



The Impact of Digitalization on Women's Employment Participation in Indonesia: A Binary Logistic Regression Analysis

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Abstract: Women's employment in Indonesia has shown a substantial increase in recent years. Women's participation in the workforce in Indonesia continues to grow, although there is still a significant gap compared to men. This is driven by various factors such as digitalization, increased access to education, and policies that support women's involvement in the world of work. This study aims to identify and analyze the factors that most affect women's participation in the world of work in Indonesia. Using secondary data from the 2023 National Labor Force Survey (Sakernas) with individual observations, the publication of BPS Economic Growth, the website of the Indonesian Digital Society Index, was analyzed using binary logistic regression. The results of the study show that education, work experience, regional classification, and economic growth have a significant positive effect on working women while marital status, job training, and the Indonesian Digital Society Index have a significant negative effect on working women. This research shows the importance of a holistic approach to women's empowerment in the world of work, which includes increasing access to education and training, creating a supportive work environment, and utilizing technology to open up wider job opportunities for Indonesian women.

Keyword: Working Women, Digitization, Sakernas, Binary Logistics Regression.

INTRODUCTION

Women's employment conditions in Indonesia reflect complex social, economic, and political dynamics, where significant transformations in the labor market have occurred in recent decades in tandem with rapid economic growth and widespread urbanization, although major challenges remain, such as fluctuating unemployment rates, gender inequality, and varying quality of work (Siagian, 2022). Although the open unemployment rate was recorded at around 5.9% in 2023, with many unemployed coming from young people and recent graduates who face difficulties in adapting their skills to industry needs (Munawaroh, 2021). The sector that absorbs the largest workforce is still held by the agricultural sector, although its contribution to gross domestic product (GDP) has begun to decline in line with the development of the industrial and service sectors, which are now the main drivers of employment growth in Indonesia (Putra, 2018).

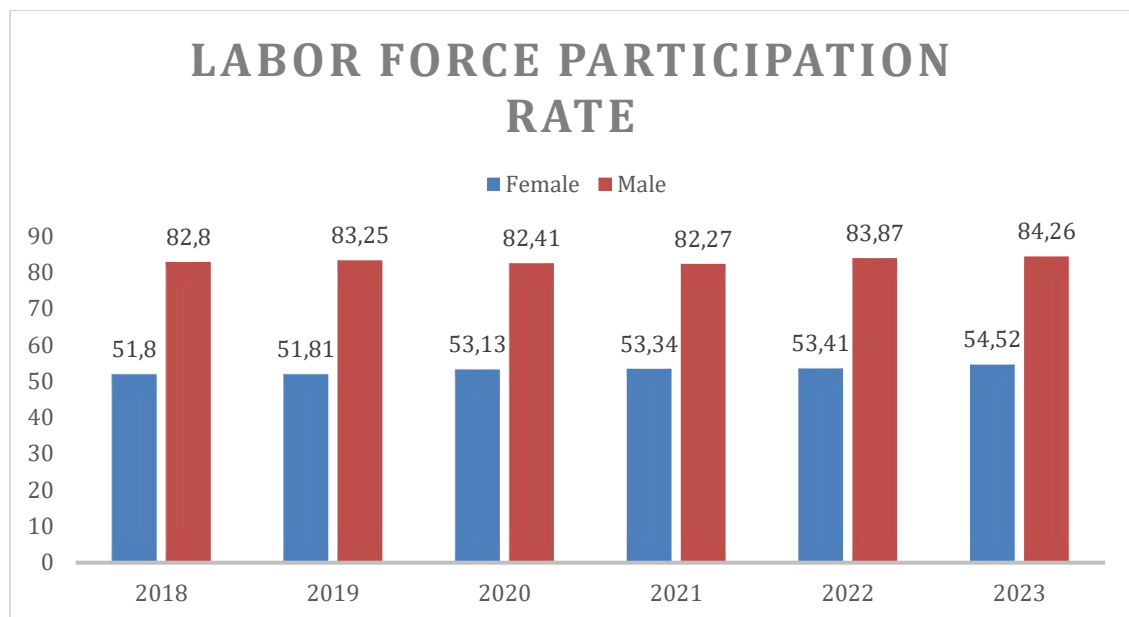


Figure 1. Women's Labor Force Participation Rate (TPAK) in Indonesia in 2023
(Source: BPS 2023 Publication, processed)

