insights into the use of ICT in learning were relatively adequate, but their statements still were based solely on the teacher's perspective. Their experience and insights still needed to be objectively proven. Therefore, a number of tests were carried out to measure and map the teacher's digital competence. The test was conducted practically in the ICT laboratory, located in one of the universities in Sumedang Regency. The questions on the test referred to the instrument (see Table 1).

The test results revealed that of a total of 20 teachers, two teachers (6.67%) were at Level 1, six teachers (20%) at Level 2, and 12 teachers (40%) at Level 3. These teachers were categorized as teachers who did not fulfil the minimum standards for digital competence. However, 10 teachers, namely eight teachers (26.67%) at Level 4 and two teachers (6.67%) at Level 5, were included in the category of teachers who fulfilled the standards.

4.2. Pre-Action Evaluation

The evaluation showed the need to increase teacher digital competence to Levels 4-5, in which teachers were focused on designing an ICT-based learning media product, given that only 10 teachers (33.33%) met the minimum standards, namely eight teachers (26.67%) at Level 4 and two teachers (6.67%) at Level 5. Based on the demands of learning in determining targets, in addition to having the ability to collect facts and data to carry out learning, a teacher must be able to have the ability to produce solutions for and be innovative in overcoming learning problems as well as answering the challenges and demands of learning in the current digitalization era (Buchory et al., 2017; Budimansyah et al., 2019; Supriyadi, Saptani, et al., 2020).

4.3. Action Implementation

Based on the results of the pre-action evaluation, an action formulation design was developed to improve teacher competence to the highest level of competence, namely Level 5, or minimal competence, namely Level 4. Through FGD, five action steps were obtained that needed to be implemented to improve the teachers' competency, which are elucidated below:

4.3.1. Step 1: Selection of Subject Matter for Training

In this step, the selection and preparation of training materials were considered significant to improve the teacher's digital competence. In general, the training materials were divided into three groups, namely basic materials, core materials and supporting materials. Furthermore, the materials were divided into two classifications, namely theoretical and practical classification. In detail, materials within the theoretical classification focuses on providing the participants with sufficient understanding of the topics being studied. Meanwhile, the materials within the practical classifications provide the participants with sets of skills to be mastered. These material substances are summarised in Table 3.

Table 3. Mapping of Training Materials Based on Material Groups and Categories

	Material	Material Category
Basic Material Group		
a.	ICT utilization for education and learning	Theory
Core Material Group		
a.	Information literacy in primary schools	Theory
b.	Media literacy in primary schools	Theory
c.	Digital literacy in primary schools	Theory
d.	ICT for preparing Learning Implementation Plans (RPP – <i>Rencana Pelaksanaan Pembelajaran</i>)	Laboratory Practice
e.	ICT for developing learning materials	Laboratory Practice
f.	ICT for creating learning media	Laboratory Practice
g.	Use of ICT for implementing learning in primary schools	Laboratory Practice

h.	Learning using audio-visual media	Laboratory Practice
i.	Learning using multimedia	Laboratory Practice
Supporting Material Group		
a.	Internet as a learning resource	Theory
b.	Social media for educational communication	Laboratory Practice

Each material provided was intended to assist teachers with insight and skills related to increasing their digital competence. The objectives of each training material are presented in Table 4.

Table 4. Substance of Training Materials

Classification	Material	Material Purpose
Theoretical	1. ICT utilization for education and learning	Providing understanding and mastery of the concepts, roles, benefits, and policies in Indonesia regarding ICT in education and learning in general
	2. Information literacy in primary schools	Providing understanding and mastery of the urgency of teachers having skills in acquiring, filtering, and sharing information obtained from the internet
	3. Media literacy in primary school	Providing understanding and mastery of concepts of urgency for teachers and students to be able to access, identify, evaluate and create digital media for learning
	4. Digital literacy in primary school	Providing understanding and mastery of concepts regarding the use of digital technology and digital communication tools and methods of accessing and managing information for learning
	5. Internet as a learning resource	Providing understanding and mastery of the concept of a variety of internet facility support in order to create fun learning
Practical	1. ICT for preparing Learning Implementation Plans (RPP - <i>Rencana Pelaksanaan Pembelajaran</i>)	Providing teachers with the skills and understanding to use word processing software (Microsoft Word) in In order to practise making attractive and effective lesson plans
	2. ICT for developing learning materials	Providing teachers with the ability to search for information on the internet in order to make teaching materials in accordance with learning objectives
	3. ICT for making learning media	Providing teachers with the skills to use digital-based learning media available on the internet or to create learning media with training assistance
	4. ICT for implementing learning in primary schools	Providing teachers with one of the learning media that can be used to facilitate the implementation of classroom learning
	5. Learning using audio-visual media	Providing teachers with the resources they need to develop audio-visual

