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Analysis of telehealth acceptance for basic life support training in sudden cardiac arrest in Pontianak

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ABSTRACT

Sudden cardiac arrest (SCA), which is one of the most prevalent causes of mortality, can be prevented by quickly conducting basic life support (BLS). In Pontianak City, the challenges associated with obtaining emergency health training, such as BLS, remain high. This study aims to evaluate user acceptance of Telehealth as well as its effectiveness in BLS training. We will also discuss its impact on community knowledge and skills in managing cardiac arrest. We used the human, organization, and technology Fit (HOT-Fit) method to analyze the level of acceptance of Telehealth in BLS training. We collected data from 60 respondents who underwent Telehealth-based BLS training. The results showed that participants' understanding and readiness in dealing with heart attack emergencies had increased significantly, by 90% and 92%, respectively. Analysis of the level of acceptance with HOT-Fit showed that system quality had the greatest influence on system use (0.611). Service quality exerted the most significant impact on user satisfaction (0.568). The net benefit was influenced by system use, user satisfaction, and organizational support, with user satisfaction having the greatest influence (0.600). Further research will be conducted on the utilization of augmented reality (AR) or virtual reality (VR) technology to implement Telehealth for BLS training.

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1. INTRODUCTION

In the 2023, the health center in Pontianak reported a total of 1,959 incidences of cardiac arrest. This makes the heart one of the main causes of death. Sudden cardiac arrest (SCA) is a condition that occurs suddenly due to electrical disturbances in the heart that interfere with the heart's ability to pump blood. Without immediate treatment, cardiac arrest can cause permanent brain damage and death within minutes [1]. People around the victim must immediately administer basic life support (BLS) in this situation before medical personnel arrive.

One kind of BLS is cardiopulmonary resuscitation (CPR). CPR is a series of emergency actions taken to help someone who is experiencing cardiac arrest maintain blood flow and oxygen to the brain and other vital organs [2]. Studies have demonstrated that BLS training enhances an individual's likelihood of surviving cardiac arrest. Based on information from the American Heart Association, cardiac arrest victims who receive CPR have a two to three times greater chance of survival compared to those who do not receive assistance [3]. Training is one strategy for increasing community knowledge and skills in providing BLS [4]. Anyone, including the general public, can perform BLS due to the ease of teaching and learning basic techniques like CPR [5].

A study applied the "SELAMAT" model to enhance public recall and application of the BLS steps. The general public can easily remember and implement this model's stages in emergency situations. The steps in the "SELAMAT" model include: immediately checking response and breathing; evaluating the surrounding conditions; making an emergency call; starting CPR if there is no breathing; monitoring the victim's condition; observing and providing support until help arrives; and continuing actions according to medical professionals' instructions. According to research, training with the "SELAMAT" model is effective in improving the skills and knowledge of the public in providing BLS assistance. However, public awareness and BLS training levels in Indonesia are still low Many people have never received BLS training, and access to this training is often limited to certain groups. On the other hand, although Pontianak City is one of Indonesia's largest cities, challenges related to limited resources to provide BLS training remain widespread. This includes a limited amount of time for medical personnel to provide training, as well as a lack of opportunities for the general public to attend face-to-face instruction on a regular basis.

Telehealth technology is expected to be an effective solution to improve access, efficiency, and quality of health services, especially in emergency situations or when patient mobility is limited [6]–[9]. Telehealth has been shown to provide significant health outcomes, such as reduced perinatal mortality, and its effectiveness is comparable to face-to-face training, while reducing costs and time required [10]–[13]. Health training through Telehealth has several advantages. First, the flexibility of time and place offered by Telehealth platforms allows participants to schedule training according to their availability [14]. Second, Telehealth can reach participants in various locations, even those far from health facilities [14], [15]. Third, incorporating digital technology into training can help increase community participation in health education programs [16], [17].

