

Self-development moderates the impact of digital literacy and talent on human error

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ABSTRACT

Effective public services are important for increasing community satisfaction and organizational credibility. This study aims to explore the influence of digital literacy, underutilized talent, and human error on the effectiveness of public services, with self-development as a moderating variable. This study was conducted with employees of the Trade Office of South Sumatra Province. The research method used was quantitative data analysis, which was performed using partial least squares structural equation modeling (PLS-SEM). The results of this study show that digital literacy and self-development play an important role in reducing human error and increasing the effectiveness of public services. These findings have practical implications for human resource management in the public sector, focusing on improving digital literacy and employee self-development.

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1. INTRODUCTION

Public services have a vital role in providing basic services needed by the community and improving the overall quality of life [1], [2]. The effectiveness of public services not only reflects the credibility of the organization but also builds public trust in the government [3]. However, in practice, public services are often faced with various challenges such as limited digital literacy among employees, talents that are not utilized optimally, and human error. Underutilized talent within the organization's scope can become increasingly relevant to the development of technology and information. With the advancement of technology, the opportunity to utilize the various talents and skills of employees is increasing [4], [5]. However, if existing talent is not optimized effectively, the positive potential that can be generated from technological and information developments can be missed [6], [7]. Therefore, it is necessary to harmonize the development of individual talents with the demands and advancements of technology to ensure that every employee can contribute optimally in this digital era [8], [9].

The digital skills gap among civil servants is a significant barrier to digital transformation. Despite efforts to equip civil servants with digital skills, there is a lack of willingness to learn and share knowledge, which hinders the impact of digital transformation [10], [11]. Major obstacles are the absence of standardization in digital transformation, inadequate human resources, and uneven infrastructure. These issues are exacerbated by a lack of government commitment and community involvement, which are crucial for successful e-government implementation [12], [13].

This study addresses a critical gap concerning the interaction among digital literacy, underutilized talent, and human error within public services in Indonesia. Despite growing attention to digital

transformation in public sectors, limited research has been conducted specifically addressing how untapped employee potential (underutilized talent) and frequent occurrences of human errors hinder service effectiveness. Furthermore, the role of self-development as a moderator in mitigating these negative impacts remains unclear. Therefore, this research explicitly investigates these issues within the context of the Trade Office of South Sumatra Province, Indonesia.

The development of technology and information has affected how organizations provide community services [14]–[16]. Organizations can now use a variety of tools and systems to speed up and facilitate services. Such as using online platforms and mobile applications to make it easier for people to make transactions or access information about the services provided [17]–[19]. In addition, the development of social media has also had an impact on the way organizations provide services. Society is now paying more attention to values such as sustainability and corporate social responsibility, so organizations must be able to tailor community services to match those values [20], [21]. Digital literacy is needed to enable bureaucratic leaders to understand the technology used in the decision-making, communication, and data management processes.

Digital literacy is an important thing for bureaucratic leaders to be able to lead organizations well and succeed in the ever-evolving digital era [22], [23]. Digital literacy capabilities also allow bureaucratic leaders to obtain and analyze information accurately and quickly so that they can make better decisions [24], [25]. Lack of understanding of digital literacy can lead to human error in using digital devices and applications, such as data input errors, operational errors, or mistakes in making decisions based on incorrect or incomplete data. Although many studies have highlighted the importance of digital literacy and self-development in improving organizational performance, there are still few studies that specifically examine the interaction between digital literacy, underutilized talent, and human error in the context of public service [26], [27]. In addition, the role of self-development as a moderating variable in this relationship has not been widely explored, especially in the public sector in Indonesia.

Human error can occur in various situations and contexts, both in daily life, work, and within the scope of the organization [28]. Human error can have a big influence on the effectiveness of services. Human error can lead to a wide variety of problems in service, such as delays, defects in products or services provided, and even accidents that threaten the safety of customers and employees [29], [30]. Non-compliance with established procedures or policies can also hurt the effectiveness of services. This can result in a decrease in the quality of the products or services provided and affect customer trust in the company or organization concerned [30], [31]. In addition, human error can also affect employee productivity and increase operational costs, especially if the error requires additional time and resources to fix [32], [33]. Therefore, controlling the risk of human error and increasing employee awareness and skills in following established procedures and policies are very important to improving service effectiveness [34], [35].