Based on Figure 1, the Labor Force Participation Rate (TPAK) of women in Indonesia shows a fluctuating trend but tends to increase during the 2018-2023 period. In 2018, women's TPAK was at a level of around 51.8%, which then increased in 2019. The COVID-19 pandemic in 2020 did not have a significant impact on women's TPAK, which increased to 53.13%. Entering 2021, along with economic recovery and adaptation to the pandemic situation, women's TPAK showed an increasing trend to 53.34%. In 2022, women's TPAK continued to increase to 53.41%, driven by various factors such as digitalization, increased access to education, and policies that support women's involvement in the world of work. Entering 2023, women's TPAK recorded a significant increase to reach 54.52%, showing an improvement in access and opportunities for women to participate in the labor market, although there is still a considerable gap compared to men's TPAK which is in the range of 80%.

Technological developments and digitalization are changing the employment landscape, creating new jobs in the information technology and e-commerce sectors, but also creating challenges for workers who do not have adequate digital skills, so cooperation between the government, the private sector, and civil society is essential to provide relevant training and education (Davani & Sulistyaningrum, 2023). Overall, although Indonesia is showing progress in increasing labor force participation, complex challenges such as education gaps, gender discrimination, and low quality of work must be faced to create a more inclusive and sustainable labor market, and with the right approach, Indonesia has a great opportunity to create fairer and more prosperous labor conditions for all its citizens (Sanjida Nowshin Mou, 2024).

The use of digital technology has become increasingly crucial for women entering the workforce, opening up opportunities for them to achieve success and equality in their careers. Digitalization offers ease of access to relevant information, provides flexibility in managing time and responsibilities, and significantly increases productivity. With digital technology, women can more easily balance the demands of work and family responsibilities, for example through remote work options or more flexible working hours. In addition, digital platforms also provide a means for women to develop new skills, increase their visibility and influence in the profession, and build a wider professional network (Sharma, 2022). This not only encourages women's involvement in the workplace, but also supports their career development more optimally.

The impact of technology on the increase in working women has brought significant changes in the professional world. Technological advances allow women to work more flexibly through remote or hybrid work systems, so they can better balance work and family responsibilities (Cazan, 2020). Development e-commerce And digital platforms have also created new opportunities for women to start and manage their own businesses with less investment. With technology, women can increase their professional visibility through social networks and professional platforms, which helps in building careers and achieving leadership positions (Widiani & Mahfiana, 2023). The positive impact of this technology has driven greater participation of women in the workforce and contributed to the creation of a more inclusive and equitable work environment.

Looking at the dynamics that are happening, it is very important to understand more deeply about the conditions, challenges, and opportunities faced by women workers. In-depth research on these factors can help identify appropriate policy solutions to improve women's well-being in the workforce, while encouraging gender equality across economic sectors (Davani & Sulistyaningrum, 2023). Taking into account these various determinants, this study aims to identify and analyze the factors that most affect women's participation in the world of work in Indonesia. The findings of this study are expected to provide deeper insights into the challenges and opportunities faced by women in the workforce, as well as provide recommendations for more inclusive and effective policies in supporting women's participation in the workforce.

Although women's participation in the labor force in Indonesia has shown an increase over the past few years, previous research has tended to focus more on aspects of education, job training, and marital status as the main factors. However, the role of digitalization in influencing women's participation in the workforce is still rarely analyzed in depth, especially related to its influence in the context of the digital economy and modern employment dynamics. In addition, although digitalization is often referred to as a solution to empower women, the results of this study actually show a significant negative influence of the Indonesian Digital Society Index on the tendency of women to work. This opens up new research spaces on how digital technology can be used in a more inclusive way to empower women in the job market.

This study presents a new perspective by in-depth evaluating the influence of Digitalization on women's participation in the world of work, using the latest national data from the 2023 National Labor Force Survey (Sakernas). Unlike previous studies that generally highlighted the benefits of digital technology for women's empowerment, this study found that digitalization actually has a significant negative impact, exposing potential barriers such as technology access gaps, digital skills mismatches, and automation risks. These findings provide a foundation for formulating a digitalization strategy that is more inclusive and responsive to the needs of women workers.

