

Implementation of Digital Scientific Literacy in Family Education (Gender Study in Remote Areas of South Sulawesi)

Syamsuni HR^{1*}, Jumadi², Aisyah Nursyam³, Besse Nurul Kafilawaty⁴

¹ Universitas Megarezky, Program Studi Pendidikan sosiologi, Fakultas Pendidikan Makassar, Indonesia.

² Universitas Islam Makassar, Program Studi Pendidikan Islam, Fakultas Pendidikan Agama Islam Indonesia.

³ Universitas Muhammadiyah Bone, Program Studi Pendidikan Islam, Fakultas Pendidikan Agama Islam Indonesia.

⁴ Universitas Megarezky, Makassar, Program studi Sarja Administrasi Rumah Sakit, Fakultas Teknologi Kesehatan, Indonesia.

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Corresponding Author:

Syamsuni HR

syamsunicarsel@gmail.com

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Abstract: Gender is a crucial aspect in problem-solving within families that can influence a child's social activities in society. Globally, there are disparities between males and females in accessing Digital Scientific Literacy. Access to Digital Scientific Literacy is predominantly observed in urban areas and utilized within the family education context. This study aims to investigate the implementation of family education using the scientific approach, employing the 5M pattern: Observing, Questioning, Trying, Reasoning, and Communicating. The study utilized a Mixed Methods approach involving 100 households, consisting of 80 boys and 80 girls, in remote areas of South Sulawesi. Findings reveal that the application of family-based education rooted in Digital Scientific Literacy remains suboptimal. This is attributed to a lack of parental comprehension regarding Scientific Literacy in remote areas of South Sulawesi. The predominant role in educating children within the family lies with the mothers, while fathers mainly reinforce the implementation of family education. Additionally, there exists a disparity between boys and girls in accessing Digital Scientific Literacy, with boys demonstrating a higher dominance in this domain.

Keywords: Digital; Education; Family; Gender; Remote Areas; Scientific Literacy.

Introduction

Education, especially in the global era, is vital for human development and civilization, fostering competence and maturing processes in individuals (Rahmadania et al., 2021; Tohri et al., 2022; Zuhara et al., 2019). Science education, crucial for facing globalization, aims to cultivate scientific literacy essential for modern learning (Budiman et al., 2021; Husna et al., 2022). Family-based learning, rooted in scientific literacy, aids children in vocabulary mastery and real-life experiences (Sukmawati et al., 2022; Ernawati et al., 2021).

Parents, as primary educators, significantly influence a child's development and progress, particularly in remote areas where access to resources may be limited (Zhao & Lini Zhang, 2020; Widiyanto, 2015). Scientific literacy within families is vital for children's development, bridging the gap between

modernity and remote regions (Handayani, 2021; Sunandar et al., 2022). Digital scientific literacy, facilitated by information technology, enhances parental access to educational materials, fostering problem-solving skills crucial for children's development (Demir et al., 2020; Yamtinah et al., 2022).

Gender differences influence the implementation of family-based digital scientific literacy, impacting problem-solving approaches within families (Maharani et al., 2019; Ruddah et al., 2023). Research in remote areas like South Sulawesi sheds light on challenges in accessing and applying digital scientific literacy, offering insights into its role in child development (Maharani et al., 2019; Leni & Suripah, 2022). This study emphasizes the significance of digital scientific literacy in family education, considering gender disparities, in

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remote regions like South Sulawesi, providing a fresh perspective on educational challenges in such areas

From the research findings (Maharani et al., 2019), it's stated that male students' scientific literacy abilities enable them to select answers indicating better problem-solving skills compared to female students. This suggests that parents' approaches to solving family-related issues may differ (Leni & Suripah, 2022). This study aims to depict the implementation of family-based scientific literacy education in remote areas of South Sulawesi. Additionally, the research observes the transformation of gender-related digital scientific literacy in these remote regions."

The novelty of this research lies in its focus on remote areas, offering a new perspective on the challenges faced by families in accessing and applying digital scientific literacy, and how this can affect a child's development. It specifically centers on the implementation of digital scientific literacy within the context of family education in remote areas of South Sulawesi. This is relevant because research on scientific literacy often tends to be conducted in urban or more accessible environments. Moreover, this study will explore how digital scientific literacy can be applied in family education, considering gender differences, in remote regions of South Sulawesi.

Method

This study employs a Mixed Methods approach, combining qualitative and quantitative methods (Romiyati et al., 2023), depicting the comparison of digital scientific literacy implementation between males and females within families in remote areas of South Sulawesi.