Public services play an important role in improving people's quality of life, and the effectiveness of these services is heavily influenced by factors such as digital literacy, underutilized talent, and human error. However, while there have been many studies investigating the influence of digital literacy and personal development in improving service effectiveness, most studies do not explicitly address how underutilized talent and human error also play an important role. Most existing solutions tend to focus on improving digital literacy and skills training, but few explore the interplay between digital literacy, underutilized talent, and human error in the context of public service. This study aims to address that gap by investigating how self-improvement can serve as a moderating variable in the relationship between these factors and service effectiveness. This research offers a new contribution by exploring how digital literacy and underutilized talent can affect human error and the effectiveness of public services, as well as how self-development can moderate these relationships. This study is focused on employees of public service agencies in South Sumatra Province, Indonesia, which has not been widely researched before. This study investigated the combined effects of digital literacy, underutilized talent, and human error on public service effectiveness, explicitly addressing how self-development moderates these relationships. While previous research has highlighted the importance of digital literacy and employee self-development in enhancing organizational performance [36], [37], limited attention has been given to understanding how underutilized talent and human error collectively impact public service effectiveness, particularly in the Indonesian public sector context.

2. LITERATURE REVIEW

The theory of planned behavior (TPB) states that individual behavior is influenced by the intention to behave, which in turn is influenced by attitudes toward behavior, subjective norms, and perceptions of behavioral control [38]. In this context, digital literacy and self-development can affect employee attitudes and perceptions toward the use of technology in public services, which can ultimately reduce human error. The theory of reasoned action (TRA) states that an individual's behavior is influenced by the intention to perform a particular action, which is determined by subjective attitudes and norms [39]. Digital literacy can increase positive attitudes toward the use of technology, while self-development can strengthen subjective

norms that support the use of technology in public services. The technology acceptance model (TAM) explains that the acceptance of technology is influenced by the perception of ease of use and the perception of usability [40]. Digital literacy can increase the perception of ease of use of technology, while self-development can increase the perception of the usefulness of technology in the context of public services.

Digital literacy refers to an individual's ability to understand and use information and communication technology effectively. High digital literacy allows employees to operate information systems properly, reducing the possibility of human error in the service process [19], [41]. Underutilized talent refers to the potential and skills of employees who are not used to their full potential in their jobs. Optimal utilization of talent can improve organizational performance and the effectiveness of public services. Human error in the context of public service can be caused by various factors, including a lack of training, limited digital literacy, and a lack of talent utilization. Reducing human error is the key to improving the effectiveness of public services. Self-development refers to the process by which individuals refine their skills and knowledge to reach their full potential. In this context, self-development can improve the ability of employees to overcome challenges in public service, reduce human error, and increase service effectiveness.

The proportion of this research is on underutilized talent on service effectiveness, with an emphasis on the role of self-development as a moderation variable. The general statement indicates that underutilized talent, which reflects the inadequate utilization of individual skills or talents in the work environment, can have a negative impact on service effectiveness. This study explores the relationship between underutilized talent and decreased service effectiveness in the context of organizations. In addition, the researchers tested the hypothesis that individual self-development can moderate the negative influence of underutilized talent on service effectiveness. Researchers argue that by improving employee skills and competencies through self-development efforts, the impact of underutilized talent can be reduced, allowing individuals to make maximum contributions in the work environment. Increased self-development is identified as a key factor in improving service quality by optimizing the utilization of talents that may be underutilized.

This study provides insight into how underutilized talent affects service effectiveness, as well as detailing the contribution of self-development in moderating these impacts. In addition, researchers anticipate that the results of this study can contribute to the understanding of factors that affect employee productivity and job satisfaction levels. The conceptual model of the research includes the main variables of underutilized talent, service effectiveness, and self-development, with self-development acting as a moderation variable that moderates the relationship between underutilized talent and service effectiveness. Based on the review of literature and literature as well as the development of models from the research variables, namely digital literacy, underutilized talent, and human error as independent variables, service effectiveness as a dependent variable with self-development as a moderation variable, then empirically, the conceptual framework of the research is as shown in Figure 1.

