GENDER DISPARITIES IN TECHNOLOGICAL PROFICIENCY AMONG WOMEN ONLINE WORKERS IN THE DIGITAL ECONOMY ERA

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Abstract

This research examines the themes of women's digital literacy within the evolving digital economy. Digital literacy includes the ability to operate technological devices, critical understanding on information, and the use digital media safely and effectively. The literacy is one of the crucial keys to succeed in the competitive market, particularly for online women workers. This literature study employs descriptive analysis from a feminist political economy perspective that analyzes how power relations, social structures, and the economy shape gender inequality in the context of work and technology. This analysis explores the technology gap among women online workers, focusing on challenges, opportunities, and skills gaps. The findings indicate that in the era of the digital economy, technological proficiency is one of the keys to enhance women's livelihood. Nevertheless, women tend to possess lower technological skills than men. Several factors contribute to this gap, including socio-cultural structures, gender-biased technology, and limited access to education. It is essential to implement appropriate policies and initiatives to improve women's digital literacy, so, we can empower women to compete in the digital economy.

Keywords: Digital economy, Digital divide, Digital literacy, Gender-biased technology.

Abstrak

Penelitian ini mengeksplorasi tema-tema literasi digital perempuan dalam konteks ekonomi digital yang terus berkembang. Literasi digital mencakup kemampuan mengoperasikan perangkat teknologi, pemahaman kritis terhadap informasi dan penggunaan media digital secara aman dan efektif. Literasi ini menjadi salah satu kunci penting untuk memenangkan persaingan di pasar bagi para pelaku ekonomi, termasuk bagi perempuan pekerja daring. Studi literatur ini menggunakan analisis deskriptif dengan perspektif politik ekonomi feminis yang menganalisis bagaimana hubungan kekuasaan, struktur sosial, dan ekonomi membentuk ketidaksetaraan gender dalam konteks pekerjaan dan teknologi. Analisis ini mengeksplorasi adanya kesenjangan penguasaan teknologi pada perempuan pekerja daring, dengan berfokus pada tantangan, peluang, dan kesenjangan keterampilan. Studi ini menunjukkan di era ekonomi digital, kecakapan teknologi menjadi salah satu kunci meningkatkan kesejahteraan perempuan. Namun, perempuan cenderung memiliki keterampilan teknologi yang lebih rendah dari laki-laki akibat struktur sosial budaya, teknologi bias gender, dan akses terhadap pendidikan. Kebijakan dan inisiatif untuk mendukung peningkatan literasi digital di kalangan perempuan pekerja daring perlu terus didorong agar perempuan mampu bersaing.

Kata Kunci: Ekonomi digital, Kesenjangan digital, Literasi Digital, Teknologi bias gender

Introduction

Recent technological developments have seen a marked acceleration over the past two decades. The internet has become an integral part of people's daily lives in the modern era, particularly for those residing in major cities. A survey conducted by the Indonesian Internet Service Providers Association (APJII) in early 2024 revealed that the number of internet users in Indonesia reached 221,563,479, constituting 79.5% of the total population of 278,696,200 Indonesians in 2023.When analysed based on gender, the survey findings indicated that men constituted 50.7% of internet users, while women constituted 49.1%.

The survey results indicate an internet penetration rate of 79.5% in Indonesia, marking a 1.4% increase compared to the previous period. However, the rapid increase in the proportion of internet users in recent years has not been correlated with GDP growth. The high digital divide in Indonesia is identified as a contributing factor, as it results in an internet user proportion that remains below 50%[1].

The internet has become an integral part of people's daily lives, not only for socialising and finding information, but also for work and shopping. The internet-based economy has had a significant impact on global development, including in Indonesia[2]. In accordance with forecasts made by Google, Temasek, and Brian & Company (2019), Indonesia has the potential to become a digital economic giant in Southeast Asia by 2025[3]. UK-based research organisation, Merchant Machine, released a list of the ten countries with the fastest e-commerce growth in the world. In the list, Indonesia leads with a growth rate of 78% in 2018 (Fransiska and Paramita, 2020)[4]. A study by Bachtiar (2020) suggests that, despite the encouraging outlook, a digital divide persists across various aspects, including gender disparities in internet usage. The study indicates that women utilise the internet less frequently than men. This disparity is further compounded by the fact that women generally have lower levels of education and welfare compared to men.

However, the internet's role as an economic tool is still underutilised. While it is primarily used for social media (87%), entertainment (62%), and news or information (70%), its potential as a conduit for expanding businesses and generating income remains untapped. The adoption of the internet for economic activities, such as e-commerce (13%), selling goods (5%), and digital banking services (6.5%), remains limited. This indicates a need for greater digital literacy, as the internet has not been widely utilised for economic purposes or to improve welfare[5].

According to Ferro, Helbig, and Gil-Garcia (2006) cited by Bachtiar (2020), the digital divide is not only about 'who can access the internet', but also 'what someone can do or achieve with internet access'. This gap has evolved into a more complex issue, including aspects of digital inclusion. This evolution signifies that beyond the mere accessibility of internet resources, there is an emphasis on their effective and productive utilisation. As the scope of this issue broadens, the digital divide is emerging as a significant concern for public policy. It is essential that the government recognises the genuine consequences of this discrepancy and prioritises strategies to enhance societal well-being. Ensuring access to and the ability to utilise digital technology is key to creating a more inclusive and prosperous society, where everyone can maximise the potential of technology in various aspects of life.