Therefore, this investigation will address numerous issues that constitute the primary concerns. At first, the challenges encompass the limitations of technological infrastructure, such as the unequal internet access in Pontianak, and the variations in digital literacy of training participants. Second, the challenges that BLS training through Telehealth may encounter in terms of the delivery of practical skills, the limited interaction, and the challenges associated with evaluating participant competency. Third, the impact on community knowledge and skills can also be influenced by low information retention or inappropriate training methods. Fourth, the paucity of representative data and the varying motivation of participants present additional obstacles to the development of pertinent recommendations. Fifth, the manner in which mitigation strategies are implemented to ensure that the research results provide the greatest possible benefit.

System quality and information quality in telemedicine applications have a positive and significant effect on user satisfaction. Improving system and information quality significantly increases user satisfaction. Patients are more satisfied with telemedicine services that are of high quality, which can lead to an increase in their utilization [18]. Therefore, in the field of Telehealth, substantial net benefits can be achieved through high user satisfaction and system usage.

Therefore, the purpose of this study is to evaluate user acceptance of Telehealth, and its effectiveness in BLS training in BLS training in Pontianak City. We will also discuss its impact on community knowledge and skills in managing cardiac arrest. The identification of challenges in its implementation, such as participants' digital literacy and technological infrastructure support, complements this analysis. We hope that by analyzing the results of this Telehealth training, we can find solutions to enhance future training and broaden public access to essential health education like BLS.

2. METHOD

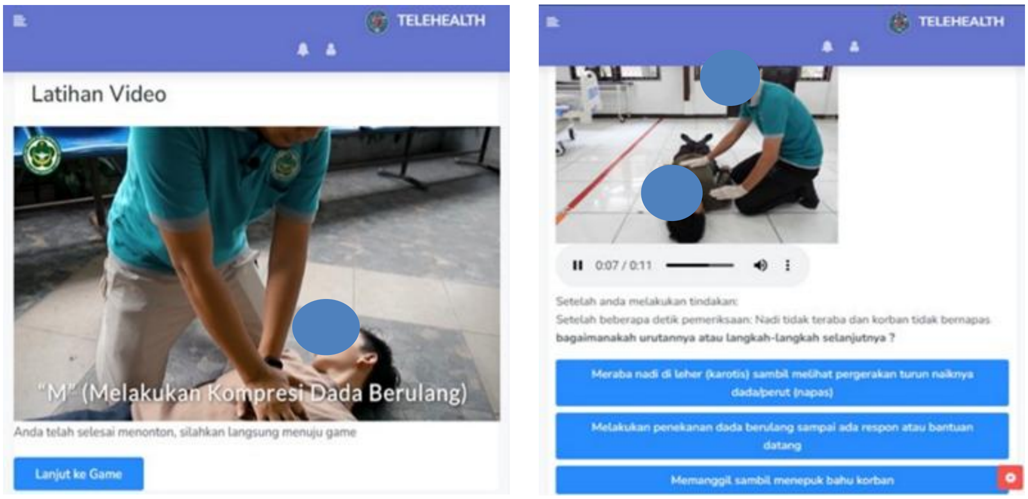
2.1. Data collection

Pontianak City has currently implemented a Telehealth system for BLS training in the context of cardiac arrest management. The "SELAMAT" model was implemented to develop this Telehealth system. Figure 1(a) illustrates a partial view of a Telehealth application, specifically a game, while Figure 1(b) illustrates a partial view of a Telehealth application, particularly a video. Despite the development of this system, we have never evaluated its effectiveness and level of user acceptance.

This study used a quantitative method with a survey approach. Respondents consisted of 60 participants registered in the Telehealth-based BLS training program in Pontianak City. This study used a questionnaire that inquired about the participants' training experiences, the quality of the delivered material, and the training's impact on their preparedness to handle cardiac arrest emergencies.

