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Information and communication technology-based learning practices and teacher professional development

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ABSTRACT

The rapid development of information technology has implications for its massive use in the field of education. Expectations for teachers to integrate technology into their learning practices and professional development are increasing. The teacher's ability to integrate technology in these two activities is influenced by various factors. However, previous research has not focused on uncovering how gender, experience, certification status, and social media can contribute to information and communication technology (ICT)-based learning practices and professional competency development for teachers. Based on this gap, this research was designed to investigate the contribution of gender, experience, certification status, and social media access to teachers' ICT-based learning practices and professional competency development. The current research was designed as a cross-sectional survey. A total of 1,756 elementary school teachers in South Sulawesi, Indonesia, were involved as research samples through online questionnaire data collection. The research results showed that there were differences in teachers' learning practices and professional development intentions based on work experience and intensity of social media access. However, no differences were found in gender variables and certification status. Thus, these two variables become key elements in integrating ICT in learning in the future. These findings will be beneficial for teacher training institutions and policy makers.

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1. INTRODUCTION

Mastery of information and communication technology (ICT) is crucial for teachers' learning practices and future career development. The integration of ICT into teachers' learning practices and professional development programs helps teachers to become adaptive and compatible with the needs of the digital-technology world. ICT literacy is one of the six foundational literacies needed to apply core skills to everyday tasks [1], [2]. Teachers who demonstrate a better attitude towards ICT create a positive circle that improves the learning process, even serving as a catalyst for educational innovation [3]. Conversely, teachers who do not use technology actively will have difficulty understanding student learning [4]. Harnessing ICT in learning includes integrating it into subject content, developing soft skills, and increasing interactivity in the classroom [5]. Therefore, teachers need to adapt to the role of technology in learning [6].

The use of ICT in the classroom and in teacher competency development is associated with access to various learning resources, governance management and teacher career development. The success of ICT

integration into learning practices and professional development is determined by the learning environment, the teacher's ability to combine technology with pedagogy, and the teacher's ability to encourage cooperative interactions and collaborative learning [7]. In short, integration of technology into learning practices is influenced by three key factors, including the teacher, institutional and technological factors [8]. Teachers' attitudes, self-efficacy, competence [9], access to technology, ICT proficiency [10], training and support, and perceptions of technology [11] determine the realization of ICT-based learning.

Nowadays, teachers need to develop the ability to design innovative ways of using technology to encourage the acquisition, deepening and creation of knowledge. ICT competency refers to the knowledge, skills, and ability to utilize ICT for collecting, processing and presenting information in supporting work and communication activities [12]. Competent teachers will demonstrate excellent performance in selecting appropriate instructional tools, collecting various information in an ethical manner, finding solutions to problems, and carrying out work effectively. The use of ICT has been proven to provide reliable results for student learning outcomes [13], increase student cognitive engagement and encourage collaboration between students [14]. Moreover, technology makes teaching and learning practices more flexible, allows students to learn at their own pace, and adapts to students' individual learning needs [15].

ICT can be used by teachers to facilitate the learning process. Teachers may integrate ICT into the classroom as a means of developing students' competence. In learning practices, ICT can be utilized for: i) planning and preparing learning; ii) supporting teaching practices; iii) implementing ICT-based classroom activities; iv) fostering students' 21st century skills; and v) developing students' digital skills [16]. Regarding professional development, ICT is used by teachers to develop communication skills, develop collaboration skills, evaluate pedagogical skills, and acquire digital resources [17].

Past studies have shown the connection between learning practices and digital technology use in the classroom. Teacher education programs that utilize digital resources can facilitate innovative learning practices in Ireland [18]. Previous findings show that gender and socioeconomic status were found to be variables that contribute to learning [19]. However, this research has not examined the relationship between experience, certification status, gender, and social media access with learning practices and teachers' competency development. Therefore, the current research focused on filling the gap in the literature regarding the contribution of these variables to ICT-based learning practices and teachers' competency development.