[1] Palmira Permata Bachtiar, Rendy Adriyan Diningrat, Ahmad Zuhdi Dwi Kusuma, and Ridho Al Izzati, *Ekonomi Digital untuk Siapa? Menuju Ekonomi Digital yang Inklusif di Indonesia* (Jakarta: SMERU Research Institute, 2020), Cetakan Pertama.

[2] Bachtiar, et al.

[3] Bachtiar, et al.

[4] Vinia Fransiska and Sinta Paramita, 'Live Shopping dalam Industri Komunikasi Digital melalui Instagram', *Prologia*, 4.1 (2020), 67-74.

[5] Bachtiar, et al.

The digital economy shows great promise for the future. Indonesia's economic growth is projected to be driven by the development of digital technology, and the need for labour in this sector is predicted to increase. This opens up opportunities for both men and women to participate as digital economy actors, for the welfare of their personal and family livelihoods. Klasen and Lamanna (in Nabiel, 2021) argue that economic growth is influenced by the impact of gender inequality in education and employment[6]. It is vital to ensure equal opportunities for men and women to engage in digital economic activities. Working women have a role to strengthen the family economy[7].

However, technological advancements can also lead to labour displacement due to machine replacement. According to Rani et al (2022) in Women, Work, and the Digital Economy, the impact of digital innovation on labour replacement varies by occupation and task, but women tend to be in more vulnerable jobs due to gender inequality in the labour market, including their underrepresentation in STEM (Science, Technology, Engineering, and Mathematics) fields[8].

However, digital technology is increasingly regarded as a means of promoting economic empowerment for women in developing countries. Furthermore, the influence of deeply entrenched social constructions regarding traditional gender roles, where women typically assume domestic responsibilities while men are employed outside the home, has led to the emergence of the concept of remote working in the digital economy as a potential solution for women who also support their families. It should be noted that a significant number of women opt to work close to home, despite the comparatively modest income.

Research in the journal Spatial Entrapment of Women Workers in Metropolitan Areas indicates that women's reluctance to commute is associated with their role as mothers. The presence of children in the household has a negative impact on women's income from commuting and reduces their labour mobility, but not that of men (Halimah and Chotib, 2020).The number of children has a significant impact on the feasibility of working from home, with more children making remote work a more attractive option for women. Professions that permit remote working, such as live shopping host, virtual assistant, content creator and seller, are prime examples. However, it should be noted that working online demands special skills in the use of technological devices, including the proper operation of certain software or applications.

Research conducted by Fauzi et al. (2020) has shown that financial literacy and digital literacy have a significant and positive influence on the growth of MSMEs, especially when women manage the business. According to Potter (2005), digital literacy is defined as an individual's interest, attitude and ability to use digital technology and communication tools to access, manage, integrate, analyse and evaluate information, build new knowledge, create and communicate with others in order to participate effectively in society.

This article employs a literature review approach, which involves the identification, evaluation and synthesis of empirical studies from published and open-access journal articles. It also discusses the dynamics of digital literacy issues in relation to the digital economy and online women workers.

In today's digital economy, a new labour market has emerged, known as the digital labour market, where individuals are employed using internet-based platforms[9]. Melián-González

[6] M. Nabiel, 'The Effect of Gender Equality on Economic Growth in West Sumatera 2017-2020', *HUMANISMA: Journal of Gender Studies*, 5.2 (2021), 193-205.

[7] Roman Rezki Utama and Roslinwati Roslinwati, 'Kaili Women in Strengthening the Family Economy', *HUMANISMA: Journal of Gender Studies*, 7.2 (2023), 196-205.

[8] Uma Rani, Ruth Castel-Branco, Shivani Satija, and Mahima Nayar, 'Women, Work, and the Digital Economy', *Gender & Development*, 30.3 (2022), 421-435.

[9] Santiago Melián-González, 'The Impact of Digital Technology on Work' SSRN (2019)

(2019) also references several studies that reveal the existence of the term 'online' or 'virtual' labour in the digital labour market, which includes work carried out remotely. In this article, the term 'online female workers' refers to women who carry out their work using internet-based technology.

A literature search was conducted within the publication timeframe of the last ten years using the Scopus and Google Scholar databases. The reference lists from a selection of empirical studies and systematic reviews were evaluated to identify additional relevant articles. The keywords used in this literature search were a combination of the phrases 'digital literacy'; 'technology'; 'women workers'; 'digital divide'; and 'digital economy'; in both English and Bahasa Indonesia. The Indonesian keywords were applied to the Google Scholar database to identify research literature conducted in Indonesia and written in the Indonesian language. The selection of relevant articles was conducted to explore the dynamics of technology mastery among female online workers in the digital economy. The selected literature was then analysed using a content analysis method to identify themes, patterns and gaps in the existing literature.