Through a more comprehensive understanding of the determinants of women workers, it is hoped that this research can contribute to the development of policy strategies that not only increase women's participation in the labor market, but also strengthen gender equality and empower women in various economic sectors.

METHOD

Types, Sources and Techniques of Data Collection

This study uses a quantitative approach that aims to analyze the influence of independent variables on dependent variables. This study uses data sourced from micro data from the National Labor Force Survey (SAKERNAS) conducted by the Central Statistics Agency (BPS) of Indonesia in August 2023 and uses macro data published by BPS in 2023 and the Indonesian Digital Society Index (IMDI) website. This study uses cross section individual data in one survey period. The observations in this study specifically include individuals with

the female gender who are classified as the labor force in Indonesia in 2023 with a total of 207,916 respondents.

Table 1. Research Variables

Variable	Information
Dependent Variable (Bound)	Female gender
	0: Unemployment : Reference (Comparator)
	1 : Work
Independent Variable (Free)	Education
	0 : Low: Reference (Comparison)
	1 : High
	Married Status
	0 : No : Reference (Comparison)
	1 : Mating
	Job Traning
	0 : No : Reference (Comparison)
	1 : Yes
	Job Education
	0: No : Reference (Comparison)
	1 : Yes
	Regional Classification
	0 : Rural : Reference (Comparison)
	1 : Urban
	Economic Growth (EG)
	Numerical Data EG)
	Indonesia Digital Society Index (IMDI)
	Numerical Data IMDI

The variables of the level of education were divided into the categories of higher education (SMA/MA/SMLB/Package C, SMK, MAK, Diploma I/II/II, Diploma IV, S1, S2 and S3) and low education (Not yet completed SD, SD/MI/SDLB/Package A, and SMP/MTs/SMPLB/Package B.) as a comparison category. The marital status variable was divided into married categories (consisting of married, living divorce, and dead divorce) and unmarried as a comparison category. The work experience variable is divided into yes and no categories (comparison categories). Regional classification variables are divided into urban and rural categories (comparison categories). Meanwhile, the economic growth variable and the Indonesian Digital Society Index are numerical variables.

Analysis Model

In this study, the econometric model used is a double binary logistic regression model. Dual binary logistic regression (Multiple binary logistic regression) is a statistical method used to predict binary dependent variables (categorical) with two categories based on one or more independent variables (predictors). This model is a development of simple binary logistic regression, which can handle more than one independent variable. In this model, the goal is to determine the significance of the influence of independent variables simultaneously (together) and partially (individually) on dependent variables, as well as to predict the probability of an event occurring based on the values of the given independent variables (Beacom, 2023).

Binary logistic regression is used when dependent variables have two mutually exclusive categories, such as "yes" or "no", "success" or "failure", "sick" or "healthy". In this model, the dependent variable has a value of 0 or 1, while the independent variable can be a numerical or categorical variable. Binary logistic regression is a form of non-linear regression with bound variables in the form of binary variables, namely variables that only have two values. In addition to binary variables, this model can also use predictor variables that are numerical or categorical. In binary logistic regression models, bound variables that are binary or dichotomous are modeled using binomial distributions. The free variable used in this model is referred to as the covariate variable.

Data processing techniques and regression assumption tests have limitations in data collection, such as the possibility of bias due to uneven digital access between regions. In addition, because this study uses cross-section data in a certain period, the results obtained cannot fully describe the long-term dynamics of women's participation in the workforce, especially in the face of structural economic changes and technological developments.

In binary logistic regression, there are two or more predictor variables that are used together to estimate the probability of an event occurring in a dichotomous dependent variable. These independent variables can be numerical variables, such as age, income, or the number of family members, or they can also be categorical variables, such as gender, marital status, or education level. Because in the binary logistic regression there are more than 1 (k) independent variable or what is called a double binary logistic regression, the logit function used is as follows:

$$\ln(P_i/(1-P_i)) = \beta_0 + \beta_1 \text{ Education} + \beta_2 \text{ MarriedStatus} + \beta_3 \text{ JobTraining} + \beta_4 \text{ JobEducation} + \beta_5 \text{ RegionalClass} + \beta_6 \text{ EconomicGrowth} + \beta_7 \text{ Digitalization}$$