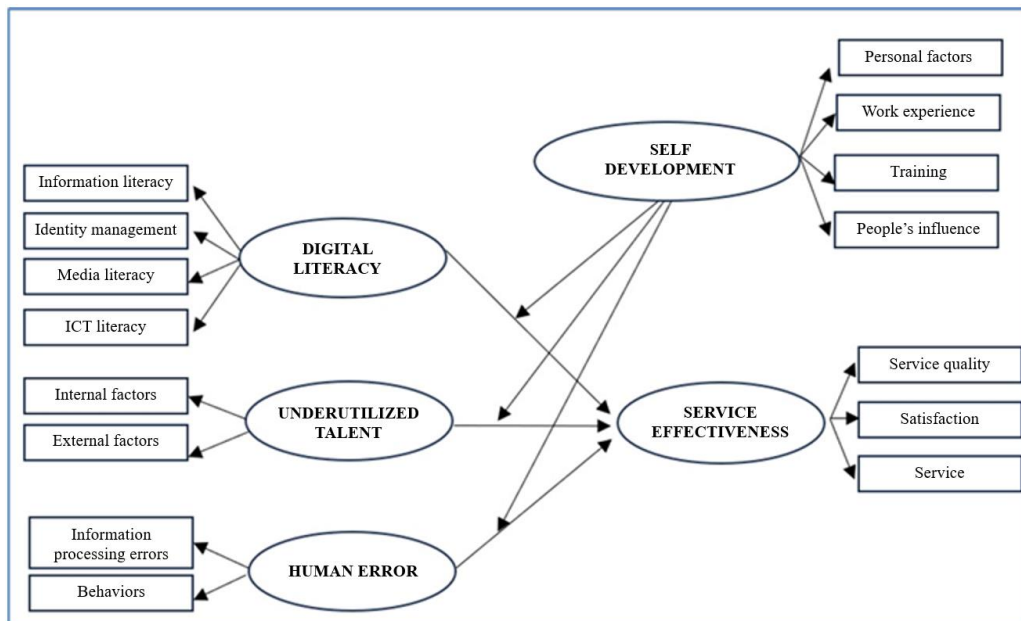


Figure 1. Research thinking framework

3. RESEARCH METHOD

This research uses a quantitative approach with survey techniques to collect data from employees at the Trade Office of South Sumatra Province. The population of this study consists of all state civil apparatus (SCA) who work at the Trade Office of South Sumatra Province. The sample was taken using purposive sampling, which means that the sample was selected based on certain criteria relevant to the research objectives.

Data were collected using a questionnaire designed to measure the main variables in the study, namely digital literacy, underutilized talent, human error, self-development, and service effectiveness. This questionnaire has been validated in previous studies and adapted a well-tested instrument. The number of samples used in this study was 207 respondents. These numbers are considered representative to provide an overview of the population studied.

Data was collected using questionnaires compiled based on research variables, namely digital literacy, underutilized talent, human error, self-development, and service effectiveness. This questionnaire consists of several sections that each measure one research variable.

- i) Digital literacy: measured using a scale that assesses employees' ability to search, evaluate, and use digital information.
- ii) Underutilized talent: measured using a scale that assesses the extent to which an employee's potential and skills are utilized in their work.
- iii) Human error: measured using a scale that assesses the frequency and type of mistakes made by employees in carrying out their duties.
- iv) Self-development: measured using a scale that assesses employees' initiatives and efforts in improving their skills and knowledge.
- v) Service effectiveness: measured using a scale that assesses the performance of public services provided by employees.

The definition of the operational variables in this study can be seen in Table 1.