This study employs a feminist political economy theory perspective to synthesise and categorise findings on the gender gap in the digital economy related to technological mastery or digital literacy. This perspective helps to understand how economic structures and patriarchal forces contribute to the inequality of access and digital literacy for women online workers. A feminist theoretical framework is essential for identifying relevant articles, as it enables a more detailed analysis of gender inequality dynamics within the digital economy and digital literacy for women online workers.

Theoretical models of feminist political economy include a gender perspective, incorporating women's experiences within the context of economic activity. In their article, Yu and Cui (2019) assert the significance of gender as a crucial dimension when analysing the moral imperative of the political economy approach. While gender is often synonymous with 'woman', it should be regarded as an analytical tool and category for examining power relations and hierarchies within economic production and social reproduction[10].

In Feminist Reflections on Political Economy (1989), Dorothy E. Smith asserts that traditional political economy operates on the assumption of a gender-neutral concept, yet in reality, it exhibits bias, disregarding the contributions and experiences of women within the economic domain. Capitalism has had a significant impact on this dynamic. Dorothy revealed that capitalism has broken the previously integral production and reproduction. In pre-capitalist times there was no separation between 'production' and 'reproduction'. Prior capitalism was characterised by a seamless integration of these two aspects. In the pre-capitalist era, the production of food, shelter, tools and so on was directly linked to livelihoods and the nurturing of children for those engaged in production. However, the capitalist era has seen the breakdown of this direct link between production, producers and reproduction, with capitalist production activities driven by money and commodities. In a traditional political economy, the dimensions of domestic labour and childcare become invisible[11].

The marginalisation of women in traditional political economy discourse is not only due to sexism, but also as an effect of how the discourse is built on textual accounting, the way knowledge economies and practices have been shaped by focusing on what is deemed relevant for 'mainstream business'[12]. As Therborn implies in Smith (1989), the absence of women is naturally

[10] Haiqing Yu and Lili Cui, 'China's E-Commerce: Empowering Rural Women?', *The China Quarterly*, 238 (2019), 418-437.

[11] Dorothy E. Smith, 'Feminist Reflections on Political Economy', *Studies in Political Economy*, 30.1 (1989), 37-59.

[12] (Smith, 1989)

linked to male dominance over working-class organisations. In order to understand economic problems as a whole, Smith suggests that we need to study women's experiences in depth. The production of knowledge for women and the transformation of academic discourse can be a tool for political action and social change[13].

A feminist political economy approach examines the interrelationships between components of structural hierarchies and stratifications, such as class and age/generation, as well as gender. It encourages a focus on the legitimacy of women's representation and inclusion in socio-economic activities and the effect this has on changes in economic opportunities[14].

Achieving gender equality in the digital world is a shared responsibility of policymakers, technology companies and society as a whole. Addressing this inequality requires a collaborative effort to ensure equal access to technology tools and opportunities for women to acquire digital skills that are relevant and adaptable in the face of rapid technological development. Community and family participation is also crucial in supporting women's engagement with technology. By fostering an environment that is conducive to growth and empowering women, we can unlock their potential and maximise their contributions to the expanding digital economy. This is not merely about ensuring equal opportunity, but also about leveraging the full potential that can benefit all social and economic sectors.

This article will map the studies that have been conducted on women workers' digital literacy in the context of the growing digital economy and its relation to women's livelihoods.

Result and Discussion

A comprehensive review of the existing literature on the subject reveals that the study findings can be categorised into several themes, including the technology mastery gap experienced by women, the factors causing the digital divide, and its impact on women's economic lives.This gap includes limited access to technological tools, low digital literacy, and cultural norms that limit women's role in technology.

This article also examines the digital training required for women to compete in the digital economy, including skills relevant to modern labour market needs, as well as exploring potential solutions that could reduce the barriers encountered by women. These include gender-based training and policies that support greater equal access. By categorising these various aspects, this paper aims to provide a deeper understanding of the importance of creating an inclusive and gender-equitable online work ecosystem, where women can access equal opportunities in an ever-evolving digital world.

Disparity in Technological Proficiency

Nielsen and Makpor's (2021) research indicates that, to date, the academic literature on the digital gender divide has predominantly focused on global and national contexts. According to the aforementioned scholars, the digital gender divide emerges from a combination of three factors: limited technical skills, restricted physical access to technology, and social inequalities[15]. It is also known that entrepreneurs who use technology in production are predominantly male, with a composition of 77.9% men versus 22.1% women[16].

The digital divide between men and women is characterised by a lack of parity in the utilisation

[13] (Smith, 1989)

[14] (Yu and Cui, 2019)

[15] Morten Meyerhoff Nielsen and Mercy Erhi Makpor, 'Digital Inclusion and Gender-Associated Indicators: A Critical Review of Post-2010 Literature', in *Proceedings of the 14th International Conference on Theory and Practice of Electronic Governance*, pp. 123-128 (2021).