Where:

P_i : Opportunities for women to become workers

$1-P_i$: Opportunities for women to become unemployed

RESULTS AND DISCUSSION

Overview of the Characteristics of Women's Employment Opportunity Levels by Province in Indonesia in 2023

Employment Opportunity Rate (TKK) is a fundamental concept in employment analysis that measures how much an individual has a chance to get a job in a certain region or economic system. This concept is not just a statistical figure, but a reflection of complex socio-economic dynamics and is very meaningful for the development of a region or country. In essence, TKK describes a balance between the number of people who have the ability and desire to work and the availability of existing jobs (Damayanti & Astuti, 2024). Every individual in productive age who meets the physical and mental criteria for work has the right and opportunity to get a job that is decent, dignified, and in accordance with his or her competence. The calculation of the Employment Opportunity Rate is carried out by comparing the number of available job opportunities with the number of existing labor force, then multiplied by one hundred percent. However, these mathematical numbers should not be understood rigidly, but rather should be interpreted in a broader socio-economic context (Setiani Tanjung et al., 2024).

The macroeconomic conditions of a region or country significantly affect the Employment Opportunity Rate. When the economy is growing, investment is growing, and various industrial sectors are expanding, job opportunities will be more and more wide-open. On the other hand, when there is economic stagnation or crisis, employment will be very limited, which has a direct impact on the decline in the Employment Opportunity Rate (Setiani Tanjung et al., 2024). The socio-economic impact of a good Employment Opportunity Rate is significant. Extensive employment opportunities will reduce poverty rates, improve people's welfare, encourage economic growth, and in turn will create conducive social stability. In the context of national development, the Employment Opportunity Rate is not just an economic indicator, but a manifestation of social justice and the fulfillment of citizens' basic rights to live a decent life through dignified work.

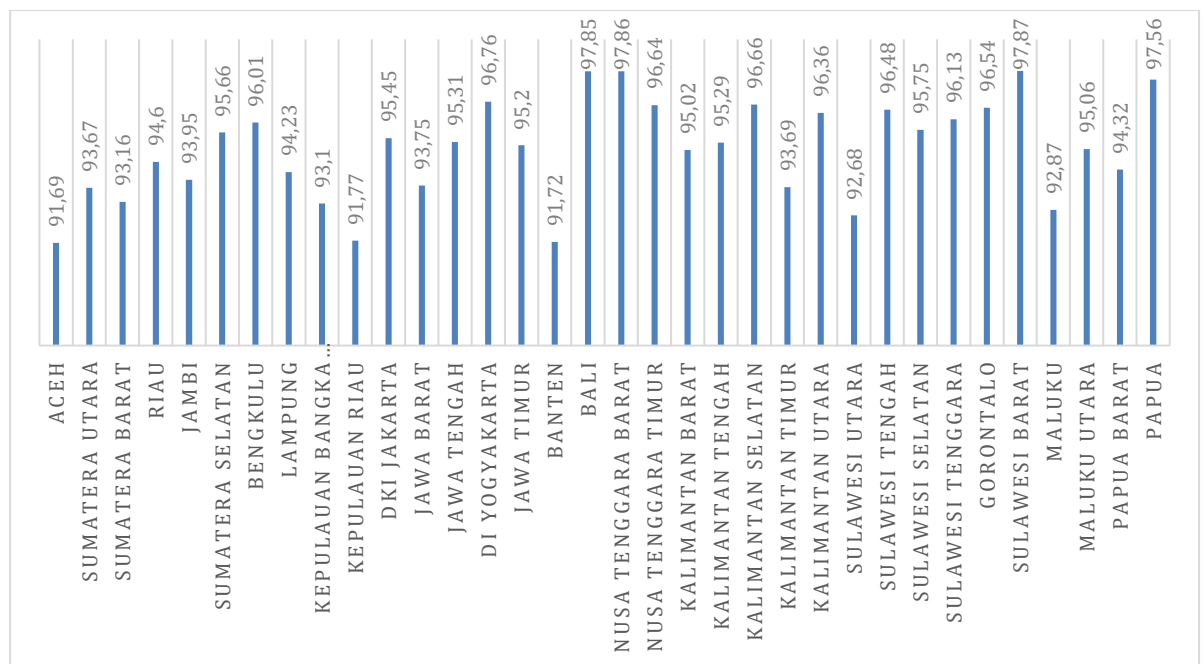


Figure 2. Women's Employment Opportunity Rate (TKK) in Indonesia
(Source: BPS Indonesia Publication 2023, processed)