The current research attempted to investigate the contribution of gender, experience, certification status, and social media access to teachers' learning practices and professional development. There was a tendency for better ICT mastery for male aged 18 years [20]. In contrast, Aesaert and Braak [21] demonstrated that female at a young age possessed higher ICT technical skills than male. Hashemi [22] discovered that there were no gender differences in the acceptance and use of ICT in English language learning. Some of the research results have not produced consistent conclusions regarding ICT competency and gender variables. Therefore, these conflicting findings provide a strong basis for looking for links between gender, learning practices and teachers' competency development.

A study illustrated that experience contributes to behavior and use of technology [23], but it is not clear whether the conclusion was specific to teacher learning and competency development. Research by Adam and Metljak [24] revealed that teachers with less professional experience used ICT more and encountered fewer problems compared regarding ICT use than teachers with more professional experience. These findings contradict general learning practices indicating that professional experience is the key to teacher career success. Therefore, this research would also reveal the effect of accumulated experience and status as a certified teacher on teachers' ICT-based learning practices and professional development. Moreover, in the context of Indonesian teachers, previous research showed that certified status did not have a significant influence on the learning process and student learning outcomes [25].

The interaction between ICT-based learning, teacher professional development, gender, experience, certification status, and social media access has important and significant meaning to reveal. The findings of this research can provide the basis for establishing teacher career development policies and accommodate teacher preparation in institutional teacher training. Research by Alt [26] has uncovered a relationship between support for ICT activities and teacher professional development. In short, this study aimed to explore the contribution of teacher experience, certification status, gender, and social media access to teachers' learning practices and professional development.

2. METHOD

The current study was designed as explanatory research with a cross-sectional survey [27], [28]. To reveal differences in ICT-based learning practices and teacher competency development based on experience, certification status, gender and social media access, this study used a survey. A total of 1,756 teachers who taught in elementary schools in Gowa District, South Sulawesi, Indonesia, were involved as research

samples. Samples were spread across urban and inland areas. The teachers involved obtained employment status as government (public) teachers and private teachers. The teachers' certification and non-certification status was based on their ownership of a certificate issued by the Ministry of Education, Culture, Research and Technology of the Republic of Indonesia. Table 1 shows the demographics of the participants.

The instrument was developed by referring to the ICT competency framework for teachers [7]. The indicators included policy implementation (IK, 3 items), implementation of curriculum and assessment (IKA, 4 items), use of ICT in the learning process (IMPP, 3 items), use of learning media (PMPD, 7 items), management and administration of learning (IPAP, 5 items), and professional development (IPP, 3 items). The instrument used a Likert scale with the options: very rarely=1, rarely=2, sometimes=3, often=4, and very often=5. The following are two examples of items on the IKA aspect: "I utilize ICT in the assessment process" and "I use ICT to monitor student progress." The instrument was designed as an online questionnaire containing 25 items in total.

We distributed the online questionnaire to all respondents separately. Each respondent was allowed to either complete or refuse to fill in the questionnaire. As part of the research ethics, respondents' personal data would not be revealed. Respondents were informed that the information they presented would be kept confidential and would only be used for research purposes. The questionnaire was divided into two parts: i) sample demographic information and ii) learning practices and professional development. Regarding demographic information, respondents were asked to provide information about gender, profession, years of service, certification status, school status, and class level they were teaching.

The research instrument had undergone validity and reliability tests. The results showed that every aspect of the questionnaire was reliable: IK (α=.853), IKA (α=.895), IMPP (α=.833), PMPD (α=.934), IPAP (α=.914), IPP (α=.900). According to the corrected item-total correlation at significance level of .05, all questionnaire items were valid (Pearson correlation item >.080). Thus, the instrument was deemed valid and reliable for collecting data. Table 2 illustrates the validity and reliability of each of the questionnaire's items.