Classification	Material	Material Purpose
		learning media that can be distributed to their students
	6. Learning using multimedia	Providing teachers with the ability to develop a variety of more complex and varied media for many types of learning strategies used in classroom
	7. Social media for educational communication	Providing teachers with the ability to manage social media in order to share learning materials with students and the general public

In this first step, a product in the form of a training module comprising a theoretical module and a practicum module was obtained. The product was then validated by a team of experts through a focus group discussion to obtain an assessment and input for improvement. Three people were involved in product evaluation, namely a professor in the field of educational technology, a lecturer in curriculum and a head of officials, and the assessment included seven aspects. The results of the assessment are presented in Table 5.

Table 5. Table of Module Assessment

No	Assessment Aspects	Expert 1	Expert 2	Expert 3
1	Relevance of Title and Content	3.73	3.82	3.85
2	Having a Clear Purpose	3.82	3.74	3.71
3	Didactic Principles Used in Writing	3.65	3.67	3.81
4	Use of Easy-to-Understand Language	3.74	3.82	3.75
5	Material Adequacy	3.75	3.73	3.76
6	Novelty of the Method	3.7	3.65	3.8
7	Literature Review	3.55	3.65	3.77
	Score	25.94	26.08	26.45
	Average	3.71	3.73	3.78

The results of the expert team's assessment had an overall average of 3.7, which indicated that the training material gained a good criteria assessment. In other words, the training material in this module was feasible to be implemented in the form of training. In addition, this module's presentation received feedback, allowing the theoretical module to be presented in the form of a web-based electronic module. The results of these inputs have been followed up and presented in the form of an electronic module. It can be accessed at the following link <https://sites.google.com/upi.edu/modulpelatihan/halaman-muka>. The design of the website pages is presented in Figure 2.

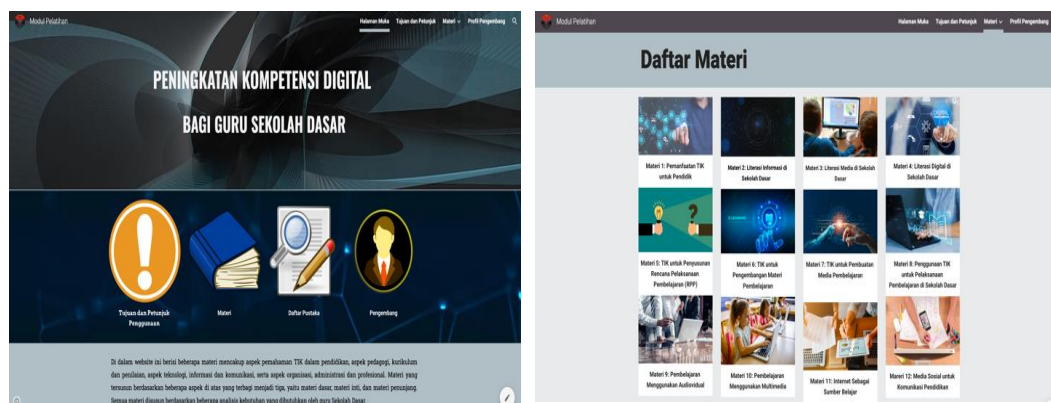


Figure 2. Training Module

4.3.2. Step 2: Management and Implementation of Training

In this step, the team created a training management plan for teachers. The training was designed using two forms of activities, including online course activities and practicum activities. The first form was aimed at teachers who were at Levels 1 to 3 on the pre-test. Meanwhile, those at Levels 4 to 5 were allowed to participate in the first form of training as reinforcement. However, all teachers had to participate in the second form of training conducted in the ICT laboratory.

Furthermore, the teachers were introduced to the design of this training implementation via the Zoom platform. In this introduction the implementation time, the material being trained, the source of the material, and the technical implementation were discussed. Based on this design, the duration of the training time was 12 weeks, with a meeting of eight hours each week. The teachers were informed about related resources and material sources based on what was provided on the website, especially for teachers at Levels 1 to 3 who needed to participate in online conceptual training courses. However, other suggestions were made during the introduction, particularly for the teachers at Levels 4 and 5 who were willing to participate in the online training course as an insight strengthening. Thus, all stages of the activity involved all participants, namely 30 teachers, in this research.