Participants must create an account on the provided Telehealth platform. This step guarantees participants' access to the designated training platform. After successfully registering, participants are required to watch an educational video containing material about BLS. Participants will take part in an interactive game that includes evaluation questions that are pertinent to the video's content following its viewing. The design of this game is to gauge the participants' comprehension of the BLS material they have acquired. The questions in the game include basic BLS concepts, CPR steps, and identification of cardiac arrest situations.

Participants will fill out a questionnaire after finishing the game. This questionnaire will measure several key aspects, such as participants' experience using Telehealth, satisfaction with the Telehealth system, the effectiveness of educational videos in improving participants' understanding of BLS, perceived support from the Pontianak Health Office in implementing the Telehealth program, and completion and data collection. Once the participants complete the questionnaire, we will collect and statistically analyze the data to assess the effectiveness of Telehealth in enhancing their knowledge and skills.



(a) (b)

Figure 1. Telehealth for BLS training: (a) video and (b) game

2.2. HOT-Fit model development

The human, organization, and technology Fit (HOT-Fit) model was used to evaluate the implementation of Telehealth in this training. The HOT-Fit model emphasizes three main aspects: human, organization, and technology [19]. This model is used to understand critical components of application implementation and the evaluation of readiness. We compiled the questionnaire based on the HOT-Fit model, incorporating the variables of system quality, information quality, service quality, system use, user satisfaction, organization, and net benefits. The questionnaire uses a Likert scale of 1–5 to measure respondents' perceptions of each variable. Users can fill out this questionnaire after completing the Telehealth training process.

We performed data analysis using partial least squares (PLS), a statistical method suitable for evaluating models with many variables. Figure 2 shows the hypothesis model by adopting research from Hardiyanti *et al.* [19]. Ten hypotheses can be derived from Figure 2, as illustrated in Table 1.

Variant-based PLS-SEM is implemented to evaluate reliability and validity. This method is also used to evaluate the structural model in the causality test, which is a hypothesis test that uses a predictive model. Model testing is conducted in two stages: outer model and inner model testing.

In this outer model, the causal relationship is explained. In other words, the outer model explains the relationship between latent variables, both endogenous and exogenous, and indicators in existing variables. The variability of exogenous variables is influenced by assumptions about causes that are either external to the model or can be referred to as independent variables. The analysis of validity and reliability is enhanced by the testing of the outer model.

We conduct validity testing to evaluate the research instrument's capabilities. The outer model's measure is evaluated using three criteria: convergent validate, discriminant validate, and composite stability [20]. Convergent validation is shown in the loading factor value (correlation of item scores with construct scores) of each construct. The optimal loading factor value is greater than 0.7. Meanwhile, discriminant validate testing is evaluated by comparing the average variance extracted (AVE) root value of each construct with the correlation between one construct and another construct in the model. The minimum AVE value that is accepted is 0.50 [21], ensuring that more than 50% of the latent variables can explain the indicator.