Table 1. Participants' demographic information (n=1,756)

Category	Description	n	%
Gender	Male	305	17.37
	Female	1,451	82.63
Years of service	≤5	270	15.38
	6-10	394	22.44
	11-20	713	40.60
	≥21	379	21.58
Certification status	Non-certified	305	17.37
	Certified	1,451	82.63
Intensity of social media use	High	868	49.43
	Low	888	50.57

Table 2. Item validity and reliability

Dimension	Items	Corrected item-total correlation	Cronbach's alpha if item deleted	Cronbach's alpha
Policy implementation	IK_1	.712	.806	.853
	IK_2	.745	.775	
	IK_3	.716	.803	
Implementation of curriculum and assessment	IKA_1	.738	.875	.895
	IKA_2	.777	.860	
	IKA_3	.803	.851	
	IKA_4	.749	.871	
ICT implementation to support learning	IMPP_1	.687	.776	.833
	IMPP_2	.690	.773	
	IMPP_3	.704	.759	
Application of digital skills	PMPD_1	.806	.922	.934
	PMPD_2	.837	.919	
	PMPD_3	.817	.921	
	PMPD_4	.724	.929	
	PMPD_5	.812	.921	
	PMPD_6	.773	.925	
	PMPD_7	.734	.928	
Implementation of learning management and administration	IPAP_1	.796	.892	.914
	IPAP_2	.794	.892	
	IPAP_3	.788	.894	
	IPAP_4	.784	.894	
	IPAP_5	.745	.903	
ICT implementation in professional development	IPP_1	.781	.874	.900
	IPP_2	.828	.834	
	IPP_3	.796	.862	

The data was analyzed using inferential statistics. Differences in gender, certification status, and intensity of accessing social media were analyzed using the t-test, while the length of service was analyzed using a one-way ANOVA test. The significance of the differences between group means was tested using the Tukey post hoc test. The significance value used as an analysis parameter was $\alpha \leq .05$.

3. RESULTS AND DISCUSSION

3.1. Years of service, ICT-based learning practices, and teacher professional development

According to the analysis, elementary school teachers who had worked for 6-10 years practiced the highest ICT-based learning and professional development among other teachers in all aspects. There was a significant difference in curriculum and assessment implementation between teachers who had worked for 6-10 years and those who had worked for 11-20 years (p=.040). We also observed a significant difference in digital media implementation between teachers who had worked for 1-5 years and those who had worked for 6-10 years, 11-20 years and ≥21 years (p=.000). Likewise, a significant difference was found in ICT-based professional development between teachers who had worked between 1-5 years and 6-10 years and those who had worked 11-20 years (p=.000). Other aspects, however, did not show any differences based on length of service. Table 3 presents the analysis results on teachers' years of service, ICT-based learning practices, and teacher professional development.

Table 3. The differences in teachers' ICT-learning practices and professional development based on years of service

Component	Years of service	N	M	SD	SE	F	p	Comparison
IK	≤5	270	10.3556	2.02390	.12317	2.757	.041	
	6-10	394	10.6396	2.04456	.10300			
	11-20	713	10.3506	2.03906	.07636			
	≥21	379	10.6332	2.13067	.10944			
IKA	≤5	270	14.9963	2.78672	.16959	2.773	.040	6-10>11-20
	6-10	394	15.3477	2.78462	.14029			
	11-20	713	14.8962	2.78951	.10447			
	≥21	379	14.8470	2.74157	.14082			
IMPP	≤5	270	11.2037	2.12070	.12906	2.362	.070	
	6-10	394	11.4721	2.16624	.10913			
	11-20	713	11.1459	2.06728	.07742			
	≥21	379	11.1372	2.12373	.10909			
PMPD	≤5	270	26.9222	5.23335	.31849	28.280	.000	(1-5) (6-10)>(11-20) (≥21)
	6-10	394	27.0711	5.27417	.26571			(11-20)>(≥21)
	11-20	713	25.4053	4.97181	.18620			
	≥21	379	24.0422	5.27080	.27074			
IPAP	≤5	270	17.9741	3.27024	.19902	1.630	.180	
	6-10	394	18.4264	3.52106	.17739			
	11-20	713	17.9691	3.42359	.12821			
	≥21	379	18.0660	3.62945	.18643			
IPP	≤5	270	11.9333	2.19902	.13383	6.047	.000	(1-5) (6-10)>(11-20)
	6-10	394	12.0863	2.23497	.11260			
	11-20	713	11.7433	2.21335	.08289			
	≥21	379	11.4327	2.26372	.11628			