From Figure 2, it can be seen that there is a variation in the level of women's work participation in various provinces in Indonesia. In general, women's employment opportunities are relatively high across most regions, indicating that women have significant opportunities to participate in the labour market. However, there are stark differences in some provinces, with provinces such as Aceh and West Papua recording lower levels than the national average, while other provinces such as Papua and some areas in Kalimantan tend to have higher rates. This can reflect a variety of factors, including differences in education levels, access to employment, local culture, and regional policies that affect women's participation in the workforce.

Table 2. Results of Estimation of Regression Coefficient and Significance of Independent Variables to Dependent Variables

	Variable	Coefficient	Significance	Odds Ratio
Step 1a	Indonesia Digital Society Index	-0.018***	.000	0.982
	Economic Growth	0.001***	.000	1.001
	Education (Higher)	0.608***	.000	1.836
	Marital Status (Married)	-1.914***	.000	0.148
	Job Training (Ever)	-0.373***	.000	0.689
	Work Experience (Yes)	0.110***	.000	1.117
	Regional Classification (Urban)	0.280***	.000	1.323
	Constant	4.435	.000	84.350

Source : SAKERNAS 2023, processed

Remarks: ***Significant at the level of 1%

**Significant at 5%

*Significant at 10%

Trends of Variables Affecting Women's Work Participation

Digital technology brings opportunities and challenges for women in the world of work. Digitalization improves job access and skills development, but it also deepens the gender gap

due to barriers to access to technology, education, and training. In addition, job automation often replaces the role of women in certain sectors, especially those who are vulnerable to technology. In table 2 above, the Digitization variable is obtained odds ratio by 0.982. Digitalisasi has a significant negative trend. This means that if the use of technology in daily life increases by 0.9%, it will reduce the tendency of women to work in Indonesia. This is in line with research (Rimkute & Sugiharti, 2023), the use of technology can have a negative impact on working women due to the potential for increased gender inequality in the world of work, especially in terms of access to technology, digital skills, and job opportunities. Although digitalization opens up new opportunities, not all women have the same opportunity to access technology education or training due to pre-existing social, economic, and cultural barriers. This inequality can make women lag behind men in taking advantage of the benefits of digitalization, such as technology-based jobs that generally have higher wages. Moreover This research is in line with (Widyawati & Suhermin, 2024), jobs that are often performed by women, such as in the administrative or manufacturing sectors, tend to be more vulnerable to automation, thus increasing the risk of losing their jobs. Digital transformation in the formal sector also demands higher technical and digital skills, but women often face barriers to accessing relevant training, education, or career development due to gender stereotypes, unbalanced domestic responsibilities, or less inclusive corporate policies. This inequality makes it difficult for women to compete in an increasingly technology-based job market.

The phenomenon of digital transformation in the context of informal employment has a significant impact on the socio-economic dynamics of women, especially those in the informal sector. Digital technology, through various online platforms and modern communication instruments, has provided a strategic alternative for women informal workers to explore their economic potential (Adi Rakhmawan, 2022). Digital instruments such as social media, marketplace applications, and online communication platforms allow them to transcend geographical, social, and cultural boundaries that have limited their economic mobility. For example, a woman who lives in a rural area can develop a handicraft business, food products, or creative services through digital platforms without having to face mobility constraints and the limitations of conventional market networks.

The psychological and social aspects of the use of technology for informal women workers are also very significant. Technology is not only an economic tool, but also a medium to build confidence, express creativity, and build a network of solidarity with fellow working women. Through digital platforms, they can share experiences, gain support, and create an empowerment ecosystem that transcends traditional geographical and social boundaries. In a broader context, the relationship between technology and informal women workers reflects a complex process of socio-economic transformation. Technology plays a role as a driver of change, opening up opportunities while challenging the entrenched structure of inequality, with the potential to encourage gender equality and women's economic empowerment in a more comprehensive manner (Danquah & Owusu, 2021).