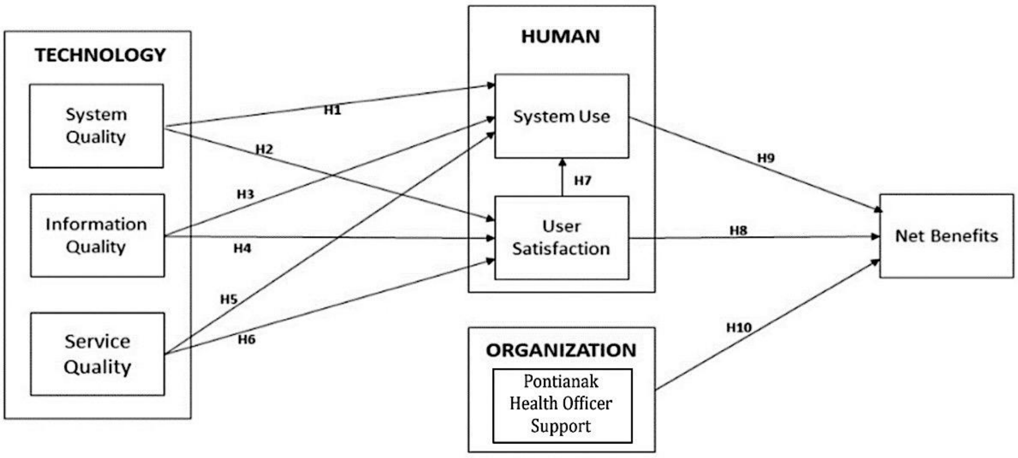


Figure 2. Hypothesis model diagram

Table 1. Ten hypotheses

Code	Hypothesis
H1	System quality has a positive effect on system use
H2	System quality has a positive effect on user satisfaction
H3	Information quality has a positive effect on system use
H4	Information quality has a positive effect on user satisfaction
H5	Service quality has a positive effect on system use
H6	Service quality has a positive effect on user satisfaction
H7	User satisfaction has a positive effect on system use
H8	User satisfaction has a positive effect on net benefit
H9	System use has a positive effect on net benefit
H10	Pontianak Health Officer support has a positive effect on the net benefit

In the next evaluation, the Fornell-Larcker criterion is utilized to compare the AVE root of each construct with the correlation between one construct and another in the model [22], [23]. The model has acceptable discriminant validity if the AVE root value exceeds the correlation between constructs. In other words, the constructs in the model exhibit substantial differences from one another, as they are more closely associated with their own indicators than with other constructs in the model.

In order to verify the accuracy and consistency of the instrument in conducting measurements, reliability testing or composite reliability is implemented. Cronbach's alpha and composite reliability are the two methodologies employed in reliability testing with PLS. The lower limit of a construct's reliability is determined using Cronbach's alpha, while the actual reliability of the construct is measured using composite reliability. A reliability estimate is provided by Cronbach's alpha, which is determined by the intercorrelation of indicators. Based on the criteria established by Haenlein and Kaplan, a Cronbach's alpha value exceeding 0.7 is considered acceptable [24].

Inner testing is done after outer testing. Testing of the inner model or structural model are conducted by examining the R-square value of the dependent variable. The indicator's reliability with respect to the dependent variable is indicated by the R-square value. The prediction model generated by the proposed research model is more accurate when the R-square value is higher. A value of 0.75 indicates a strong model, 0.50 indicates a moderate model, and 0.25 indicates a feeble model [19].

The next step is hypothesis testing. The objective of hypothesis testing is to ascertain whether the analyzed data support the hypothesized relationship between constructs in the research model. In the context of partial least squares structural equation modeling (PLS-SEM) analysis, hypothesis testing is performed by assessing the t-statistic values and path coefficients that are acquired through the bootstrapping process. The direction and intensity of the relationship between constructs are indicated by path coefficients, while the statistical significance of the relationship is evaluated using t-statistic values. If the t-statistic value surpasses a predetermined threshold, the hypothesis has been determined to be confirmed.

Based on the result of hypothesis testing, data analysis is carried out. The user acceptance of Telehealth applications will be the subject of the analysis's findings. Furthermore, discussions will be held regarding numerous implementation challenges, particularly those associated with digital literacy and regulations. The final section will also address the potential for future Telehealth development.

3. RESULTS AND DISCUSSION
3.1. Improving of knowledge and skills

The results showed that Telehealth-based BLS training significantly improved participants' knowledge and skills. As many as 90% of respondents reported an increase in their understanding of BLS procedures as shown in Figure 3. More than 90% stated that they felt more prepared to deal with cardiac arrest situations after participating in the training as presented in Figure 4. This finding is in line with research [12], which found that Telehealth-based training can improve medical skills in areas with limited access to face-to-face training.

Telehealth-based BLS training not only improves participants' knowledge, but also provides wider access to the community to receive training without having to spend time and money traveling to a training center. This is especially important for people who have limited time due to work or other commitments [6]–[9]. Telehealth's ability to provide flexible, accessible training is one of its main advantages compared to traditional training methods.

