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Neuroscience Perspectives on Gender Communication Patterns and Interpersonal Relationship in The Digital Era: A Literature Review

Perspektif Neurosains tentang Pola Komunikasi Gender dan Hubungan Interpersonal di Era Digital: Sebuah Tinjauan Literatur

Nadila Putri Pramesti[1], Pratiwi Uly Romadhoni[2], Kurdeniansyah[3], Ajmil Irodah[4]
nadilapprmst@gmail.com
[1]Politeknik Kesehatan Kemenkes Surakarta, Indonesia
[2]Universitas Muhammadiyah Karaganyar, Indonesia
[3]Universitas Sriwijaya, Indonesia
[4]Universitas Muhammadiyah Semarang, Indonesia

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ABSTRACT

The development of digital technology has transformed interpersonal communication patterns and introduced new dynamics in gender interactions. Differences in how men and women communicate need to be examined from a neuroscientific perspective to understand the underlying cognitive and emotional mechanisms. This study aims to analyze how neuroscience explains gender communication patterns and their implications for interpersonal communication in the digital era. This study employs a qualitative method using a literature review approach by examining relevant scientific articles and books. The findings indicate that variations in brain connectivity, neurotransmitter systems, and emotional processing may be associated with differences in communication responses. However, these differences are not absolute, as they are also influenced by social, cultural, and individual experiential factors. In the digital context, the use of text, emojis, images, and short videos has shaped new ways of conveying and interpreting emotional messages. Generation Z tends to use visual media to express feelings; however, the intensity of digital connections does not necessarily guarantee deeper interpersonal relationships and may be associated with feelings of loneliness. This study concludes that a neuroscientific perspective can enrich the understanding of gender communication but should be integrated with social and cultural perspectives. Therefore, digital literacy, empathy, and adaptive communication skills need to be developed to foster healthy, inclusive, and equitable interpersonal relationships.

Keyword: *neuroscience; gender communication; interpersonal communication.*

ABSTRAK

Perkembangan teknologi digital telah mengubah pola komunikasi interpersonal dan menghadirkan dinamika baru dalam interaksi gender. Perbedaan cara laki-laki dan perempuan berkomunikasi perlu dikaji melalui perspektif neurosains untuk memahami mekanisme kognitif dan emosional yang mendasarinya. Penelitian ini bertujuan untuk menganalisis bagaimana neurosains menjelaskan pola komunikasi gender serta implikasinya terhadap komunikasi interpersonal di era digital. Penelitian ini menggunakan metode kualitatif dengan pendekatan tinjauan literatur (*literature review*) melalui penelaahan artikel ilmiah dan buku yang relevan. Hasil kajian menunjukkan bahwa variasi konektivitas otak, sistem neurotransmiter, dan pemrosesan emosi dapat berkaitan dengan perbedaan respons komunikasi. Namun, perbedaan tersebut tidak bersifat mutlak karena turut dipengaruhi oleh faktor sosial, budaya, dan pengalaman individu. Dalam konteks digital, penggunaan teks, emoji, gambar, dan video pendek telah membentuk cara baru dalam menyampaikan dan menafsirkan pesan emosional. Generasi Z cenderung memanfaatkan media visual untuk mengekspresikan perasaan. Namun, intensitas koneksi digital tidak selalu menjamin kedalaman hubungan interpersonal dan dapat berkaitan dengan perasaan kesepian. Penelitian ini menyimpulkan bahwa perspektif neurosains dapat memperkaya pemahaman

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mengenai komunikasi gender, tetapi perlu dipadukan dengan perspektif sosial dan budaya. Oleh karena itu, literasi digital, empati, dan keterampilan komunikasi adaptif perlu dikembangkan untuk membangun hubungan interpersonal yang sehat, inklusif, dan setara.
Kata Kunci: neurosains; komunikasi gender; komunikasi interpersonal