Additionally, the study conducts a case study approach within several families or communities in remote areas of South Sulawesi to comprehend the implementation of digital scientific literacy in family education and its influence on scientific awareness and gender equality. It involves structured surveys and in-depth interviews with families or individuals in remote communities to gain direct insights into the level of scientific literacy and gender perceptions within family education.

The survey conducted in this study refers to the indicators that will be measured to understand the implementation of family-based scientific literacy education, specifically using the 5M approach: Observing, Questioning, Trying, Reasoning, and Communicating. This was then developed into a research instrument in the form of a Likert-scale questionnaire. The targeted recipients for distributing the questionnaire were:

The study comprised 50 households, each consisting of both fathers and mothers. Among these households, there were a total of 80 female children and 80 male children. To select the samples, a purposive sampling technique was employed, adhering to specific criteria. These criteria included families with both male and female children aged at least 12 years old, families practicing Islam, and families comprising both parents along with male and female children.

The data collected from interviews, observations, and questionnaire distributions will be analyzed using descriptive analysis (Ghosal et al., 2020)." This study uses two analysis techniques namely qualitative and quantitative techniques. For qualitative data, verbal transcript will be arranged by analyzing textual technique (Paul Vogt, 2015).

Result and Discussion

The depiction of family-based scientific literacy education implementation in remote areas.

Education is an incredibly important endeavor, whether it occurs within schools or within families, as it guides children through the creation of good morals, ethics, mental aptitude, communication skills, self-control, cooperation, and spiritual strength. Especially when education is based on scientific literacy, particularly in remote areas, children can communicate, cooperate, develop morals, mental faculties, and more based on a strong foundation of scientific knowledge (Suryanto et al., 2023). Education stands as one of the processes in developing human resources, particularly within the family (Simanullang et al., 2023)

Fundamentally, the implementation of family-based scientific literacy education in remote areas has not reached its maximum potential. Based on interviews, it's evident that the application of family-based scientific literacy education is not yet optimal due to the limited awareness among parents in remote areas. However, despite this, there are several families implementing education for their children with a scientific approach, particularly among parents with higher education levels (interview findings, Rundile, December 2, 2023).

Scientific literacy can be obtained through mobile phones, which nearly all age groups are using nowadays. Hence, parents have a significant opportunity to acquire scientific concepts that can be applied or transferred to their children within the family (interview findings, Mr. Teacher, December 2, 2023)

Actually, education has been implemented by parents in families in remote areas of South Sulawesi. However, the methods and concepts used by parents are not yet optimal and do not apply scientific concepts (scientific literacy), even though nowadays parents have a great opportunity to access scientific literacy through

digital means (mobile phones) (interview, Ustads Rafi, December 3, 2023).

Here is an overview of the characteristics of parents in remote areas."

Table 1. Description of the characteristics of parents and children

Education	F	%	Textual
Have no school	32	32	Reasons for not attending school: <ul style="list-style-type: none"> • Lack of finances • Early marriage
(SD)	29	29	
(SMP)	27	27	
(SMA)	6	6	
Higher Education	6	6	
	100	100	
Age at marriage			
15-17	34	37	<ul style="list-style-type: none"> • Early marriage due to family reasons • Early marriage to avoid unwanted circumstances • After completing elementary school without further education due to financial constraints, the family arranges early marriage even at the ages between 15-17
18-20	35	34	
21-30	19	18	
31<	12	11	
	100	100	
parents' work"			
Farmer Daily	76	76	
laborer	19	19	
Civil Servant"	5	5	
	100	100	
Child marriage plans based on age			
Daughter			
15-17	10	12.5	<ul style="list-style-type: none"> • "Wants to get married quickly to avoid the temptations of Satan." • Hopefully soon. • Find a job first before getting married • Go to school first for a change in the family."
18-20	57	71.3	
21-30	13	1.3	
31<	-	-	
	80	100	
Son			
15-17	14	17.5	<ul style="list-style-type: none"> •Wants to marry quickly to have children and become independent •Find a job first before getting married •Just focus on schooling first to get a good and decent job.
18-20	62	77.5	
21-30	4	5	
31<	-	-	
	80	100	
Desire to continue schooling			
Daughter			
Yes	65	81.2	<ul style="list-style-type: none"> •Wants to continue schooling in order to build a good family and be able to educate children better. •Can't continue due to lack of funds
No	15	18.8	
	80	100	
Son			
Yes	75	93.8	<ul style="list-style-type: none"> • Wants to continue schooling so that we can break out of economic hardship, change thinking patterns, and facilitate change. • Wants to continue to get a better job, tired of being a farming family. • Wants to continue schooling because the farmland is no longer sufficient for our family. • Wants to study to become someone. • Can't continue due to lack of funds
No	5	6.2	
	80	100	
Habit of searching for information on the mobile phone.			
Daughter			
Yes	65		<ul style="list-style-type: none"> • Girls in the research location generally have a mobile phone as a means to access digital science literacy • Girls in the research location rarely use their mobile phones to search for knowledge-based information.
No	15		