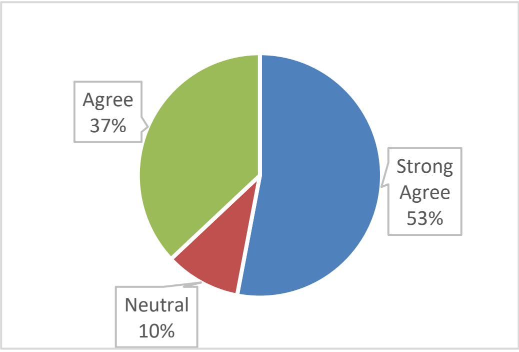


Figure 3. Improvement in knowledge of BLS procedures

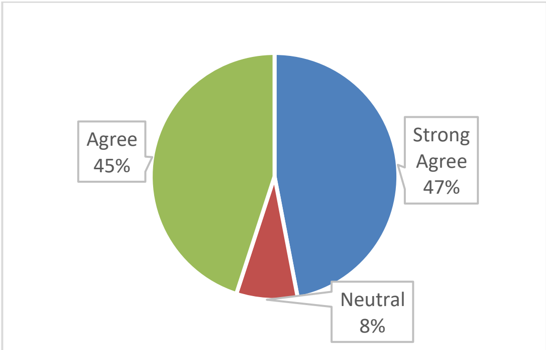


Figure 4. Improvement in readiness to handle SCA cases

3.2. HOT-Fit model

The validity test results are presented in Table 2. The outer loading values in the table suggest that all variables and indicators use in this study have strong convergent validity, with outer loading values exceeding 0.7. This suggests that each indicator has a strong correlation with the measured variables. The measured constructs demonstrate a very strong correlation with indicators with increased outer loading (above 0.9), as observed in the information quality and service quality variables.

The evaluation results based on the Fornell-Larcker criterion are presented in Table 3. It is shown in the discriminant validity table that all constructs possess strong discriminant validity, indicating that they can be easily distinguished from one another. A strong discriminant validity is indicated by the cross-loading value, which indicates that each indicator is more correlated with its own construct than with other constructs. The variables in this model have been accurately measured, and the indicators do not measure the incorrect or overlapping constructs, as evidenced by the high discriminant validity.

Table 4 shows the Cronbach's alpha and composite reliability values. As seen in the results, the variables in the model show good to very good reliability. Cronbach's alpha values for all constructs exceed 0.8, with the majority approaching or exceeding 0.9. This suggests that the indicators within each construct are highly correlated and stable. The constructs are also consistently measured by composite reliability (rho_a) and composite reliability (rho_c), with majority values exceeding 0.9. Overall, the indicators in this study are regarded as reliable, indicating that the results are consistent and stable in their measurement of each construct.

Table 5 shows the R-square value of the dependent variables in this study. The results of this study indicated that user satisfaction has a very strong R-square (0.864), suggesting that the independent variables in the model properly represent the majority of the variance in US. The model could be responsible for nearly all of the variance in net benefit, as indicated by its outstanding R-square (0.989). This suggests that this model is nearly perfect in its ability to predict the net benefits of the Telehealth system. The R-square of system use is also very high (0.898), indicating that the model could be responsible for the majority of the variance in system use.

Table 2. Validity test results

Variable	Indicator	Outer loading
System quality (SQ)	SQ1	0.850
	SQ2	0.892
	SQ3	0.855
Information quality (IQ)	IQ1	0.945
	IQ2	0.952
	IQ3	0.900
Service quality (VQ)	VQ1	0.916
	VQ2	0.912
System use (SU)	SU1	0.819
	SU2	0.704
	SU3	0.817
	SU4	0.811
	SU5	0.777
	SU6	0.877
	SU7	0.781
	SU8	0.843
	SU9	0.845
User satisfaction (US)	US1	0.878
	US2	0.781
	US3	0.834
	US4	0.770
	US5	0.841
	US6	0.825
	US7	0.796
Pontianak Health Officer Support (PHOS)	PHOS1	0.771
	PHOS2	0.803
	PHOS3	0.860
	PHOS4	0.844
	PHOS5	0.835
	PHOS6	0.810
Net benefit (NB)	NB1	0.835
	NB2	0.737
	NB3	0.790
	NB4	0.807
	NB5	0.782
	NB6	0.798
	NB7	0.804
	NB8	0.810
	NB9	0.790
	NB10	0.793