[16] Fitriya Fauzi, Darius Antoni, and Emi Suwarni, 'Mapping Potential Sectors Based on Financial and Digital Literacy of Women Entrepreneurs: A Study of the Developing Economy', *Journal of Governance and Regulation*, 10.2 (2021).

of technology itself, with numerous interconnected factors contributing to this disparity. A study by Widyastuti et al. (2016) examined the digital literacy among women-owned Micro, Small Medium Enterprise (MSME) in Yogyakarta, revealing that over half of the respondents lacked access to fundamental digital media facilities, such as computers, and consequently, lacked proficiency in their operation. This disparity in access is a significant contributing factor to the gender gap in technological literacy. However, with adequate capabilities, opportunities for economic advancement, particularly in accessing global markets, become more prevalent. Mastery of internet technology facilitates easier access to these markets. Digital literacy programmes for MSMEs have been shown to have a dual impact: they not only enhance cognitive skills but also equip participants with the necessary skills to utilise digital media for the development of their businesses[17]. Addressing the gender digital divide is critical as mastery of mobile technologies including digital financial services drives the achievement of gender equality and sustainable and inclusive economic growth (OECD 2017, 2018).

The lack of access to technology can be attributed to a number of factors, including a limited understanding of its importance and a societal attitude that views women's work outside the home as secondary to that of their male partners. This perspective often results in women's contributions being viewed as supplementary to their husbands' income, rather than as a valuable contribution to the household. This mindset is further compounded by a lack of initiative and a reluctance to pursue initiatives that could enhance access and expand women's knowledge. Despite the increased accessibility of technology in some regions, its utilisation remains suboptimal. The utilisation of social media and messaging applications remains predominantly for entertainment and leisure, with little evidence of these platforms being employed to promote the growth of productive activities, such as handicrafts[18]. Intararat's study of homeworkers in Thailand found similar findings. For women homeworkers, the technology they use, such as mobile phones, is more often used for verbal communication than business purposes[19].

Women's reluctance to use technology is partly due to their lack of confidence in doing so. Concerns about making costly and potentially embarrassing errors when operating devices frequently arise. Common obstacles encountered by parents include poor coordination between eye and hand movements, inadequate manual dexterity training, and difficulty in adapting to rapidly evolving technological advances[20]. The need for simple and easy-to-use software including technology that helps overcome the language barrier in running a business is important for women[21].

A study by Sambasivan et al. (2019) in Google Research, entitled 'Toward Gender Equity: Research with the Next Billion Users', revealed that women have restricted access to the internet due to their traditional gender roles, and that this issue is further compounded by time constraints, as most women already dedicate a significant portion of their day to childcare and domestic duties. Research conducted in seven countries demonstrates that women allocate an average of 3.8 hours per day to household chores, which is significantly higher than the 1.5 hours per day

[17] Dhyah Ayu Retno Widyastuti, Ranggabumi Nuswantoro, and Thomas Adi Purnomo Sidhi, 'Literasi Digital pada Perempuan Pelaku Usaha Produktif di Daerah Istimewa Yogyakarta', *Jurnal Aspikom*, 3.1 (2016), 1-15.

[18] (Widyastuti, et al.., 2016)

[19] Kamolrat Intaratat, 'Women Homeworkers in Thailand's Digital Economy', *Journal of International Women's Studies*, 18.1 (2016), 87-103.

[20] Rita L. Rosenthal, 'Older Computer-Literate Women: Their Motivations, Obstacles, and Paths to Success', *Educational Gerontology*, 34.7 (2008), 610-626.

[21] (Intaratat, 2016)

spent by men on the same activities[22]. Women from all social classes are typically responsible for household chores and childcare, even after devoting significant portions of their days to professional activities, both inside and outside the home. In low-income brackets, these activities are often driven by financial necessity. Conversely, in higher income brackets, the employment of domestic servants, such as housemaids, is more prevalent[23].

The digital age opens up new economic opportunities for anyone with creativity and the ability to use software, such as video editing apps, to pursue a career as a content creator. This profession has become one of the most promising sources of income as various social media platforms, such as Instagram, YouTube and TikTok, provide ample space for those who want to explore their creativity and showcase fresh ideas through content sharing.

The rise of social media platforms has facilitated the emergence of new celebrities from the general public, characterised by their distinctiveness and uniqueness. The advent of these platforms has also introduced a high level of creativity and technological expertise, particularly in the domain of software operation, which has become a prerequisite for achieving popularity and generating substantial revenue through advertising offers, brand collaborations, and the monetisation of content.

However, women encounter further barriers when seeking to achieve a better livelihood through online professions. Despite advances in technology and the increased accessibility of the internet, there remains a pervasive feeling of discomfort and unease amongst female users when expressing themselves or creating content. Research undertaken by Google has revealed that while women may have equal or greater access to internet content, they still feel reluctant to produce it. This phenomenon can be observed even in countries where internet access is relatively equal between genders, such as Mexico and Brazil[24]. This reluctance to engage in content creation online is a significant factor that limits their participation in digital spaces, resulting in their reduced visibility compared to their male counterparts. The factors contributing to this discomfort are multifaceted, including security threats, gender-based violence online, and a lack of support for women seeking to express themselves freely[25].