Education	F	%	Textual
			<ul style="list-style-type: none"> Girls more frequently use their mobile phones for taking photos, writing status updates. Girls use their mobile phones to search for recipes, fashion models, and celebrity gossip
Son	80	100	
Yes	55		<ul style="list-style-type: none"> Boys usually use their mobile phones to look for current news like the war in Gaza, sports news, and watch YouTube.
No	25		<ul style="list-style-type: none"> Boys often watch YouTube, TikTok to find references related to agriculture or hand skills
	80	100	

From the description above, it provides an illustration that in facing technological advancements, parents are required to accept input and broaden their perspectives in preparing themselves to act as teachers for their children within the family (Rahmadani et al., 2021). The following is a scheme of parental roles in educating children that can be implemented

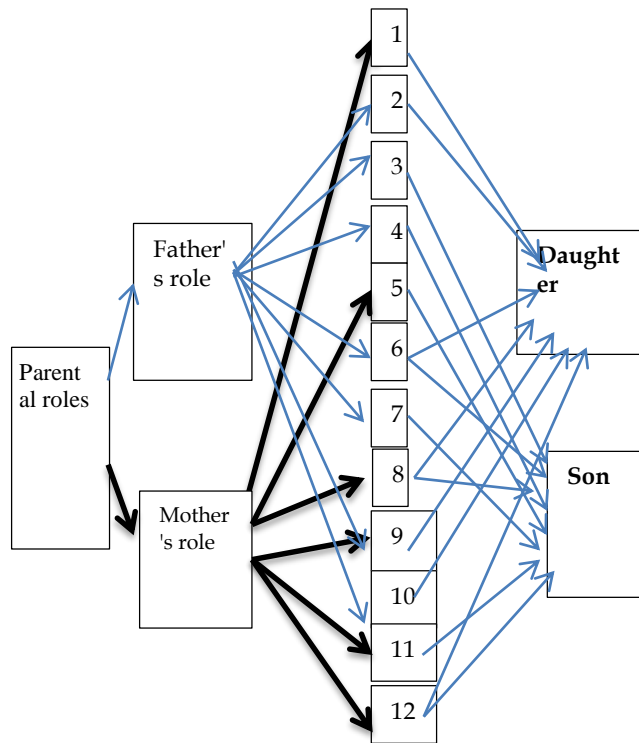


Figure 1. Parental roles in implementing gender-based education within the family"

Explanation: (1) Loving their children; (2) Maintaining the tranquility of the home environment and preparing for the tranquility of their children's souls; (3) Mutual respect between parents and children; (4) Building trust; (5) Holding family meetings and gatherings; (6) Doing good deeds; (7) Listening wholeheartedly; (8) Recognizing children's problems; (9) Empathizing with children; (10) Being a good listener; (11) Not acting as if a teacher; (12) Being able to keep secrets

Here is an illustration of the map for implementing family education based on digital science literacy.

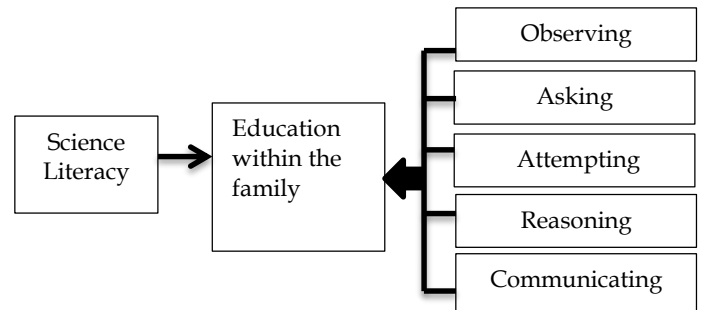


Figure 2. Map of family-based science literacy education implementation

Parents play a crucial role within the family, especially mothers, as they serve as the educational medium within the family, particularly in remote areas. (Khairunnisa et al., 2023) Mothers typically have the most time to provide education within the family, while fathers serve as reinforcement for implementing education within the family.