Table 3. Discriminant validity test results

Indicator	PHOS	IQ	VQ	US	SQ	NB	SU
PHOS	0.821						
IQ	0.754	0.933					
VQ	0.932	0.685	0.914				
US	0.941	0.789	0.890	0.819			
SQ	0.810	0.782	0.740	0.818	0.866		
NB	0.970	0.805	0.883	0.982	0.839	0.795	
SU	0.904	0.819	0.796	0.854	0.926	0.911	0.810

Table 4. Composite reliability and cronbach's alpha values

Indicator	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)
PHOS	0.903	0.903	0.925
IQ	0.925	0.928	0.952
VQ	0.803	0.803	0.910
US	0.918	0.919	0.934
SU	0.833	0.833	0.900
NB	0.935	0.936	0.945
PS	0.934	0.935	0.945

Table 5. R-square values

Indicator	R-square	R-square adjusted
US	0.864	0.859
NB	0.989	0.988
SU	0.898	0.892

In general, this model shows outstanding ability to predict in explaining the variance of the primary dependent variables, including user satisfaction, net benefit, and system use. This indicates that the dependent variable is significantly influenced by the independent variables used in the model. To test the effectiveness of Telehealth in this training, PLS analysis was used. The results of the statistical tests in Table 6 show that system quality and information quality significantly contribute to user satisfaction and net benefits obtained from training.

Table 6. Statistical test results with PLS model

Hypothesis	Independent variable	Dependent variable	Coefficient	p-value	Results
H1	SQ	SU	0.611	0.000	Significant
H2	SQ	US	0.218	0.037	Significant
H3	IQ	SU	0.167	0.055	Not significant
H4	IQ	US	0.230	0.021	Significant
H5	VQ	SU	0.151	0.288	Not significant
H6	VQ	US	0.568	0.000	Significant
H7	US	SU	0.089	0.581	Not significant
H8	US	NB	0.600	0.000	Significant
H9	SU	NB	0.172	0.000	Significant
H10	PHOS	NB	0.250	0.000	Significant

According to Table 6, the statistical analysis results show a relationship between independent variables: system quality, information quality, service quality, user satisfaction, system use, and Pontianak Health Office support and dependent variables: user satisfaction, system use, and net benefits. System quality has a significant effect on system use and user satisfaction. This means that excellent system quality contributes positively and significantly to increasing user use and satisfaction. Information quality has an effect on user satisfaction, but the effect on system use is less significant. Service quality has a significant effect on user satisfaction, but not on system use. Quality service has a greater impact on user satisfaction than system use. User satisfaction has a significant effect on net benefits, but not significant on system use. System use also has a significant effect on net benefits, indicating that more frequent system use can provide greater benefits. Support from the Pontianak Health Officer has a significant effect on net benefits, indicating that support from local health institutions is essential to increase the net benefits of system use.

Overall, these results indicate that system and service quality have a significant impact on user satisfaction, and ultimately, user satisfaction and system use provide significant net benefits. This is consistent with and supports the research of previous researchers [18]. The Health Office's support also plays a significant role in increasing the net benefits of Telehealth in Pontianak City. The results of this test emphasize the importance of maintaining the technical quality of the Telehealth system and the information provided so that training can run well and provide optimal benefits for users. Additionally, we need government support in terms of policy and infrastructure.