In the implementation of the first stage of training activities, the teachers were instructed to access the material page. The main material was explained and presented via the Zoom platform for 40 minutes for each material. The participants were then involved in discussions and questions and answers. A number of tests and quizzes were provided to evaluate the mastery of the theoretical concepts presented in each material. The results of theoretical concepts mastery are presented in Table 6.

Table 6. Theoretical Conceptual Assessment of ICT Materials

No	Assessment Aspects	Assessment Criteria				
		Very Poor	Poor	Fairly Good	Good	Very Good
1	Mastery of Theoretical Material				23	7

No	Assessment Aspects	Assessment Criteria				
		Very Poor	Poor	Fairly Good	Good	Very Good
2	Ability to Answer Practice Questions			5	21	4
3	Ability to Re-Explain Each Material				28	2

Table 6 shows that the average teacher's mastery of theoretical conceptual training material was in a good category. In other words, the training could be continued in the second stage, namely practicum in the ICT laboratory.

Practicum activities refer to the application used in training. Each material was presented by taking into account the learning objectives summarised in Table 4, so that the main topics and applications used can be provided in a matrix, as presented in Table 7.

Table 7. Trained Subjects, Materials and Applications

Category	Material	Subject	Materials and Applications
Practical	1. ICT for preparing Learning Implementation Plans (RPP - <i>Rencana Pelaksanaan Pembelajaran</i>)	<ul style="list-style-type: none"> • Features in MS Word 2019 • Procedures for saving work in various formats • Presentable layout for RPP in the format used • Maximizing the function and workings of the References feature for RPP 	<ul style="list-style-type: none"> • Microsoft Word
	2. ICT for developing learning materials	<ul style="list-style-type: none"> • Procedures for finding learning materials on the Internet • Procedures for copying material to Microsoft Office (Word and PowerPoint) • Procedures for saving material in various formats • Procedures for presenting and publishing material through various learning media 	<ul style="list-style-type: none"> • Internet (search engines; Google, Google Scholar) • Microsoft PowerPoint

Category	Material	Subject	Materials and Applications
3.	ICT for making learning media	<ul style="list-style-type: none"> • Creating internet-based learning media; infographics, podcasts, online quizzes, and the Google Site website 	<ul style="list-style-type: none"> • Canva, Anchor, Quizizz, and Google Sites
4.	ICT for implementing learning in primary schools	<ul style="list-style-type: none"> • Introducing the optimization of ICT devices/hardware for the management of learning in the classroom 	<ul style="list-style-type: none"> • InFocus/projector • Speaker • PC/Computer/Laptop • Interactive online boards
5.	Learning using audio-visual media	<ul style="list-style-type: none"> • Motionless audio-visual media (sound elements and silent image elements), for example, PowerPoint with sound slides • Motion audio-visual media (sound elements and motion picture elements), for example, learning films, learning videos, and animations 	<ul style="list-style-type: none"> • Canva (an application for creating animated videos)
6.	Learning using multimedia	<ul style="list-style-type: none"> • Developing multimedia-based learning media (media with image, sound, and interactive elements) 	<ul style="list-style-type: none"> • Canva and Microsoft PowerPoint (applications for creating interactive presentations)
7.	Social media for educational communication	<ul style="list-style-type: none"> • Creating media player content; videos and photos • Sharing media player content via WhatsApp group, Facebook Messenger, Instagram Stories and Feed 	<ul style="list-style-type: none"> • WhatsApp, Facebook, Instagram, and TikTok

In this practicum process, all participants were categorized into three groups. Each group had a companion from the collaboration team, resulting in the ratio between participants and assistants being 1:10. This was done to reduce the technical constraints that participants experienced during the training. An evaluation was carried out each time the material was presented. The evaluation results are presented in Table 8.

Table 8. Results of Practicum Evaluation

Material	Very Poor	Poor	Fairly Good	Good	Very Good
1				4	26
2				21	9
3				13	17
4				2	28
5				12	18
6				11	19
7				2	28
Total				65	145
Average				9.29	20.71

Table 8 shows the results of the assessment on practicum activities, with an average of 21 teachers in the *very good* category, and nine teachers in the *good* category. These results indicated that teachers' skills in ICT had shown improvement. However, to evaluate the consistency of their skills, the next step was to actualize the results of their training by creating a learning media project.