The implementation of family-based science literacy education in remote areas is not yet optimal due to the lack of parental knowledge about science literacy used in the implementation of family education. This was articulated by one parent who mentioned that family education has been carried out in essence, but anything related to science literacy has not been addressed. This is because parents in remote areas have limited insights, especially in the field of scientific knowledge. (interview, Ustads Rafi, December 3, 2023)"

Similar sentiments were expressed by Mr. Rasyid, stating that they have indeed implemented family education within their household. However, the digital science literacy-based education has not been maximally applied. Nevertheless, there are certain concepts imparted to their children that essentially align with science literacy-based education. For instance, parents observe their children's behavior, inquire about matters related to their attitudes and behaviors, and consistently communicate with their children in remote areas about things that need to be changed and improved (interview, Amiruddin Abbas, December 3, 2023).

From the aforementioned interviews, it is evident that the implementation of family-based science literacy education has been conceptualized but not maximized. This is due to the fact that parents in remote areas such as in Borong sub-district, Sinjai Regency, among the Tomabalo tribe in East Luwu, have limited insights regarding science literacy associated with implementing family-based education grounded in scientific concepts and the principles of the scientific approach, encapsulated in the 5M pattern: Observing, Asking, Trying, Reasoning, and Communicating (5M) (Helwig et al., n.d.). Therefore, there's a need for an educational approach specifically implementing digital-based science literacy education, especially in remote areas. Science literacy is crucial in preparing the younger generation to face the dynamic developments in the digital era and globalization (Wumu et al., 2023)."

The following is a quantitative analysis of the implementation of family-based science literacy education in remote areas

Table 2. Overview of the implementation of family-based science literacy education

Gender	indikator	Option	f	skor	%
Male	Observing	Yes	11	22	13.75
		No	69	69	86.25
	Asking	Yes	14	28	17.5
		No	64	64	80
	Attempting	Yes	9	18	11.25
		No	71	71	88,75
	Reasoning	Yes	6	12	7.5
		No	74	74	92,5
	Communicating	Yes	13	26	16,25
		no	67	67	83,75
Female	Observing	Yes	43	86	52.43
		No	47	47	58.75
	Asking	Yes	11	22	13.75
		No	69	69	86,25
	Attempting	Yes	8	16	10
		No	72	72	90
	Reasoning	Yes	6	12	7.5
		No	74	64	80
	Communicating	Yes	14	28	
		no	66	66	
TOTAL					

From the description in Table 2, it is evident that the implementation of family-based science literacy education generally has low scores, indicating that the execution of science literacy-based family education is still relatively low, meaning it's suboptimal

The Gender Transformation of Digital Science Literacy in Remote Areas

Referring to efforts to significantly alter the way women and men in remote areas engage with digital

technology-related science literacy. This involves enhancing equal access, understanding, and utilization of digital technology and science among both genders.

Remote areas often face challenges in accessing adequate technology and educational resources. Gender transformation in digital science literacy here means bridging the gap between women and men in terms of mastering and utilizing digital technology and scientific knowledge. (Nurfadilla et al., 2022) This could involve approaches that empower women through technology education, equitable internet access, and training programs that strengthen skills in digital science literacy.

By implementing gender transformation in digital science literacy in remote areas, it is hoped that there will be increased accessibility, knowledge, and skills in using digital technology, enabling more equitable and inclusive participation for women in the fields of science and technology. This, in turn, can create greater opportunities for women to develop and contribute significantly in the realm of science and technology, both at the local and broader levels (Zan & Amnah, 2023).

Globally, internet access or access to digital science literacy has shown progress. Women have parity with men in terms of safe access to digital science literacy. In Indonesia, according to data from the Central Statistics Agency (BPS) in 2020, women constituted 54.70% of internet users in 2022, while men accounted for 60.40%. According to the National Digital Literacy Index Survey 2021, the percentage of women using the internet is higher than men, at 56.6% (<https://indonesia.go.id/> accessed on December 8, 2023). Gender-based disparities in digital science literacy are a current issue, particularly experienced by rural women, especially in remote areas and among the elderly, due to educational and economic reasons (Jenderal et al., 2022).

Table 3 indicates that women often face limitations in accessing digital science literacy or seeking knowledge information through the internet. One of the main factors is possibly their lower level of education compared to men. The lack of adequate formal education access can hinder women from acquiring skills in using digital technology and comprehending science literacy in depth (Khoirotunnisa, 2023). Additionally, economic factors also play a significant role in these limitations. Many women may lack access or sufficient financial resources to acquire the devices and internet connection needed to obtain comprehensive and extensive information in the realm of digital science. This situation places women in a position where they are less capable of utilizing the full potential of available digital resources to support their personal development and knowledge.