INTRODUCTION

Communication plays a crucial role in shaping a person's development, whether in the cognitive, emotional, or social aspects. Parenting communication encompasses how parents or caregivers interact with children through both verbal and non-verbal expression. This includes expressions of affection, the giving of guidance, and responses to the child's needs. Appropriate communication patterns can help develop self-confidence, social skills, and the ability to manage emotions (Armiyati et al., 2025). In Indonesia, the issue of effective communication has become a complex challenge amid rapid digital transformation and changes in family structure. Data from the Ministry of Women's Empowerment and Child Protection (2023) reveals that 62% of Indonesian parents still adopt a one-way instructive communication pattern rather than a participatory dialogical approach (Anggraini et al., 2025).

The digitalization era has brought changes in interaction between individuals through the use of online media as a space for communication. Online media is a form of media based on telecommunications and multimedia, mediated through computers and the internet. Online media has the capability to present news in text, audio, and video formats, is interactive, and is flexible in form, content, and use. In a journalistic context, online media includes news websites, e-commerce sites, social media, and personal websites (blogs). The emergence of internet-based online media, as part of the rapid and widespread acceleration of access to information technology, can serve as a means of voicing various ideas, opinions, and issues in society. By gender, internet penetration contribution in Indonesia is dominated by males at 50.7% and females at 49.1%. In terms of age, the majority are Gen Z (born 1997-2012) at 34.40%, followed by the millennial group (born 1981-1996) at 30.62% (Nurmadewi, 2024).

Media today has become a fundamental part of social life and can serve as a means of information, communication, social control, and entertainment. Mass media, as part of media in general, disseminates information through text, audio, and visuals. As technology has developed, mass media has made use of the internet network to spread messages, known as online media. This online media has the advantage of being able to transcend space and time at a relatively low cost and with a wider reach.

A study (Annisa et al., 2025), examines platforms that use visual aesthetics and reinterpretation to highlight gender equality and challenge patriarchal views. This marks a shift in religious authority, in which digital figures take on an

interpretive role that was previously more dominated by traditional religious scholars. However, not all narratives in digital media are progressive. There is also strong contestation from the conservative side, including antifeminist narratives on the YouTube platform. Another study found that antifeminist content often indoctrinates women into domestic roles, reinforcing traditional gender stereotypes in the digital sphere.

Study (Anggraini et al., 2025), communication must be understood as a dynamic process that involves not merely verbal exchange, but also nonverbal, paralinguistic, and contextual aspects. Recent research in developmental neuroscience shows that the communication patterns a child receives in early life directly affect brain structure and function, particularly in the prefrontal cortex area, which is related to emotional regulation and decision-making. These findings confirm that every communicative interaction between caregiver and child is not merely an ordinary daily activity, but rather a process of neurological formation that is permanent in nature.

Good communication is not merely about conveying material verbally, but also involves emotional and social aspects, so that it can be truly understood in everyday life (Dewanti et al., 2025). Neuroscience, as a branch of science that studies brain function and the nervous system, provides deeper insight into how communication patterns influence brain development. Every interaction a person receives from others will shape the structure and function of their brain through a mechanism known as neuroplasticity (Armiyati et al., 2025). Neuroscience explains how the human brain works in receiving, processing, and storing information. The principles of neuroscience in learning communication make it possible to better understand the best way to convey something so that it aligns with how the brain works.

In accordance with (Najmi et al., 2026), inability to manage emotions, such as anxiety, frustration, or boredom, has been empirically shown to hinder the brain's executive function and reduce the efficiency of information processing. Several problems in this study are as follows. First, a low ability to recognize and manage emotional responses when facing challenges causes disruption to attention processes and memory consolidation. Second, activating the processes of metacognition and self-reflection, which are critical components in the development of higher-order cognitive abilities. Third, insufficient attention to neurobiological conditions. Emotion is not merely a complement to the cognitive process, but rather a condition that is neurologically necessary for moral decision-making and the formation of self-identity.