The perception of risk has been identified as a significant barrier that limits women's participation in the utilisation of technology for business operations. This concern is not exclusive to the field of technology, but is also evident in various digital professions, including online massage services. The perceived risks associated with direct customer interaction and the perceived insecurity of digital platforms have been identified as factors that deter women from actively engaging in these professions. Additionally, the limited awareness of effective risk mitigation strategies further exacerbates this barrier, perpetuating a cycle of exclusion[26]. A significant number of women are not fully versed in the methods of conducting transactions securely and utilising security features on digital platforms to ensure their own protection. In such cases, the provision of education on risk management is imperative to cultivate a sense of security among women when operating within the digital domain. By acquiring a more profound understanding of how to utilise technology safely and responsibly, women can enhance their confidence in pursuing economic opportunities in the digital age, thereby mitigating excessive fear.

In the contemporary digital era, which offers considerable economic opportunities, it is essential to address these challenges so that women feel secure and confident to work, create, and

[22] Nithya Sambasivan, Garen Checkley, and Taylor Marable, *Toward Gender Equity Online: Research with the Next Billion Users* (2019).

[23] (Sambasivan, et al.., 2019)

[24] (Sambasivan, et al.., 2019)

[25] (Sambasivan, et al.., 2019)

[26] (Bachtiar, et al.., 2020)

participate in the growing digital world. Research conducted by Dewaranu and Dina (2022) on 95 female micro-entrepreneurs in Wonosobo, Central Java also confirmed the need for digital training for women entrepreneurs. The primary barriers hindering their utilisation of digital platforms were identified as a lack of skills (45% of respondents), inadequate marketing and promotion strategies (24%), and connectivity issues (14%)[27].

While there is no doubt that addressing the gender digital divide is critical, at its core is the question of who gets access to digital networks and technologies and whether it enables women to access employment opportunities and increase income, so that they can overcome long-standing inequalities[28].

Social and cultural norms limit women's access

According to Chetty, et al (2018), the digital divide can be considered a manifestation of discrimination, poverty and inequality. Since the dawn of IT development, women have been marginalised. This is due to the masculine image of technology, which has resulted in various technological products being created that are sexist because they do not adopt the perspective of women[29].

There are various contributing factors, including dysfunctional digital skills programmes and socio-cultural norms in some countries, which further prevent women from gaining equal access to digital services. The challenges faced by women in the digital economy have been thoroughly examined by Intaratat (2016). The study revealed that women face difficulties in terms of technological literacy and equal participation. Intaratat also identified a masculine technology culture where men dominate and control technology, as well as cultural factors that inhibit women from being more active in using technology.

Furthermore, numerous women find themselves constrained by conventional family roles and patriarchal norms, which limit them from accessing and using digital technologies for their social and economic empowerment[30]. Borborah and Das in Rani, et al (2022) revealed that women traders in urban informal markets in India experience limited access to digital technology and mobile phones due to economic constraints, cultural norms, and power relations within the household. Women's work is often perceived as secondary work in the household, so scarce resources such as mobile phones are often given to men[31].

In line with that, Sambasivan et al. (2019) in Google's research Toward gender equity online: Research with the next billion users also highlights the issue of ownership of technological devices that are not fully controlled by women, with mobile phones often shared, mediated, or monitored[32]. The research revealed that women frequently share their mobile phones with members of their family for a variety of reasons. Women often entrust their phones to individuals who possess the technical expertise to configure or enable digital experiences for them, such as locating specific content.

The high cost of accessing new technologies, combined with women's low purchasing power, infrastructure constraints and gender-biased value systems, indirectly exacerbates the digital skills gap (Mishra, 2017). Rural women are often reluctant or not allowed to visit 'warnet' (internet cafes), or community training centres that are often owned by men or frequented by men. This environment, which is considered less welcoming to women, is also an obstacle to increasing women's knowledge. Consequently, women are deprived of access to

[27] Siti Alifah Dina and Thomas Dewaranu, 'Reformasi Regulasi untuk Peningkatkan Partisipasi Pengusaha Mikro Perempuan dalam E-Commerce' (Center for Indonesian Policy Studies, 2022).

[28] (Rani, et al.., 2022)

[29] Dedi Wahyudi and Novita Kurniasih, 'Narasi Perempuan dan Literasi Digital di Era Revolusi Industri 4.0', *SETARA: Jurnal Studi Gender dan Anak*, 3.1 (2021), 1-19.

[30] (Rani, et al.., 2022)

[31] Rani, et al..

[32] (Sambasivan et al. 2019)

digital training opportunities that could enhance their skills.

In certain cultures and societies, women are often subject to restrictions on their mobility, primarily for reasons related to safety and social norms. These restrictions, while intended to ensure their protection, can also impose limitations on their opportunities for exploration and engagement with the world beyond their immediate environment. Consequently, many women may experience a sense of uncertainty or even fear when it comes to travelling long distances or entering unfamiliar spaces. A young woman in her productive years who is skilled as a domestic helper, for example, may be reluctant to use digital platforms to connect with potential customers in a wider region, as she is used to being in a confined environment[33]. She feels hesitant and anxious at the thought of accepting a job far from home, so she turns down opportunities that come her way. These mobility limitations make it difficult for her to develop her career or increase her income, despite the economic opportunities of the digital age. Experiences like this demonstrate the importance of training and support so that women feel more secure and confident in taking on digital-based work, and so that this culture of mobility restrictions does not continue to hinder the development of their potential.