Table 1. Variable operational definition

Variable	Indicator	Reference
Digital literacy	Ability to evaluate digital information	[25], [36]
Underutilized talent	Employee skill optimization	[42], [43]
Human error	Frequency of operational errors	[28], [29]
Self-development	Employee initiative for skill enhancement	[44], [45]
Service effectiveness	Quality and efficiency of public services	[6], [20]

The data was collected through a questionnaire consisting of several sections, including questions about digital literacy, talent utilization, human error, self-development, and service effectiveness. The questionnaire is adapted from instruments that have been validated in previous studies. The data collection and analysis procedures used in this study refer to methodologies that have been published in previous literature, such as those described by [46]–[48] regarding the use of partial least squares structural equation modeling (PLS-SEM) in the context of social and behavioral research. By using this data collection technique, the research is expected to produce valid and reliable findings regarding factors that affect the effectiveness of services in public institutions.

Data analysis technique: data were analyzed using PLS-SEM, which was chosen for its ability to test complex models with multiple latent variables and associated indicators, as well as their ability to handle non-normally distributed data. This approach allows for testing direct and moderating relationships between variables. The data were analyzed using PLS-SEM to test the relationship model between digital literacy, underutilized talents, human error, self-development, and service effectiveness. Moderation testing was conducted to see the role of self-development in moderating the relationship between independent and dependent variables. The steps of data analysis include: i) measurement model testing to ensure the validity and reliability of the construct, and ii) structural model testing to test the research hypothesis regarding the influence of digital literacy, underutilized talent, and human error on service effectiveness with self-development as a moderation variable.

4. RESULTS AND DISCUSSION

4.1. Characteristics of respondents

In this study, the sample used was the SCA of the Trade Office of South Sumatra Province, which amounted to 207 people. These respondents consisted of various demographic categories such as gender, age, working period, formal education, and job title. Male respondents numbered 86 or 42%, female respondents

121 or 58%. Respondents aged 55-60 years were 24 people (11.7%), 31 people aged 45-54 years old (15%), 69 people aged 35-44 years old (33.3%), 43 people aged 30-34 years old (20.7%), and the rest aged <30 years old 40 people (19.3%). Respondents with doctoral education (S3) as many as 1 or 0.5%, respondents with postgraduate education (S2) as many as 76 or 36.8%, respondents with bachelor's education as many as 92 or 44.4%, respondents with a diploma education (D3) as many as 14 or 6.7%, and respondents with high school/vocational education as much as 24 or 11.6%.

4.2. Structural model analysis

Confirmatory factor analysis (CFA) has been conducted to test the measurement model on each indicator in the construct variable. The test results showed that there was no factor loading value of <0.7. The results of the reliability calculation with Composite Reliability on both exogenous and endogenous variables also show that all indicators in all variables have good reliability, so they are valid and can be further analyzed. The results of the measurement model analysis, or CFA, were obtained as shown in Figure 2.

The results of data processing with SmartPLS-4 are shown in Figure 2, where all indicators in each variable in this study are above the required value, which is above 0.7, so that it can be said to be valid. Assessing the significance of the direct influence of the structural model can be seen from the p-value in the path coefficient table. The significance value of the direct influence between exogenous and endogenous is seen in Table 2.