The brain has a special feature, namely neuroplasticity, the ability to renew cells that have been damaged, and it can even change a person's future. Neuroplasticity has the ability to change the human brain. Imagine that the human

brain is processing an uncountable amount of data, yet humans are only aware of a small portion of that process. According to (Oktavianisya et al., 2021), Neuroplasticity is the brain's ability to form new neural connections throughout life, influenced by intrinsic or extrinsic stimuli, or the capacity of neurons and neural networks in the brain to change their connections and behavior in response to new information, sensory stimulation, development, damage, or dysfunction.

The brains of girls and boys are different. Furthermore, such conditions will certainly change the way they learn. When providing appropriate guidance to their children, parents and educators must take these differences into account. These brain differences show that differing brain structures are important, though not complete, factors in learning styles and how their brains work. Boys tend to prefer learning about developmental stages and differences in brain structure by looking at pictures or diagrams, or by learning through practice, assembly, design, simulation, and other activities that involve the body in movement, because school-age children make greater use of the right brain to understand things. Girls, on the other hand, more easily gain knowledge through reading, writing, collaborating (talking) with friends, or using communication media such as theater or drama. This is because they learn and master language more quickly than boys. There are differences in brain structure as well as in the learning behavior that occurs between male and female students, viewed from the perspectives of philosophy and neuroscience. This study shows that the brain plays a very important role in a person's life. All humans develop with biological characteristics, including the brain. It turns out that sex can influence different ways of thinking. Thus, different potentials exist within each person of a different sex (Hadiyanto & Suyadi, 2023).

Although various studies have discussed gender communication in the digital era from the perspectives of communication, media, and education, studies integrating a neuroscience perspective to explain the cognitive and emotional mechanisms in gender communication are still relatively limited. Most tend to focus more on social aspects, while understanding of how brain processes influence the formation of perception, emotion regulation, and responses to digital messages based on gender remains scarce. Various research findings on gender communication in the digital era are examined from a neuroscience perspective based on the discussion above. This study is expected to provide a comprehensive overview and highlight the implications of neuroscience in understanding the dynamics of gender communication in the digital era.

RESEARCH METHOD

This study is a qualitative study using a library research approach, an approach aimed at examining and analyzing information from various relevant literature sources, such as scientific books and journal articles. The data collection process was

carried out by tracing credible and up-to-date references through both physical libraries and online sources, including international journals. This method is considered relevant because it is able to provide a comprehensive conceptual and practical understanding of the phenomenon being studied.

RESULTS AND DISCUSSION

1.1 How Neuroscience Findings Explain Differences in Communication Patterns Between Men and Women?

Differences in brain structure between men and women exist across various brain regions. These differences are found in the amygdala, hippocampus, temporal lobe, and insula, with men generally having a larger brain volume than women. In addition, differences are also found in several specific areas, such as the left frontal gyrus, left occipital gyrus, left insula, right orbitofrontal gyrus, and left occipital sulcus. Variation in white matter has also been identified, particularly in the midbrain, corpus callosum, right anterior cingulate gyrus, right superior colliculus, and left medial anterior cingulate gyrus. Male brains tend to have stronger connectivity within the same hemisphere (intra-hemispheric), while female brains show stronger connectivity between hemispheres (interhemispheric). The research also revealed that brain development in males and females begins to show differences from an early age, resulting in structural and functional brain differences from adolescence into adulthood (Kim & Lee, 2024).