4.3.3. Step 3: Actualization

This step was the actualization stage of the teacher in applying the results of the training. In this step, the teachers who participated in this research were tasked with a project to develop learning media based on the objective needs of each teacher. The four projects they were working on sequentially included: creating a one-meeting lesson plan in one field of study, compiling material infographics, compiling interactive learning media, and evaluating media.

Table 9. Score of Teacher's Project

Aspects of Multimedia Learning	Indicator	Sub-Indicator	Score				
			1	2	3	4	5
1. Subject Matters	1.1 Content material	1.1.1 Material Depth				22	8
		1.1.2 Content Truth				3	27
		1.1.3 Material Actualization (up-to-date)				12	18
		1.1.4 Material Sequence				16	14
	1.2 Material accuracy with learning objectives	1.2.1 Conformity of learning objectives and materials				9	21
1.3 Language use		1.3.1 Clarity of layers used				2	28
		1.3.2 Clarity on the use of layers for primary school students				6	24
2. Affective Considerations	2.1 Learning motivation	2.1.1 Attractiveness of the media in terms of				24	6

		motivating people to learn			
3. Learning Suitability	3.1 Compatibility of material media selection	3.1.1 Accuracy in media element selection	17	13	
	3.2 Media display	3.1.2 Compatibility with colour theme	16	14	
		3.1.3 Compatibility with image	15	15	
		3.1.4 Compatibility with animation	17	13	
		3.1.5 Compatibility with video	13	17	
4. Auxiliary Information	4.1 Initial display	4.1.1 Clarity of media titles	16	14	
		4.1.2 Attractiveness of the initial/opening layer	17	13	
	4.2 Instructions for using media	4.2.1 Availability of media navigation/user guide	11	19	
		4.2.2 Ease of understanding icons/images/navigation buttons	7	23	
	4.3 Menu display	4.3.1 Consistency of the menu display	21	9	
	4.4 Media elements layout	4.4.1 Accuracy (proportion) of the placement of text, images, animation and video elements	22	8	
		4.5 Music/sound	4.5.1 Music/sound quality	14	16
Total			280	320	
Average			14	16	

Table 9 shows the project results for teachers, with an average of 14 participants. The average of the results fell in the *good* category, while the *very good* category was represented by 16 participants on average.

4.3.4. Step 4: Reflection

At this stage, the teachers reflected on the training in which they had participated. This was important to assess the meaningfulness of the training in which they participated, and provided feedback on the training process. The results of the survey of 30 teachers revealed the teachers' reactions to the training. After participating in this training, 22 teachers stated that their knowledge of ICT learning had increased (73.33%), and eight teachers (26.67%) strongly agreed. Furthermore, 12 teachers (40%) agreed, and 18 teachers (60%) stated that they strongly agreed that their skills had improved after participating in the training. As for the growth of motivation to innovate in carrying out learning in the classroom by making ICT-based interactive learning media, a total of 11 teachers (36.67%) agreed, and 19 teachers strongly agreed about increasing their motivation. Based on this reflection, a positive response can be reported to the training programme in which they had participated.

4.3.5. Step 5: Training Assessment

In this step, the team conducted an assessment of the competence of the teachers after they had participated in all the training activities. Similar test questions were provided to a total of 30 teachers during the pre-test by referring to the indicators in Table 1 about mapping of competence level. The results of the assessment revealed that all teachers had a minimum digital competence, which was indicated by a total of 12 teachers (40%) at Level 4 and 18 teachers (60%) at Level 5. This also shows that there were no more teachers at Levels 1 to 3, indicating that teachers who participated in this training programme were able to improve their digital competence.

4.4. Post-Action Analysis

The results of the action implementations showed a number of competency level increases. This could be compared to the results of the pre-test and post-test. A comparison that shows an improvement in teachers' competence is presented in Figure 3.