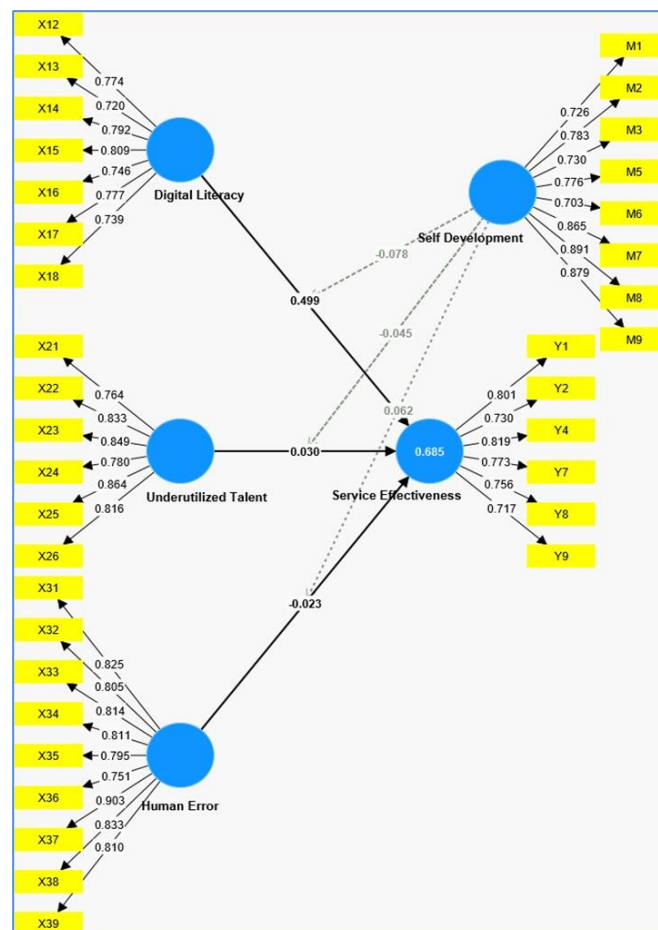


Figure 2. Full models

Table 2. Direct influence

Relationships between variables	Original sample (O)	P values
Digital literacy → Service effectiveness	0.499	0.000
Underutilized talent → Service effectiveness	0.030	0.675
Human error → Service effectiveness	-0.023	0.744
Self-development → Service effectiveness	0.369	0.000

The path coefficient shown in Table 2 can be seen in the values on the original sample. This shows that digital literacy has a positive effect on the human error of the SCA of the Trade Office of South Sumatra Province by 0.499. Underutilized talent has a positive effect on the human error of the SCA of the Trade Office of South Sumatra Province of 0.030. Human error has a negative effect of -0.023 on service effectiveness. Self-development had a positive effect of 0.369 on service effectiveness.

Our analysis revealed several critical insights. Digital literacy positively and significantly influenced public service effectiveness ($\beta=0.499$, $p<0.001$). Self-development also had a substantial positive direct influence ($\beta=0.369$, $p<0.001$). However, underutilized talent and human error did not show significant direct effects ($\beta=0.030$, $p=0.675$ and $\beta=-0.023$, $p=0.744$, respectively). Interestingly, self-development significantly moderated the relationship between digital literacy and service effectiveness ($\beta=0.078$, $p=0.014$), indicating that self-development enhances the benefits of digital literacy on public services. The significance value of the moderating effect between exogenous and endogenous variables is seen in Table 3.

Table 3. The effect of moderation

Relationship between variables	Original sample (O)	P values
Self-development \times Digital literacy \rightarrow Service effectiveness	0.078	0.014
Self-development \times Underutilized talent \rightarrow Service effectiveness	-0.045	0.594
Self-development \times Human error \rightarrow Service effectiveness	0.062	0.454

Based on Table 3 it shows that the moderation between self-development and digital literacy has a significant positive impact on service effectiveness by 0.078. The relationship between self-development moderation and the influence of digital literacy on service effectiveness is positive and significant. This means that self-development strengthens the relationship between digital literacy and service effectiveness. In other words, the higher the digital literacy and self-development of employees, the more effective the services provided. Moderation between self-development and underutilized talent harmed service effectiveness by -0.045. Self-development did not moderate the relationship between underutilized talent and service effectiveness significantly ($p>0.05$). It shows that self-development is not strong enough to affect the impact of underutilized talent on service effectiveness. Moderation between self-development and human error had a positive impact on service effectiveness by 0.062. Self-development also did not moderate the relationship between human error and service effectiveness significantly ($p>0.05$). The influence was found to be positive but not significant, indicating that self-development was not strong enough to reduce the negative impact of human error on service effectiveness.

The findings on digital literacy are consistent with previous research showing that improving digital skills can improve service performance and effectiveness [36]. However, underutilized talent shows a greater negative impact than expected, in line with the findings of [42], which highlights the importance of optimizing individual potential to improve productivity. Although self-development can improve service effectiveness through strengthening digital literacy, the results are insufficient to address the negative influence of human error associated with fatigue or non-compliance with procedures.