Table 3. Overview of Internet Access Based on Gender

Gender	Options	The frequency of internet access	%
Child			
Daughter	Yes	54	67.5
	No	26	32.5
Son	Ya	39	48.8
	Tidak	41	51.2
Parents			
mother	Yes	23	23
	No	78	77
Father	Yes	54	54
	No	46	46
	Ownership of a cellphone		
Child			
Daughter	Yes	68	85
	No	12	15
Son	Ya	77	96.2
	Tidak	3	3.8
Parents			
mother	Yes	65	65
	No	35	35
Father	Yes	75	75
	No	25	25

Amidst these disparities in access, steps to enhance the inclusion of women in digital science literacy become crucial. Educational programs focused on empowering women in technology and digital sciences can offer more equitable opportunities. Additionally, initiatives to provide affordable internet access and inexpensive technological devices can help overcome the economic barriers often faced by women. With collaborative efforts from various stakeholders, the potential and contributions of women in the digital science realm can be more optimal and widespread, paving the way for the creation of a more inclusive and sustainable society.

Discussion

Science literacy is an essential necessity in facing the advancements of science and technology in the era of globalization (Santoso et al., 2022). This ability equips generations with a scientifically-based mindset and skills to solve problems across various aspects of human life (Seprianto & Hasby, 2023). Therefore, science education and literacy have become a major focus internationally (Zahara et al., 2022). Indicators of science literacy include the ability to recall theories, identify, provide good examples, and have sufficient understanding to justify attitudes, concepts, and behaviors based on science (Putri & Wulandari, 2022).

The application of digital science literacy in education within families in remote areas is crucial to unlock the potential of children for fostering religious

obedience, self-control, intelligence, moral character, as well as the necessary skills for both the child and the community. (Nurhayati et al., 2023) In essence, science literacy in family education can be implemented through habits, exemplification, advice, and the 5M approach—Observing, Asking, Trying, Reasoning, and Communicating—aimed at enhancing the attitudes, moral values, and behaviors of children in their social lives (Sumirat et al., 2023)

The application of digital science literacy in education within families in remote areas is a vital aspect because scientific literacy instills contextual knowledge, attitudes, and competencies in children. This opens doors for the development of children's potential, not only acquiring understanding related to digital technology but also shaping key aspects of their personalities and skills (Suparya et al., 2022) With digital science literacy integrated into family education, children have the opportunity to develop religious obedience, self-control, acquire better intelligence, build strong moral character, and obtain the skills they need (Framanta, 2020). Education within the family environment forms the primary foundation for building this. The involvement of technology in education opens broader horizons for children in remote areas. Through digital science literacy, they can gain relevant, up-to-date, and diverse knowledge (Joko et al., 2023). Additionally, the technological skills acquired also assist them in the learning process, making them more prepared to face the demands of an ever-evolving era. Besides the individual benefits for children, the implementation of digital science literacy in family education also influences society as a whole. Children adept in digital science literacy have the potential to become agents of change in their communities. They can contribute to solving local problems, create new opportunities, and build technologically advanced communities.

Therefore, the integration of digital science literacy into family education in remote areas is not just about technological development, but also about shaping resilient individuals with moral values, a balanced set of hard and soft skills, and readiness to face future challenges amidst the dynamic changes in an evolving global society (Wuryani & Nugraha, 2021).

Remote areas often face significant challenges in accessing basic services such as education, healthcare, and infrastructure. Limited infrastructure and difficult geographic accessibility, such as mountains, rivers, or wilderness, often isolate remote areas from broader access. Additionally, constraints in internet access also affect the development and connectivity with the outside world (Putri et al., 2022)"

South Sulawesi, for instance, is a region composed of islands with mountainous terrain. (Sui et al., 2020)

This often makes access difficult for its inhabitants. The main challenge faced is how to enhance the quality of life for the communities in this area. Policies formulated should focus on providing better access to basic services such as education, healthcare, and adequate infrastructure.

Realizing social justice for all Indonesian citizens, as mandated by the fifth principle of Pancasila, becomes a complex task. Education stands as the primary key in transforming the lives of communities in remote areas, as quality education opens doors to economic advancement and family welfare. Hence, special attention to enhancing educational access in remote areas becomes highly important in achieving this goal.

Conclusion

The implementation of digital science literacy in family education focusing on gender studies in remote areas of South Sulawesi has not been fully optimal; one of the factors is the limited ownership of devices such as mobile phones. Ownership of these technological devices is predominantly by men. However, some principles of the scientific approach using the 5M pattern - Observing, Questioning, Trying, Reasoning, and Communicating (5M) - have often been practiced by parents within the family. Still, these parents lack conceptual understanding that what they have implemented constitutes a principle of science literacy approach.

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