In addition, economic growth also has an important role in encouraging women's participation in the world of work. Improved economic conditions create more job opportunities, increase incomes, and change people's perception of women's roles, thus supporting their participation in the labor market. It can be seen in table 2, the economic growth variables obtained odds ratio by 1. Economic growth has a significant positive trend. This means that the economic growth will increase by 1%, which will increase the tendency of women to work in Indonesia. The relationship between economic growth and women's participation in the workforce is closely related and mutually influencing. This is in line with research (NorehanBt Abdullah, Abdul Razak Chik, 2021), Positive economic growth creates more jobs and business opportunities, thus opening up wider opportunities for women to participate in the job market. In addition, this research is in line with (Ouaïmon & Zhang, 2019) As the economy grows, the industrial and service sectors experience an expansion that drives

demand for labor, including female workers. This creates a wide range of job options with better income levels, allowing women to contribute significantly to the economy. In addition, economic growth is often followed by modernization of people's perspectives on gender roles. The community has become more open to the concept of working women, which in turn supports increased women's participation in the workforce.

Furthermore, higher education plays an important role in increasing women's participation in the world of work. With better education, women have a greater chance of getting decent jobs, overcoming socioeconomic barriers, and contributing significantly to economic development. As can be seen in table 2, higher education has a significant positive influence on becoming a working woman, with odds ratio of 1,836. This means that women with higher education tend to be 1.8 times more working women compared to women with low education. Education significantly increases women's participation in the workforce, allowing them to overcome socioeconomic barriers and engage in various sectors, especially in urban areas, while rural women remain largely in agriculture. The relationship between education and working women has a significant influence on various aspects of life. This is in line with research (ŞAHİN, 2023), Education is the main capital for women to enter the world of work because it provides the knowledge, skills, and competencies needed in work. The higher the level of education that women have, the greater their chances of getting a job with a better position and salary. In addition, this research is in line with (Sanjida Nowshin Mou, 2024), Educated women are also better able to manage their dual roles effectively, both as workers and in carrying out domestic responsibilities. Furthermore, women's education has a positive impact on economic development through increased work participation and contribution to economic growth.

Then, marital status is an important factor that affects women's participation in the world of work, especially because domestic roles are often the main responsibility of women after marriage. As can be seen in table 2, Married status (married, divorced alive, and divorced dead) has a significant negative influence on being a working woman, with odds ratio by 0.148. This means that married women tend to be working women 0.1 times less than unmarried women. This is in line with research (Tsaniyah & Sugiharti, 2021), marital status has a negative influence on women's participation in the world of work because after marriage, women are often faced with social and cultural expectations that place them as the main responsible persons in household affairs and childcare, where this dual responsibility can create a significant time and energy conflict between their domestic and professional roles. In addition, this research is in line with (Yeni et al., 2022), Economic factors Households can also influence women's decision to marry into work, where if the husband's income is considered sufficient to meet the needs of the family, some women may choose or feel compelled to focus on their domestic roles, especially in societies that still hold traditional values about the division of gender roles in the household.

Furthermore, job training has become an important topic in the context of increasing women's participation in the job market. However, although job training designed to empower women can be seen in table 2, job training has a significant negative influence on becoming a working woman, with odds ratio by 0.689. This means that women who have participated in job training tend to be 0.6 times smaller working women compared to women who have never participated in job training. This is in line with research (Rimkute & Sugiharti, 2023), the phenomenon of job training that has a negative effect on women's participation in the workforce can occur due to the complexity of the gap between the design of training programs and the actual reality of the job market, where the curriculum that is prepared often does not fully consider the dynamics of industry needs that continue to change rapidly. In addition, this research is in line with (Farida & Sopiah, 2022), Misalignment Between training materials and the demands of modern technology and industrial innovation can result in women trainees

acquiring outdated skills, so that when they try to enter the job market, their competencies are no longer relevant to the actual needs of the company which is always changing rapidly.