In accordance with (Harahap & Adeni, 2021), Stereotype is an attempt to generalize from one phenomenon to another. For example, if a female friend of ours is not interested in sports, there is a tendency for us to say that all women are not interested in sports. This drive toward the polarization of sex and gender occurs within the thought structures of most people; (5) Language evaluates gender. Language is sometimes evaluative of a concept. Language is a reflection of culture and has a very large influence on our perception. Although sexist language has diminished today, language still devalues women by trivializing and demeaning matters related to women; and (6) Language provides space for self-reflection. The explanation above shows that there are significant differences between men and women in communicating. This is also inseparable from the influence of existing culture. In various societal groups with different religious, ideological, ethnic, geographic, educational, and economic backgrounds, distinct registers of language use emerge. Each group has the potential to give rise to or produce its own "style of language," including differing language styles between men and women.

The concept of communication between men and women is much like cross-cultural communication, which can sometimes be confusing, as if imagining two people talking who actually come from two different countries. Men and women

often use language that conflicts with or contradicts their actual intentions and purposes.

Men and women each have their own linguistic characteristics. In terms of the number of words produced, many experts say that women use more words than men. The book Female Brain states that a woman can use around 20,000 words per day, while a man only uses around 7,000 words. In addition, the topics discussed by women and men also differ quite a bit. Men tend to discuss sports, politics, and technology, while women prefer to talk about their lives with their families, food, and lifestyle (Harahap & Adeni, 2021).

A study (Aptalitha, 2025), this shows differences in communication patterns between men and women based on five aspects of communication put forward by Deborah Tannen. First, in public and private conversation, men tend to use communication as a way of demonstrating identity, status, and competence through the delivery of information. Second, in telling stories, men more often use humor as a strategy to build status, display intelligence, and strengthen their social position. Women, meanwhile, tend to use stories that are more personal and oriented toward interpersonal relationships. Third, in terms of listening, women generally show engagement through nonverbal responses such as eye contact, nodding, and verbal feedback, while men more often show attention through direct agreement or disagreement related to position or status within the interaction. Fourth, in asking questions, women tend to ask in order to obtain information, show interest, or build mutual understanding, while men more often use questions as a form of testing, challenging, or negotiating status. Fifth, in conflict, men and women have different tendencies in dealing with disagreement. Men tend to be more accepting of conflict as part of social interaction, while women more often avoid conflict because they consider its impact on interpersonal relationships.

Differences between men and women are also found in various neurotransmitters that play important roles in regulating brain function, such as serotonin, dopamine, and gamma-aminobutyric acid (GABA). Serotonin, which plays a role in mood regulation, including depression and anxiety disorders, shows sex-based differences in terms of levels, function, and receptors. Women have higher blood serotonin levels than men. This higher serotonin level is associated with the level of the hormone estrogen, the primary reproductive hormone in women. Conversely, the rate of serotonin synthesis in men is about 52% faster than in women. These differences in serotonin levels and metabolism are thought to be one of the factors causing differences in the prevalence of depression, anxiety disorders, and bipolar disorder between men and women. In addition to serotonin, dopamine, which plays an important role in regulating the motor system and the reward system, also shows sex-based differences. Female hormones such as β-estradiol are known to increase dopamine neuron activity, resulting in higher

dopamine release. Several other physiological differences have also been identified, including the anatomical distribution of dopamine neurons, basal dopamine levels, and the influence of ovarian hormones on the dopamine system. The GABA neurotransmitter, which functions as an inhibitory neurotransmitter in the adult brain but acts as an excitatory neurotransmitter during brain development, is also influenced by sex hormones, particularly estrogen, during the early developmental period of life. Research shows differences between men and women in the volume of several nuclei as well as in the frequency and type of synapses in the hypothalamus, hippocampus, and preoptic area (Kim & Lee, 2024).

Research findings (Harahap & Adeni, 2021), shows that the communication styles of women and men differ, including: 1. Differences regarding who talks more: (a) Men talk more than women in formal group situations, (b) Men typically allow women to talk more when the atmosphere becomes informal, (c) When men and women with the same level of expertise are given the opportunity to speak in public, men tend to speak more or for longer than women, (d) Men take more initiative in interaction and in creating communication than women do. 2. Communication patterns in formal and informal meetings: (a) In formal meetings, men display social status "more strongly" in public than women do, (b) In general, the amount of time women spend asking questions of fellow women is greater than that of men, (c) When the atmosphere of a meeting with an audience is very informal and requires collaboration, women communicate more flexibly than men, (d) Women are better able to carry out informal conversations aimed at finding common ground in opinion or resolving talk that frequently overlaps. The communication styles described above also indirectly influence the choice of words or language used, and are inseparable from culture.