Notes: IK= policy implementation
IKA=curriculum and assessment implementation
IMPP=ICT implementation to support learning
PMPD=digital media implementation
IPAP=learning management and administration
IPP=professional development
*p<.05

The first finding of this research suggests that work experience can be a differentiating variable in teachers' ICT-based learning practices and competency development. Implementation of curriculum and assessment, application of digital learning media, and implementation of professional development differed significantly between teachers who had worked for 6-10 years and those who had worked for less than six years and those who had worked for more than 10 years. Teachers with shorter years of service (0-6 years) demonstrated lower ICT-based learning practices and self-development intensity than those with 6-10 years of experience. Based on these findings, we would like to submit a claim and propose a hypothesis that the accumulation of work experience is needed to promote ICT-based learning practices and teacher competency development. It can be understood that work experience will give teachers confidence in ICT-based learning practices and professional development. Teachers with little experience in teaching have low self-confidence in implementing ICT-based learning practices and professional development.

The current research findings are corroborated by previous research which examined the relationship between teachers' work experience, learning practices and professional development. As reported by Liu *et al.* [29], experience can significantly affect teachers' teaching competence. Similarly, study by Layek and Koodamara [30] found that teacher motivation and accumulated work experience could improve teacher performance. Related to the current research findings, work experience might help boost teachers' confidence to integrate technology in their instructional practices. Experienced teachers usually have better content knowledge, pedagogical skills, classroom management skills, and media implementation skills. The experience they have gained over the years gives teachers confidence to try to utilize technology in learning practices. In this scenario, experience has an indirect impact on teachers' use of technology in the classroom [31].

Another interesting finding from this research is that teachers with more than 10 years of experience demonstrated low intentions in ICT-based learning practices. This means that this study found a nonlinearity between the experience and practice of integrating technology into the classroom. This finding can be explained by the interaction between experience and age. Teachers from older age groups generally have limited ICT skills compared to teachers from younger ages. Research by Lucas *et al.* [32] showed that age could be a significant factor that created a difference in teachers' competence, self-confidence and digital skills. Therefore, the results of this research provide implications for the procurement of teacher training and professional development by considering their level of experience and age. Older teachers need to receive priority in information technology training programs, so they can improve their learning practices and self-development intentions.

3.2. Gender, ICT-based learning practices, and teacher professional development

The second part of this research examines the role of gender in ICT-based learning practices, and teacher professional development. The statistical analysis showed that there was no difference in teachers' ICT-based learning practices and professional development, perceived from the aspect of gender. According to the analysis, IK p=.251, IKA p=.068, IMPP p=.593, PMPD p=.971, IPA p=.441, IPAP p=.441, and IPP p=.281. The results of the study indicated that both men and women did not show different practices in their learning and professional development. The results are presented in Table 4.

According to the statistics, male and female teachers did not show significant differences in ICT-based learning practices and professional development. This finding indicated that both male and female teachers already had the same access to the use of ICT at school. Therefore, they had ample opportunities to develop themselves and utilize ICT tools without gender discrimination. In terms of professional development, male and female teachers possessed the same opportunity to take part in various activities according to their passion.

Table 4. The differences in teachers' ICT-learning practices and professional development based on gender

Component	Gender	N	M	SD	SE	t	p
IK	Male	305	10.354	2.173	.12444	1.148	.251
	Female	1,451	10.503	2.037	.05347		
IKA	Male	305	14.7377	2.85909	.16371	1.828	.068
	Female	1,451	15.0579	2.76320	.07254		
IMPP	Male	305	11.167	2.1843	.1251	.535	.593
	Female	1,451	11.238	2.0979	.0551		
PMPD	Male	305	25.708	5.4685	.3131	.036	.971
	Female	1,451	25.720	5.2231	.1371		
IPAP	Male	305	17.954	3.5053	.2007	.771	.441
	Female	1,451	18.123	3.4631	.0909		
IPP	Male	305	11.659	2.263	.296	1.060	.289
	Female	1,451	11.808	2.231	.059		

Notes: IK=policy implementation
IKA=curriculum and assessment implementation
IMPP=ICT implementation to support learning
PMPD=digital media implementation
IPAP=learning management and administration
IPP=professional development
*p<.05