Then, work experience is a key factor that contributes to women's success in the world of work. In this context, it is important to understand how work experience can affect women's participation and career quality. As can be seen in table 2, Work experience has a significant positive influence on being a working woman, with odds ratio amounted to 1,117. This means that women who have work experience tend to be 1.1 times more likely to be working women than women who do not have work experience. The relationship of work experience to working women has a very important role in determining the quality and success of their careers. This is in line with research (Prihartanti, 2024), Work experience is a valuable asset that provides a competitive advantage for women in the world of work, where the more experience they have, the higher their value and ability in the eyes of employers. In addition, this research is in line with (ŞAHİN, 2023), Women with adequate work experience tend to have a better understanding of the dynamics of the world of work, organizational culture, and how to overcome various challenges at work. Women who have a good track record in previous work experience have a greater chance of being promoted or getting a better job offer.

Furthermore, the classification of the area of residence plays an important role in determining women's participation in the world of work. Women living in urban areas often have better access to employment opportunities compared to their counterparts living in rural areas. As can be seen in table 2, the classification of urban areas has a significant positive influence on becoming a working woman, with odds ratio amounted to 1,323. This means that women living in urban areas tend to be 1.3 times more working women than women living in rural areas. The relationship between urban area classification and women's participation in the workforce shows a significant influence in determining employment opportunities and patterns. This is in line with research (Vakulabharanam et al., 2020), Urban areas offer more formal employment opportunities for women with a wider selection of industrial, trade, and service sectors than rural areas. The characteristics of urban areas that have more advanced infrastructure, such as public transportation, communication technology, and other supporting facilities, provide easy access for women to work. In addition, this research is in line with (Carrera & Castellaneta, 2023), Urban offers a more social environment open to the concept of working women, with a more modern view of gender roles. This creates a more supportive atmosphere for women to develop their professional careers.

CONCLUSION

This study highlights the role of digitalization in women's labor participation in Indonesia. The results show that, while digitalization has great potential to increase access to jobs, career opportunities, and new skills, the reality is that it has a significant negative impact on women's participation. This is due to a variety of factors, including women's lack of access to adequate digital training, strong gender stereotypes, and unbalanced domestic responsibilities, which limit their ability to compete in a technology-based job market. In addition, corporate policies that are not inclusive, especially in supporting the development of women's digital skills, further exacerbate this inequality. In the formal sector, digitalization often narrows women's opportunities because the increased demand for high technical and digital skills is not matched by equal access to training. Many women are stuck in positions with a high degree of automation, which makes them vulnerable to labor reductions. Meanwhile, in the informal sector, although digital technology provides a platform to increase women's economic potential, barriers such as lack of digital literacy, limited infrastructure, and discrimination in access to modern technology remain significant obstacles.

Based on the results of the study, it can be concluded that women's participation in the world of work is influenced in a complex way by various social, economic, and demographic factors that are interrelated, where the level of higher education is proven to have a significant

positive influence because it provides qualifications, knowledge, and skills that increase women's competitiveness in the job market, while job training also contributes positively because it shows credibility and proven abilities in a professional environment. The classification of urban areas exerts a significant positive influence as it offers more job opportunities, better infrastructure, and an environment that is more supportive of women's participation in the formal economy, supported by economic growth that creates new jobs and increases overall labor demand. However, on the other hand, marital status has a significant negative influence, likely due to the social expectations and dual responsibilities that married women face in balancing their domestic and professional roles. Interestingly, previous work experiences have shown significant negative influences, which may reflect gaps in skills or mismatches between past experiences and current job market demands, while the use of technology also has significant negative impacts that may be caused by the digital divide, lack of access to relevant technology training, or perhaps due to automation replacing jobs that are Traditional is mostly filled by women.

The results also highlight the need for special attention to the development of programs that can help women adapt to the demands of modern technology and transform previous work experiences into assets relevant to the needs of today's job market, as well as the importance of creating a more supportive work environment for married women through policies that allow for a better balance between family and career responsibilities. These findings indicate that women's participation in the workforce in Indonesia is influenced by complex and interrelated factors, including individual aspects (education, marital status, age, experience), institutional (job training), structural (regional classification), and macroeconomic (economic growth and digitalization). The results of this study can be a reference for policymakers in designing more effective programs and policies to increase women's participation in the job market. Efforts to increase women's work participation need to consider all of these determinants comprehensively to achieve optimal and sustainable results. This research also shows the importance of a holistic approach to women's empowerment in the world of work, which includes increasing access to education and training, creating a supportive work environment, and utilizing technology to open up wider job opportunities for Indonesian women.

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