The double burden experienced by women has also been demonstrated to exacerbate the digital literacy gap. This may be attributed to the domestication of women's roles at home, which are considered not directly related to technology. Furthermore, it is acknowledged that not all women have access to technology, particularly since acquiring proficiency in a new technology requires time and repeated practice.

Gender-biased technology

Despite the familiarity many women have with smartphones and the prevalence of big city life, technology can be perceived as unfriendly towards women. The complexity of technology, as evidenced by the numerous layers of features and the extensive steps required to operate the device, as well as the intricate nature of the UI (User Interface) and UX (User Experience) in applications, can create a negative perception of technology among women. This phenomenon can be attributed, at least in part, to the limited involvement of women in technology companies, particularly in the domain of technology product development. In many companies, the majority of information technology divisions are still dominated by men. Consequently, the resulting output products are not aligned with women's perspectives and fail to address their needs with regard to ease of operation.

A study reported by the Women in Tech Index in 2020 revealed that, even in countries with the highest ratio of female participation in technology, such as Sweden and Finland, the percentage of women is still below 30%. Furthermore, in other countries, the percentage of women must be even lower. Meanwhile, a report uploaded by PricewaterhouseCoopers (PwC) revealed that currently only 5% of women hold leadership positions in technology companies. This underrepresentation of women in the field of technology has the potential to hinder the development of technology that can better accommodate women's needs. However, the involvement of women in the creation and development of technology products can provide a different perspective, create more inclusive products, and design solutions that better suit women's needs. For instance, the design of more user-friendly devices or applications that consider women's specific needs, such as safety and health, can emerge when women are directly involved in the design and development process. Consequently, increasing women's participation in technology has the potential to reduce the gender gap, whilst simultaneously enriching innovation

[33] (Bachtiar, et al.., 2020).

and creating products that are more relevant and beneficial to all.

The persistence of gender-biased technology is an irony for women, who actually have privileged access and high digital literacy. Gender bias is defined as a view and attitude that favours one gender over the other as a result of cultural settings and beliefs that favour a particular gender (Koalisi Perempuan, 2011)[34]. The term gender-biased technology refers to technology designed and developed with a male perspective, male experience and male needs that may not take into account the needs and experiences of women as they should[35]. According to the Women in Tech Report 2021 released by TrustRadius, women in technology are four times more likely to experience gender bias than men, with 39% of female respondents believing that gender bias is what prevents them from getting promoted[36].

The marginalisation of women in technology has a long history. This is largely due to patriarchal norms and culture that dominate many aspects of life, including science and technology. For a long time, women were often seen as incapable of contributing to technological innovation, even though they have played a key role in technology since its early development. One of the most overlooked female figures in history is Lovelace, best known as the creator of the first computer program in the 19th century. Working with Charles Babbage, Lovelace designed algorithms for analytical engines that would later become the precursors of computer programs[37]. Unfortunately, her contributions are often forgotten or minimised in the history of modern computing.

As well as Lovelace, there was Hedy Lamarr, better known as a Hollywood actress, but also as a technological innovator. During the Second World War, Lamarr invented frequency-hopping technology, a system that allowed secure communications without leaks or interception[38]. This technology, although unrecognised at the time, became the basis for the development of the Bluetooth and Wi-Fi technologies we use today. Lamarr not only made great achievements in the world of entertainment, but also made great contributions to the advancement of technology that have yet to be recognised.

Another female figure is Katherine Johnson, an African-American mathematician. Johnson solved many of the complex calculations required by NASA to launch missions into space, including the first landing on the moon[39]. Despite her vital role, her contributions were only widely recognised decades later, illustrating how women are often marginalised in the historical narrative of technology.

When technology is seen as a male domain, women are at a great disadvantage. If women continue to be ignored or marginalised in technology development, the resulting products may not address women's needs. Technology designed without a gender perspective may overlook important aspects such as safety, comfort or certain needs that can only be understood if women are involved in its creation. Gender mainstreaming in technology is therefore not only about equality, but also about creating innovations that are more holistic and relevant, including for women from vulnerable groups.

The lack of inclusivity in technology, where technological developments are designed from a male perspective without taking into account women's experiences and needs, will ultimately result in devices that are less friendly to women. The accessibility for women to operate the resulting devices will not be as smooth as it is for

[34]https://www.koalisiperempuan.or.id/2011/05/04/bias-gender/

[35] Nan Rahminawati, *Isu Kesetaraan Laki-Laki dan Perempuan (Bias Gender)* (Bandung Islamic University, 2001).

[36] Elizabeth Sullivan-Hasson, *TrustRadius 2021 Women in Tech Report* https://solutions.trustradius.com/buyer-blog/women-in-tech-report/ [accessed 10 November 2024].

[37] (Wahyudi and Kurniasih, 2021).

[38] (Wahyudi and Kurniasih, 2021)

[39] (Wahyudi and Kurniasih, 2021)

men[40]. Women's limited mastery of technology in comparison to men's also has the effect of limiting women's opportunities to be more involved in technology. This limited presence of women in the technology sector or companies ultimately results in technology that is less friendly to women. It is like a vicious circle that never ends.