The findings related to gender contradictory with previous studies. As revealed by Barra *et al.* [33], women reported having higher readiness for cognitive activation practices, while men had higher self-efficacy in technology content knowledge. In terms of using technology in learning, it was also found that there were differences between men and women. Female teacher candidates believed that they had mastered more aspects of technological skills in learning compared to men [34]. Research by Lucas *et al.* [32] found gender as a differentiating variable in teacher competence in using ICT. Gender differences in the use of technology in previous research can be explained by digital proficiency which tends

to be higher for men [35] and the tendency for men to use the internet more than women [36]. Considering these differences, further investigations to see the role of other determinant factors, such as cultural background, professional development climate, and information technology support are necessary.

3.3. Certification status, ICT-based learning practices, and teacher professional development

The third part of this study examined the role of teacher's certification status in ICT-based learning practices, and teacher professional development. According to the analysis, we found that there was no difference in ICT-based teacher learning practices and professional development based on teachers' certification status. The analysis results showed that IK p=.205, IKA p=.887, IMPP p=.857, PMPD p=.820, IPAP p=.289, and IPP p=.963. These results suggested that both certified and non-certified teachers did not show different practices in their learning and professional development. Table 5 shows the complete analysis of the aspect.

The third finding from this research showed that there were no differences in ICT-based learning practices and teacher professional development based on teachers' certification status. This can be understood because in the context of professional teachers in Indonesia, teacher competence is measured by four main competencies, namely pedagogical, professional, social and personal. Certified teacher status does not place special emphasis on ICT competency. The findings related to the teacher certification status are in line with previous research findings which revealed that student learning outcomes were not influenced by teachers' certification status [26], [37].

Table 5. The differences in teachers' ICT-learning practices and professional development based on certification status

Component	Status	N	M	SD	SE	t	p
IK	Non-certified	305	10.308	2.0893	.1196	1.576	.205
	Certified	1451	10.513	2.0542	.0539		
IKA	Non-certified	305	15.0230	2.73190	.15643	.143	.887
	Certified	1451	14.9979	2.79322	.07333		
IMPP	Non-certified	305	11.2459	2.10619	.12060	.776	.857
	Certified	1451	11.2219	2.11473	.05552		
PMPD	Non-certified	305	25.6557	5.02194	.28756	.228	.820
	Certified	1451	25.7312	5.31615	.13956		
IPAP	Non-certified	305	17.9016	3.41583	.19559	.508	.289
	Certified	1451	18.1337	3.48119	.09139		
IPP	Non-certified	305	11.777	2.2426	.1284	.957	.963
	Certified	1451	11.784	2.2361	.0587		

Notes: IK=policy implementation
IKA=curriculum and assessment implementation
IMPP=ICT implementation to support learning
PMPD=digital media implementation
IPAP=learning management and administration
IPP=professional development
*p<.05

3.4. Intensity of social media access, ICT-based learning practices, and teacher professional development

The results of the analysis showed that the intensity of social media access resulted in the differences in teachers' ICT-based learning practices and professional development. Teachers who have a high intensity of social media access exhibited higher average scores for learning practices and professional development. IK differed significantly between teachers who accessed social media with high intensity and those who accessed social media with low intensity (p=.000). Similarly, IKA (p=.000), IMPP (.000), PKD (.000), IPAP (.000), and IPP (.000). Table 6 shows the complete analysis of the differences in teachers' ICT-learning practices and professional development based on intensity of social media access.

Finally, this research has unveiled the fact that teachers with higher intensity of social media access had better ICT-based learning practices and self-development intentions. This finding can be explained by access to and connectedness with social media. Those who have high access to social media can absorb more information, thereby encouraging ICT-based learning practices and teacher professional development. Teachers with higher social media access will also possess excellent digital skills. Digital skills and perceived technological capabilities have a major impact on the desire to use ICT [35]. Digital competence is characterized by knowledge of digital technology, attitudes towards digital technology, and digital skills [38]. Based on the digital competency framework, it can be concluded that social media access may have an impact on teachers' ICT-based professional development and their ability to integrate ICT into the classroom. Digital competence plays a key role in the integration of ICT in learning and professional development. Therefore, educational institutions and government agencies that manage teacher resources need to pay attention to developing teachers' digital competencies. By doing so, they can encourage teachers to integrate technology in the classroom and to dedicate themselves to ICT-based professional development.