Generally, the male brain is divided into distinctly separate compartments, which affects its ability to manage information. Most men have the ability to sort and store information neatly in their heads in a particular way. The two parts of the male brain are connected by fibers that are thinner in size compared to the female brain, which limits one side of the male brain in receiving the flow of information. This is what causes women to be more expressive in conveying their emotions through words, because what they feel can be transmitted more effectively through the verbal side of the brain. The different brain structure in women causes them to tend to "rewind" the information in their heads repeatedly. The only way to stop this is by expressing it. "Venting" or sharing one's feelings helps women classify and organize the information in their heads (Munawir, 2023).

The hippocampus consists of the hippocampus, alveus, and subiculum, among others, in the limbic system area located in the medial temporal lobe of the brain. This area handles long-term and short-term memory, as well as spatial memory and navigation. Women have a hippocampus, or memory center, in the

brain that is larger than men. Therefore, women can remember information longer and in more detail. This condition also causes men to be forgetful. Because of this, men are more vulnerable to trauma compared to women. However, in women, hippocampal cells and parietal lobe cells disappear (die off) more quickly during development, which makes memory loss and spatial recognition ability decline more easily. Estrogen and progesterone control their hormones, causing them to prefer staying calm and relaxed. As a result, they enjoy "gathering" rather than gathering material or substances in order to collect information. In addition, this condition influences the choice of positions and actions taken. Women typically work in jobs that match their attributes at this level, such as secretary, treasurer, and sexual consumption (Hadiyanto & Suyadi, 2023).

The role of gender in communication style cannot fully account for the differences between men's and women's communication styles, but gender has made its contribution through the process of socialization during the upbringing of boys and girls. This role can also be seen through the presence of sexism in the language of men and women in certain cultures. Regarding the comparison of communication styles between two different cultures, namely masculine culture (men) and feminine culture (women), it does not show that men's way of communicating is better than women's way of communicating, or vice versa.

These differences in brain structure and function do not directly determine that men or women have better communication abilities than the other; rather, these differences can complement and complete one another. However, variations in brain connectivity, neurotransmitter systems, and emotion-processing mechanisms can influence how individuals receive information and express emotions.

1.2 What Are the Implications of Neuroscience on Gender Communication in the Digital Era for Understanding Interpersonal Communication?

Interpersonal communication between men and women is an important aspect of building healthy, effective, and equal professional relationships. In practice, however, cross-gender interaction is often influenced by social and cultural factors that place men and women in different status positions. These differences give rise to various forms of communication barriers and biased perceptions regarding the competence of a particular gender (Setiawan & Pradana, 2026).

Communication is a complex phenomenon, and for that reason, each individual who observes it approaches it differently. Communication is a process in which individuals share information, ideas, and feelings with one another. It touches on deeper aspects of everyone involved, including their past life, their family, and the activities they are currently engaged in. One component of communication is mutual listening. Listening is very important, because through it, each party involved in a communication event can understand one another and give

feedback or responses in a good manner that matches what is expected. Each party can be both a giver and a receiver of messages at the same time (Nisa, 2024).

Traditional interpersonal communication involves direct interaction with deep verbal (speech) and nonverbal (facial expressions, body language, tone of voice) components. This interaction allows for emotional warmth, empathy, and better understanding in relationships between individuals. In the digital era, this pattern has shifted toward text-based communication and visual media. Technology allows individuals to communicate easily and quickly, but this often comes at the cost of losing important emotional nuance. The presence of digital technology makes long-distance communication easier, especially within the family context. However, digital communication also reduces the frequency of face-to-face interaction, which results in a decline in the quality of interpersonal relationships.