New and emerging technologies are reshaping the labour market[41]. In a changing labour market, the demand for skills is changing rapidly. Businesses have high expectations for creative thinking, analytical skills, technological literacy, curiosity, lifelong learning and resilience[42].

Large companies, especially technology companies, should make regular social contributions to society by organising technology education and training. This can facilitate access to better jobs (LIPI, 2009). In addressing cultural bias, structural policy changes are important to create opportunities for women and raise awareness of the importance of gender equality[43]. For example, by affirming quotas for racial and gender diversity, and by including women on the boards of technology companies so that there are opportunities for women to contribute to decision making. Equally important is encouraging women to take the plunge and start their own technology businesses. Providing venture capital specifically for women entrepreneurs will give them greater control over their careers and financial independence.

A gender perspective in information and communication technology (ICT) training programmes is important to bridge the employment gap. Suarmini, et al (2018) found that women's mastery of information and communication technology is an important tool for economic empowerment, especially now that many community economic activities are conducted online. Women's mastery of technology can support inclusive and gender-responsive national development, so skills training, entrepreneurship and the use of modern technology should cover all regions and be tailored to the characteristics and needs of each region[44]. The mastery of technology is also important to enable women to have access to basic needs such as health services and education[45]. Technology training programmes should help women to access wider employment opportunities and reduce economic inequality. Mastery of technology will greatly support women's entrepreneurial needs[46]. Access to technology is key to achieving digital inclusion[47]. The contribution of women entrepreneurs is not limited to the family economy; many groups of women entrepreneurs make a significant contribution to improving the regional economy, starting to absorb labour, reducing unemployment, reducing poverty and even assisting the government in creating a sustainable economy[48].

[40] Tri Marheni Pudji Astuti, 'Bias Gender Dalam Ilmu Pengetahuan dan Teknologi', *Jurnal Ilmiah Infokam*, 3.2 (2013).

[41] World Economic Forum, Global Gender Gap Report 2023

[42] World Economic Forum

[43] Yeni Nuraeni and Ivan Lilin Suryono, 'Analisis Kesetaraan Gender Dalam Bidang Ketenagakerjaan di Indonesia', *Nakhoda: Jurnal Ilmu Pemerintahan*, 20.1 (2021), 68-79.

[44] Ni Wayan Suarmini, Siti Zahrok, and Dyah Satya Yoga Agustin, 'Peluang dan Tantangan Peran Perempuan di Era Revolusi Industri 4.0', *IPTEK Journal of Proceedings Series*, 5 (2018), 48-53.

[45] Suarmini, et al..

[46] Caterin M. Simamora and Rahayu Ningsih, 'Inklusivitas Ekonomi Digital di Indonesia: Perspektif Gender dan Penciptaan Lapangan Kerja (Studi Kasus Kampung Marketer)', *Cendekia Niaga Journal of Trade Development and Studies*, 4 (2020), 15.

[47] Simamora, et al.

[48] Simamora, et al.

Figure 1 Gender-biased technology factors and impacts

Impacts of Digital Divide

The digital divide experienced by women in the digital economy has serious negative implications, particularly for their participation in the labour market. According to the findings of Sarker et al. (2024), the flexibility of work in the gig economy attracts many women as it allows them to work from home, organise their schedules according to family needs and still spend time with their children. However, while the gig economy offers flexibility, women are still held back by strong gender stereotypes, as found by Galperin et al. (in Sarker, 2024). This goes against the goal of SDG 5.B, which promotes empowering women through access to and use of digital technology. Achieving the goal of effective women's empowerment in the digital world requires a more holistic and systemic approach, covering not only technical aspects, but also cultural and policy changes to reduce existing structural barriers[49].

Digital market opportunities through the internet offer a great opportunity for MSME women entrepreneurs to expand their business reach. However, many of them have not taken full advantage of this opportunity. A study conducted by Dina, et al. (2022) revealed that while most women entrepreneurs are interested in exploring digital market opportunities, many do not yet understand how the features of digital platforms work and lack the necessary marketing skills. As a result, most rely solely on selling through WhatsApp and are limited to their personal social networks. Only a handful of entrepreneurs have accounts on e-commerce platforms. This suggests that most of these entrepreneurs have not accessed the wider market available through digital platforms. In fact, the more technology applications they master, the greater the opportunity to reach new consumers. Unlike messaging apps, which tend to be limited to known contacts, social media and e-commerce platforms can open access to a wider and potential market, helping MSME women entrepreneurs to grow faster in an increasingly advanced digital economy.

Digital literacy can serve as an important tool in the alleviation of poverty and the empowerment of women, especially among the poor[50]. However, a study by SMERU (2022) shows that the digital divide between men and women in Indonesia has persisted for at least a decade, with significant differences between internet use in rural and urban areas. Strong patriarchal cultures in rural areas, as well as in many low-income families, often mean that access to smartphones and the internet is controlled by husbands or sons, limiting women's ability to use technology for empowerment or skills development.