Our findings align with prior studies indicating digital literacy's crucial role in enhancing organizational performance and service delivery [20], [36]. Unlike previous research that identified underutilized talent as significantly detrimental to organizational outcomes [42], our results did not confirm a significant impact, suggesting that contextual factors in public institutions might mitigate these effects. Similarly, our findings on human error contrast with earlier research, which typically demonstrated stronger negative implications on service effectiveness [28], [31]. This discrepancy might indicate unique resilience mechanisms or procedural buffers in the public sector studied.

5. DISCUSSION

This study explores the influence of digital literacy, underutilized talent, and human error on public service effectiveness, with self-development as a moderating variable. While many previous studies have focused on digital literacy and service quality improvement in the context of technology, few have examined the relationship between digital literacy, underutilized talent, and human error in the public service sector. This research fills this gap by investigating how these factors influence service effectiveness, particularly in the Indonesian public sector.

Digital literacy is a key component in increasing the effectiveness of services in this digital era. Radovanović *et al.* [36] stated that there is a close relationship between digital literacy variables and service effectiveness. A good level of digital literacy can help improve service effectiveness by ensuring that customers can use the services provided properly, while the use of appropriate digital technology can help

organizations or institutions improve efficiency and better meet customer needs [12], [20], [43], [49]–[51]. Organizations that encourage and support employees in developing digital literacy skills are better able to provide better service to customers and stakeholders.

Underutilized talent, which refers to the inadequate utilization of an individual's skills or talents in the work environment, can have a negative impact on the effectiveness of services [6], [42], [52]. This situation can lead to a decrease in productivity because the maximum potential of the individual is not optimized, hinder innovation because creative ideas are not fully integrated, and cause employee dissatisfaction, which can affect morale and commitment to quality service [53], [54]. What's more, underutilized talent can contribute to a decline in service quality because specialized skills are not fully utilized, creating competency gaps and potential waste of resources. To address these negative impacts, organizations can implement regular talent assessments, employee development programs, and effective talent management practices to ensure optimal utilization of their talent [37], [55].

The relationship between the variable of human error and service effectiveness has a significant impact in various contexts. Human error, especially related to information processing, communication, or task execution, can reduce the quality of service [44]. This kind of error can cause losses to customers and damage the effectiveness of the service. In addition, human error also creates uncertainty and customer anxiety about service reliability [28]. Human error can also be an opportunity for improvement. Organizations can learn from such mistakes and implement necessary changes in processes, training, or oversight to prevent similar mistakes in the future. With education, training, good supervision, and the use of advanced technology, organizations can reduce the risk of human error that can interfere with service effectiveness, while stimulating improvement and innovation [31]. Therefore, careful management of human error variables is an important step to improve service effectiveness [34].

There was a significant moderation effect between self-development and digital literacy on service effectiveness of 0.078 and a p-value of 0.014. Digital literacy has a significant effect on service effectiveness directly by 0.499 with a p-value of 0.000. The self-development variable acts as a quasi-moderator (Pseudo-moderation), meaning that the self-development moderation variable does not change the direction of the relationship between the digital literacy variable and the service effectiveness variable, but only strengthens or weakens the relationship. Self-development can play a crucial role in moderating the influence of underutilized talent on service effectiveness. When individuals have the opportunity to develop skills and talents, this can reduce the negative impact of the underutilization of talents [56], [57]. By improving individual competencies through self-development, being better able to adapt to the tasks given, filling skill gaps, and making maximum contributions in the work environment [5], [58].

Self-development can improve the quality of service by providing individuals with the necessary tools and knowledge to overcome challenges arising from underutilized talent [45], [59]. In addition, when employees feel supported in self-development, this can increase motivation and job satisfaction, reducing the risk of dissatisfaction arising from underutilized talent [60], [61]. It is important to understand how self-development efforts can create an environment where individuals can respond positively to potential underutilized talent [62], [63]. Thus, self-development is not only a step to improve skills but also a moderator variable that can help optimize individual contributions and, ultimately, improve the effectiveness of the ministry as a whole.