The results of this research demonstrated that there were differences in learning practices and teacher professional development intentions based on work experience and intensity of social media access. Teachers with 6-10 years of teaching experience showed better ICT-based learning and professional development practices compared to those who have worked for less than 6 years or more than 10 years. Based on social media access, teachers who have higher connectedness with social media demonstrated better learning practices and higher professional development intentions in all aspects measured. On the other hand, this research also found that gender and teacher certification status had no influence on ICT integration in the classroom or ICT-based teacher professional development. Based on these findings, this research offers an important hypothesis, namely that sufficient teaching experience is needed in integrating ICT in learning practices and teacher professional development. Pedagogical and professional competence alone is not enough to support the integration of ICT in the classroom and teacher professional development, because ICT integration in the classroom needs to be supported by teachers' adequate practical experience.

This study's findings provide practical implications in the implementation of teacher professional development. It is important for teacher training institutions to sort teachers based on their teaching experience. Priority for participation should be given to those with at least 6 years of teaching experience. In other words, providing teacher training needs to be preceded by providing sufficient practical experience. Newly recruited teachers should be given the opportunity to enrich their teaching experience before they are included in the professional training program. In addition, this research found the importance of encouraging the use of social media as a means of teacher learning and professional development. Research evidence showing the significant influence of the intensity of social media access is a strong reason to provide training on the use of social media for learning and professional development for teachers.

Table 6. The differences in teachers' ICT-learning practices and professional development based on intensity of social media access

Component	Intensity	N	M	SD	SE	t	p
IK	High	868	10.1475	2.10320	.07139	6.711	.000
	Low	888	10.7995	1.96770	.06603		
IKA	High	868	14.5207	2.78334	.09447	7.277	.000
	Low	888	15.4730	2.70023	.09061		
IMPP	High	868	10.799	2.097	.711	8.534	.000
	Low	888	11.643	2.044	.069		
PMPD	High	868	24.2604	5.21500	.17701	11.924	.000
	Low	888	27.1430	4.91424	.16491		
IPAP	High	868	17.3825	3.58502	.12168	8.665	.000
	Low	888	18.7883	3.20692	.10762		
IPP	High	868	11.2753	2.26787	.07698	9.636	.000
	Low	888	12.2782	2.09102	.07017		

Notes: IK=policy implementation PMPD=digital media implementation
IKA=curriculum and assessment implementation IPAP=learning management and administration
IMPP=ICT implementation to support learning IPP=professional development

4. CONCLUSION

The results of this research fill the gap in the literature regarding the relationship between teacher experience, gender, certification status, and social media access and teacher ICT-based learning practices and competency development. The statistical analysis in this study showed significant differences in teachers' ICT-based learning practices and professional development based on their years of service and social media access. However, no differences were observed in teachers' ICT-based learning practices and professional development based on gender and certification status. Based on these findings, it can be concluded that younger teachers with sufficient experience will have higher intentions in ICT-based professional development and in adopting ICT in their learning practices. Digital competence can also be identified as the main determinant factor that drives teacher behavior in integrating ICT in learning and professional development. For this reason, teacher training institutions, training designers, policy makers and institutions need to pay attention to the development of teachers' digital competencies.

This research is limited to measuring teachers' perceptions of ICT integration in learning practices and teachers' professional competence development. Further research using experimental designs and action research is needed to test the effectiveness of ICT integration in learning and teachers' professional development regarding ICT use in the classroom. More comprehensive research, particularly on secondary school teachers, is also needed in the future.

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AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

INFORMED CONSENT

All participants in this study were provided with information about the research objectives and procedures and gave their consent before participating in the study.

ETHICAL APPROVAL

This research has received ethical approval from the Research Ethics Committee of the Institute for Research and Community Service, Universitas Negeri Makassar, Indonesia.

DATA AVAILABILITY

The data used in this study is available upon request from the corresponding author and will be provided in accordance with the applicable data access policies.

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