The transformation of interpersonal communication patterns in the digital era brings new dynamics that influence how humans interact. While technology offers many advantages in terms of efficiency and connectivity, its impact on the quality of interpersonal relationships cannot be ignored. This shift requires individuals to develop new skills, such as digital literacy and adaptive communication, in order to maintain the quality of interpersonal relationships amid the changes taking place. Neuroscience relates to how the human brain is able to adapt to changes in the communication environment. In the digital era, this can affect things such as cognition and interpersonal communication.

Interpersonal communication is communication that occurs between two or more people, which is usually not formally structured. In interpersonal communication, each participant uses all the elements of the communication process. For example, each party will discuss their own background and experiences during the conversation.

Advances in information technology have also driven changes in communication behavior across generations. Generation Z, for example, relies more on social media and instant messaging as their primary means of communication. This generation tends to use symbols such as emojis and short messages to convey emotion, which often reduces the formality of communication. How does the digital communication style of the younger generation affect the way they build interpersonal relationships, both in personal and professional contexts? (Nisa, 2024). From a neuroscience perspective, interpersonal communication in the digital era can be seen in the way the brain's processing of social messages has changed. Individuals no longer understand communication only through words, but also through visual symbols and digital expressions.

These brain differences, according to the view that different brain structures greatly affect how children learn and how their brains work, mean that the differences in learning between boys and girls are still not fully understood.

Boys tend to learn by using pictures, graphics, or physical activities such as hands-on practice, assembling, design, simulation, and so on. When entering school age, children will make greater use of their right brain, which is used in understanding emerging ideas or creativity. This is because girls are able to use language skills more quickly and more strongly than boys. This makes it easy for them to understand concepts simply through reading, writing, speaking, or discussion, as well as through drama and theater (Hadiyanto & Suyadi, 2023).

In terms of communication style, Generation Z more often uses visual media such as images, short videos, emojis, and stickers to convey their messages. More traditional text-based communication is often replaced by images or videos, which are seen as more expressive and creative. The use of emojis and stickers, in particular, gives them a more effective way to express feelings and reactions in conversation. Although they are active on social media, Generation Z tends to guard their privacy in personal communication. Many of them prefer to interact in more closed spaces, such as private message groups or direct messages (DMs), to share more personal information. This shows that even though they are digitally connected to many people, they still want control over what they share and with whom that information is shared. On social media platforms, Generation Z often presents an idealized version of themselves. They feel driven to show the best side of themselves online, creating an image that is more perfect than their real life. This phenomenon shows a gap between how they interact in the digital world and their direct social life. This study also reveals the psychological impact of digital communication felt by Generation Z. Even though they are connected to many people through digital platforms, they often feel lonely and anxious. This reflects a mismatch between the large number of digital connections they have and the quality of the emotional relationships they actually feel. Even while interacting through social media, Generation Z still experiences a deeper sense of social isolation, showing that digital connection cannot always replace the need for more personal and direct emotional relationships. Generation Z considers digital communication faster and more efficient than face-to-face communication. They feel more comfortable sending messages through text or social media, because it gives them more time to think before responding. However, even though communication becomes more efficient, they also recognize that digital interaction often loses the emotional depth that can only be felt in direct conversation (Slametno, 2025).

Platforms such as WhatsApp, Instagram, TikTok, and Discord not only facilitate fast and efficient communication, but also create space for Generation Z to express themselves in more creative and expressive ways, using images, videos, emojis, and stickers. Although the use of social media and instant messaging apps

offers ease of interaction, this digital communication also brings challenges, particularly related to issues of privacy and authenticity of self.