The novelty of this study lies in explicitly examining the combined effects of digital literacy, underutilized talent, and human error on public service effectiveness, particularly by introducing self-development as a moderating factor. Previous studies largely examined these variables in isolation without investigating how personal development might alter these relationships. Specifically, this research contributes new insights by empirically demonstrating that self-development significantly moderates the impact of digital literacy on service effectiveness but does not significantly mitigate the impacts of underutilized talent and human error. These nuanced findings provide valuable implications for human resource management strategies in public institutions.

The main findings of this study show that digital literacy has a significant positive influence on service effectiveness. Employees who have higher digital literacy can reduce human error and improve service efficiency. In addition, underutilized talent was found to have a negative influence on service effectiveness, where employees who feel that their skills are not being used optimally tend to provide less than optimal services. Self-development was shown to strengthen the relationship between digital literacy and service effectiveness, although it did not show a significant effect in moderating the effect of underutilized talent or human error on service effectiveness.

The results found in this study are in line with several previous studies, such as those conducted by [36], which showed that digital literacy can improve service effectiveness. However, this study extends the previous findings by showing that underutilized talent can negatively affect service quality, which has not been widely explored in the public context. Furthermore, the findings on self-development are also consistent

with research [57], which indicates that enhancing individual skills can improve performance in public service contexts. However, self-development did not show significant results in moderating the effect of human error, which differs from the findings of several studies that suggest that training and self-development can reduce operational errors [25].

While this research provides useful insights, there are some limitations that need to be noted. The study was conducted on employees of the Trade Office of South Sumatra Province, which may not be fully representative of the entire Indonesian public sector. In addition, the data collected were cross-sectional, which does not allow for causal inferences to be drawn. Future longitudinal data collection may provide a deeper understanding of the dynamics of the relationship between these variables over time. This study focused on the Trade Office of South Sumatra Province, which may not represent the broader Indonesian public sector comprehensively. Furthermore, the cross-sectional nature of the data limits our ability to infer causality conclusively. These limitations highlight the necessity of conducting longitudinal studies and including broader and more diverse samples to enhance generalizability and causal inference.

6. CONCLUSION

Digital literacy had a positive and significant influence on service effectiveness. Employees with a good level of digital literacy tend to be able to carry out their duties more efficiently and accurately, thereby reducing error rates and increasing service user satisfaction. Underutilized talent negatively influences service effectiveness. Employees who feel that their skills and potential are not fully utilized tend to show less than optimal performance, which can hurt the quality of the services provided. Human error negatively influences the effectiveness of services. Employees' mistakes, whether due to lack of attention, fatigue, or other factors, can reduce the efficiency and quality of services provided to the community. Self-development was a moderating variable that strengthened the relationship between digital literacy and service effectiveness. Employees who are active in self-development tend to be better able to utilize digital literacy to improve their performance. However, self-development did not significantly moderate the relationship between underutilized talent and human error in terms of service effectiveness. In conclusion, this research highlights that digital literacy and self-development substantially improve public service effectiveness. While underutilized talent and human error did not significantly impact effectiveness directly, the moderating role of self-development was particularly prominent concerning digital literacy. Thus, enhancing digital competencies through structured self-development programs can significantly improve public service delivery. These results provide definitive proof of the value of integrating digital literacy and employee self-development in public sector human resource strategies.

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C : **C**onceptualization

M : **M**ethodology

So : **S**oftware

Va : **V**alidation

Fo : **F**ormal analysis

I : **I**nvestigation

R : **R**esources

D : **D**ata Curation

O : **O** : Writing - **O**riginal Draft

E : **E** : Writing - Review & **E**editing

Vi : **V**isualization

Su : **S**upervision

P : **P**roject administration

Fu : **F**unding 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.

ETHICAL APPROVAL

The research related to human use has been complied with all the relevant national regulations and institutional policies in accordance with the tenets of the Helsinki Declaration and has been approved by the authors' institutional review board or equivalent committee.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author, [AM], upon reasonable request.

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