3.3. Digital literacy and regulatory challenges

Despite the positive impact of Telehealth-based BLS training, the study identified several challenges that require attention to enhance the program's effectiveness in the future. One of the main challenges is the low digital literacy among the community. Some participants experienced difficulties in operating the Telehealth platform, especially those who were less familiar with the use of digital technology. This creates obstacles to optimal access to training materials. Regulatory support for Telehealth at the local level is also still limited. Despite the recognition of Telehealth as a crucial tool in health services during the COVID-19 pandemic, there remains a lack of well-structured regulations for its implementation in health training, particularly in non-clinical training like BLS [12].

3.4. Telehealth development in the future

Telehealth not only offers a solution for BLS training, but also holds significant potential for application in various other health fields. For instance, a Telehealth platform enables virtual training for other first aid, including managing burns, head injuries, and trauma. This can expand public access to basic medical knowledge that is crucial in an emergency.

Future developments in multimedia technology and vision systems will enable the integration of Telehealth with virtual reality (VR) or augmented reality (AR) technology, resulting in a more immersive and realistic training experience. Participants can do live simulations using VR devices, allowing them to practice in emergency situations that are closer to real conditions. Trainees can use VR to reconstruct real cases from patient data for further study. Thus, trainees can learn from mistakes or understand clinical situations better.

AR can also help participants understand human anatomy better, making them more confident in providing first aid. The application of VR has been proved to be useful in the field of nursing education, particularly in the area of clinical knowledge and skills acquisition [25]–[27]. Similarly, other research has demonstrated that AR considerably enhances the knowledge, motivation, and self-efficacy of nursing students in comparison to traditional learning classes [28], [29]. Telehealth offers a flexible and easily accessible solution, especially amidst limited resources for face-to-face training. With the right support, Telehealth can be a very effective tool in expanding access to health training, not only in Pontianak City but also throughout Indonesia.

A national digital literacy program is required in Indonesia to enhance digital literacy and facilitate the advancement of sustainable and inclusive Telehealth. This program should encompass fundamental training, instructional campaigns, and the integration of digital literacy into the school curriculum. Free internet access in public facilities, subsidies for technology devices, and mentoring programs for vulnerable groups are all programs that the government has the ability to implement. Numerous government policies are required, particularly those that pertain to national Telehealth standards, platform accreditation, digital health insurance, and investment in information technology infrastructure in rural areas. Establishing public-private partnerships is one practical approach to accomplishing this. The government should provide funding for research on the socio-economic implications of Telehealth, local technology innovation, and campaigns for improving public trust.

4. CONCLUSION

This study shows that Telehealth has enormous potential in delivering remote health training such as BLS. Although the results show a significant increase in participant knowledge and skills, the challenges of digital literacy and regulation still need further attention. We need to improve community digital literacy and develop regulations that support the adoption of this technology in health training in Indonesia to ensure the success of sustainable Telehealth implementation. The HOT-Fit method was used to analyze the level of acceptability of Telehealth in BLS training, and the results indicated that user satisfaction is significantly influenced by system and service quality. Furthermore, user satisfaction and system use cause significant net benefits. On the other hand, government assistance is also a significant factor in the enhancement of this net benefit. In the future, we are going to explore the potential of incorporating VR or AR technology into the Telehealth application for BLS training. In order to promote sustainable Telehealth development and digital literacy in Indonesia, it is important to implement training programs, educational campaigns, and subsidies for technological devices, particularly for vulnerable populations. Policies should encompass the establishment of service standards, the implementation of digital health insurance, and the reinforcement of ICT infrastructure through public-private partnerships. Public trust in Telehealth can be enhanced through public awareness campaigns, local technological innovation, and socio-economic impact research.

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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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Rahadian Kurniawan	✓			✓						✓		✓		

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

Authors state no conflict of interest.

INFORMED CONSENT

We have obtained informed consent from all individuals included in this study.

DATA AVAILABILITY

Derived data supporting the findings of this study are available from the corresponding author [S.K.] on request.

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