The digitalization era has influenced the growth of online media, which can be used to support the achievement of principles of gender equality. Online media can be utilized as a means of communication through the internet network. Many applications are offered in online media to facilitate communication among users without boundaries or distance. Communication on online media can shape and influence public opinion through messages conveyed from one user to another. However, messages through online media do not always represent a subjective reality; at times they are instead the result of media interpretation and ideological perspective (Nurmadewi, 2024).

Men are seen as more dominant than women in line with patriarchal cultural views. Yet public spaces, including digital spaces, should be places where every individual has the freedom to express themselves, communicate, and participate on an equal footing.

Online media opens up opportunities for freedom of expression, the dissemination of information, and interaction across space and time. Online media serves as a platform for women to participate in public discussions, share experiences, and voice issues that were previously difficult to reach through conventional media. On online media, news can spread quickly and on a massive scale. In addition, knowledge and understanding of gender equality can also be received as early as possible by various segments of society.

Online media has become an important part of the struggle for gender equality in the digitalization era. Online media serves as a means to campaign for and build public understanding of women's rights and to eliminate gender discrimination and injustice, particularly in public spaces. Building communication based on gender equality in online media is important and can be done by presenting online news coverage that does not corner or disadvantage women, strengthening digital literacy to reinforce gender equality and counter gender-discriminatory narratives, and granting women the freedom and rights to fight for gender equality through online media. News coverage and content on online media, carried out on an ongoing basis, are expected to have an impact in increasing public understanding of gender equality and to contribute to social change in society.

A larger cognitive dataset was collected in this study, showing cognitive differences between men and women across various domains, including participants in the structural connectivity analysis. Variation ranged from small to fairly large, and these differences were clear. The results show large differences between groups and indicate complementarity in human brain structure, which helps explain why male students outperform female students in certain areas. For example, men are usually better in memory and social cognition, as well as in

learning and performing tasks such as cycling or direction navigation. In contrast, women are usually better in memory and social cognition (Hadiyanto & Suyadi, 2023).

Positive communication patterns not only enhance cognitive development but also play a role in maintaining emotional well-being. Quality interaction is crucial in shaping brain development (Armiyati et al., 2025).

Based on neuroscience studies, the communication patterns applied by parents greatly influence children's brain development. Positive and supportive interactions can strengthen neural connections, improve executive function, and help manage children's stress and emotions. Conversely, unsupportive communication patterns can hinder cognitive and emotional development, as well as increase stress levels that negatively impact well-being.

CONCLUSION

Differences in brain structure and function such as hemispheric connectivity, neurotransmitters, and the size of the hippocampus and limbic system tend to make men communicate to assert status, while women are more oriented toward relationships and emotions. In the digital era, this pattern is shifting through visual media (texts, emojis, short videos), which are widely used by Generation Z to express emotions, yet ironically trigger loneliness due to a decline in emotional depth despite abundant digital connections. Therefore, digital literacy and adaptive communication skills are important to develop in order to keep inter-gender relations in the digital space healthy and equal, while also opening up opportunities for further empirical research based on neuroscience in the Indonesian context.

SUGGESTION

Based on the findings of this study, further research is needed, particularly through field research, as the present study is based on a literature review. Future studies on neuroscience perspectives and gender communication patterns in the digital era should consider social and cultural factors, as well as individual experiences. Further research is recommended to employ empirical approaches, such as interviews, data collection, observation, and surveys, to obtain more comprehensive and in-depth findings regarding interpersonal communication between men and women when using digital media. Furthermore, Generation Z is expected to improve digital literacy, empathy, and the ability to understand emotional messages to establish effective communication in today's increasingly digital era and avoid misunderstandings. The use of digital technology should also be balanced with face-to-face interactions to maintain emotional closeness and the quality of interpersonal relationships. Therefore, an understanding of gender

communication that integrates neuroscientific, social, and cultural perspectives is expected to support the development of healthy, inclusive, and equitable interpersonal relationships in the digital era.

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