Figure 3. Improvement of Teachers' Digital Competence

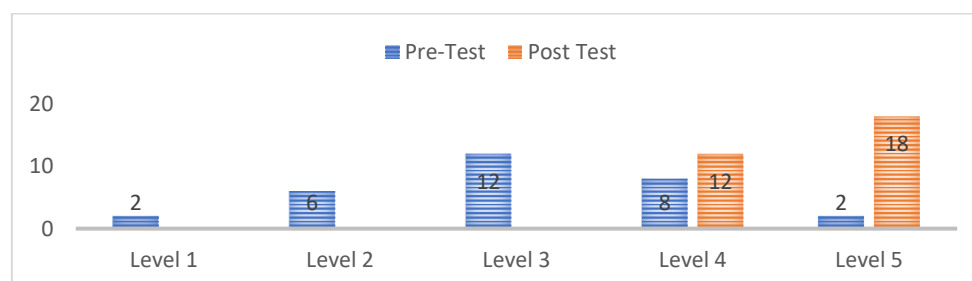


Figure 3 shows a number of increases in the teacher's digital competence level. After conducting the training, it can be seen that 12 teachers (40%) were at Level 4. When compared to the level before the pre-test, the number at Level 4 had increased. The details of the increase are as follows: two teachers experienced an increase of three levels, namely from Level 1 to 4; six teachers experienced an increase of two levels, namely from Level 2 to 4; six teachers experienced an increase of one level, namely from Level 3 to 4. In addition, 18 teachers promoted to Level 5 came from Levels 3 and 4. The details of the increase are as follows: six teachers experienced an increase of two levels, namely from Level 3 to 5, while eight teachers experienced an increase of one level, namely from Level 4 to 5. Meanwhile, those who were at Level 5 remained at Level 5. Thus, the training programme had an impact on increasing teachers' digital competence.

5. Discussion

This research was applied to exploring and mapping the digital competence of primary school teachers in the Sumedang Regency, and focused on the knowledge, use, and utilization of ICT in carrying out their work as teachers. Referring to other studies, in fact, the digital competence possessed by the teachers was not in line with the concept that the teacher was included in the digital native group (Casillas Martín et al., 2020; Elstad & Christophersen, 2017; Ottestad et al., 2014). Although, in the concept of M. Prensky (2001), these teachers belong to a generation that grew up during the digital age and thus are characterized by strong ICT integration in daily activities, as well as a positive

review of technology due to their effective use thereof; however, a large amount of data contradicts the concept of "digital natives" (Akçayır et al., 2016; Bennett et al., 2008; Brown & Czerniewicz, 2010; Casillas Martín et al., 2020). This concept is typically limited to activities in the home environment or recreational activities (Casillas Martín et al., 2020; Supriyadi, Saptani, et al., 2020). In fact, preliminary research results indicate that they lack the digital skills required to use ICT in schools and in the workplace.

This requires of schools, in particular the principal, to encourage teachers to improve their abilities in the field of digitised learning. According to Gill et al. (2014), every teacher must be given the opportunity to observe, reflect on, and experience how to utilize digital technology in the learning and teaching process. Experience and habits in applying digital technology in the teaching and learning process encourage teacher awareness to develop and seek solutions by designing innovations to respond to challenges and solve problems in the learning process (Çebi et al., 2022). This is significant because the teacher's ability to bring ICT into the learning process helps teachers and students in critically analysing material available on the internet (Hamzah et al., 2021; Saykili et al., 2020; Suherman et al., 2020). In the context of this research, teachers' digital competence shows an increase. In other words, the series of actions provided in this training programme are seen as effective in increasing their digital competence. The different test results and assessments of the projects they produce indicate this improvement.

This phenomenon implies that in order to solve educational problems, particularly in the context of improving the quality of human resources, action research must be conducted to find solutions to educational problems (Suherman et al., 2020; Supriyadi et al., 2022; Supriyadi, J. Julia, et al., 2020). The researchers believe that this programme for the development of teachers' digital competencies must be highly promoted in the curriculum on campuses that produce educational candidates, considering that some research results show that this has not yet become a reality (Cabero-Almenara et al., 2022; Røkenes, 2016; Tømte, 2015).

6. Conclusion

This research involved primary school teachers living in urban, rural, and suburban areas of a city in Indonesia. They comprise a digitally native generation of whom it is expected to have sufficient basic ICT skills, yet the preliminary study reported otherwise. Therefore, this research resulted in five reflective steps to improve the digital competence of primary school teachers implemented in the training programme, including: Selection of subject matter, Management and implementation of training, Actualization of teachers in ICT projects for learning, Reflection, and Training of assessors. These five steps are summarized in the acronym SMART. The SMART step implementation demonstrated an increase in the teachers' digital competence level. The increase in competency level is significant, ranging from one to three levels. Thus, the implementation of SMART steps in the training programme can be considered as successful in improving primary school teachers' digital competence and motivating them to develop a variety of ICT-based learning innovations as a reflection of a smart teacher.

7. Suggestion

To improve primary school teachers' digital competence, the five steps represented in SMART must be applied in teacher training. This SMART step needs to be promoted in curriculum content in higher education in producing prospective teachers who are digitally competent.

8. Limitation

This research has been conducted among teachers in primary schools only; however, this research can be developed to be used among teachers at the middle or high level and even at tertiary institutions.

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