To address this gap, it is imperative that relevant parties such as governments, NGOs and technology companies encourage the provision of appropriate yet affordable technology devices. This will enable women, especially those in remote areas or with economic limitations, to have greater access to technology. In addition, digital literacy training must be provided to enable women to make the best use of technology. This training should be tailored to the local context and needs of women so that they can develop digital skills that are relevant to their daily lives and improve their ability to access wider economic and social opportunities. With such support, women will be better able to participate actively in the digital world.

[49] Mou Rani Sarker et al., 'Gender Differences in Job Satisfaction Among Gig Workers in Bangladesh', *Scientific Reports*, 14.1 (2024), 17128.

[50] Krish Chetty et al., 'Bridging the Digital Divide in the G20: Skills for the New Age', *Economics*, 12.1 (2018), 20180024.

In addition, there are long-term effects of the pandemic that can exacerbate the situation and threaten women's lifetime earnings and mental health if not properly addressed. The pandemic has exacerbated existing social and economic inequalities, and while digitalisation offers new opportunities for women's entrepreneurship, the digital divide between men and women, in both urban and rural areas, remains a major challenge (UN Women, 2020). Avanesian (2024) also points out that while women have access to technology, they often do not have the same opportunities to develop skills due to educational limitations and social barriers, resulting in technology use being focused on basic or social activities rather than professional development.

Conclusion and recommendation

In the digital age, the mastery of technology has become an important component affecting the continuity of human livelihoods, including for women. With the development of Internet technology, new job opportunities are opening up in various fields, providing new opportunities for women to participate actively in the economy. Freelance workers, both full-time and part-time, benefit greatly from technology because it allows them to work flexibly from anywhere. This technology allows women to do their work without being tied to a specific location or working hours, allowing them to balance work and family responsibilities.

There are new jobs that have emerged with the development of the digital economy, including content creators, affiliate sellers, and other professions that use digital platforms in the transaction and work process, such as masseurs, virtual assistants, and so on. Although these jobs look simple, they actually require communication skills and mastery of technology, such as understanding digital marketing techniques, content strategies and the ability to use social media applications and live streaming platforms. These jobs are open to both men and women. In reality, however, many companies target women, especially housewives, who have more flexible hours and are more likely to be active on social media. In addition, many products marketed through live shopping or affiliate programmes are targeted at female consumers. This shows that mastering technology is not only a necessity, but also opens up job opportunities for women in the digital world.

The results of the literature review in this study shows that the main barriers to women's low digital literacy are socio-cultural factors, limited access to technology, and low educational and economic levels. The strong patriarchal culture, especially in rural areas, limits women's access to technology and the development of their digital skills. In addition, limited access to decent technology equipment, both in terms of infrastructure and ownership, also has a significant impact. This, combined with women's low levels of formal education in many areas, further exacerbates the digital divide for women. As a result, women are missing out on a huge opportunity to improve their lives in the digital economy, where mastering technology is key to securing better jobs and achieving financial independence.

Indeed, the digital literacy gap can be addressed through affirmative action that includes the provision of affordable technology devices and digital literacy training that meets women's needs. In addition, women-friendly technology policies, such as scholarships and support for women pursuing careers in technology, are essential to widen access. Governments, businesses and communities must work together to create an inclusive ecosystem where women have equal opportunities to participate and innovate in the digital world. By taking these steps, the digital literacy gap can be reduced and women can become more competitive and contribute to the digital economy.

It is important that technology development considers usability for women to maximise this potential. Digital literacy remains a challenge, and technologies that are easy for women to

understand must be developed if they are not to be left behind in the competition. The many opportunities to work and create in the digital age make mastering technology an urgent matter. Women also need support in the form of affirmation so that their digital livelihoods are well served. One aspect that needs to be addressed is reducing technological bias when designing products. Often technology products are launched without considering women's perspectives, making the technology feel less friendly to them. This can be seen in masculine designs, large sizes or complicated and unintuitive interfaces.

In addition to developing female-friendly products, it is also important to create an inclusive environment to help women feel comfortable using technology. For companies recruiting, it is highly recommended that they make technology training opportunities widely available, both to potential female employees and to the general public. This regular training will give women the skills they need to compete in the digital workforce. This concrete step is an important part of the effort to improve women's digital literacy, which will ultimately benefit the economy as a whole.

In the digital age, social constructs that limit women's roles to the home or traditional work also need to change. The rigid gender division of labour needs to be broken down so that women have more time and opportunity to develop themselves and their potential. This change is not only for the sake of the family economy, but also for the sake of women's human rights to develop fully as human beings. Men's roles in domestic work and childcare also need to be strengthened. By sharing roles equally, gender justice can be achieved and women can be fully empowered in the digital age.

On the other hand, there is a need for policies that encourage technology companies to organise trainings or affirmations that target young women to develop their potential in technology development through scholarships or internship programmes. These programmes can give young women early access to learn about and explore their potential in technology, while preparing them to compete in an increasingly advanced digital world. Technology scholarships for women can be a gateway to higher formal education in science and technology, which is often overlooked in patriarchal societies. By creating platforms that allow young women to develop their talents and skills from an early age, they will have a greater chance of breaking into the male-dominated tech industry. To support young women's talents and give them the opportunity to learn, innovate and inspire future generations, governments and the private sector must work together.

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