



DIGITAL LITERACY LEVEL OF ELEMENTARY SCHOOL STUDENTS: A DESCRIPTIVE QUANTITATIVE STUDY

Fithri Nurlaelasari^{1*}, Wahyu Sopandi², Rina Heryani³, Angga Hadiapurwa⁴

^{1,2,3,4}Universitas Pendidikan Indonesia, Bandung, Indonesia

*Corresponding Author: ✉ fithrinurlaelasari@upi.edu

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Abstract. Digital literacy is a crucial competency for Generation Alpha students growing up in an increasingly complex digital environment. Although elementary school students are now intensively exposed to technology from an early age, their digital literacy levels have not yet developed optimally across all dimensions, and the contextual factors that shape their profile differences, such as grade level, age, gender, and device ownership, are not yet empirically understood. This study aims to analyze the digital literacy levels of upper-grade students at a public elementary school in Cimahi City, based on the four pillars of digital literacy, and to compare their profiles across these contextual variables. A quantitative descriptive survey was conducted with 150 students through purposive sampling, using a 20-item questionnaire adapted from the Ministry of Communication and Digital Development (Kemkomdigi) framework (2025). The results showed an overall achievement of 83.56% (Good category), with the highest digital security (90.59%) and the lowest digital skills (74.52%). There is a consistent upward trend across grade (79.71%–85.87%) and age (76.67%–85.17%), with minimal gender differences, and students with their own devices outperformed those using parental devices on the digital skills and safety pillar. The gap between high levels of ethical awareness and digital safety on the one hand and low levels of productive skills on the other hand indicates that technology exposure has not been optimally directed in the learning context. These findings indicate the need for targeted interventions to strengthen elementary school students' productive digital competencies.

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Correspondence address:

Jl. Dr. Setiabudhi No. 229 Bandung 40154 Indonesia.

✉ fithrinurlaelasari@upi.edu

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Program Studi PGSD Universitas Flores. Jln. Samratulangi,
Kelurahan Paupire, Ende, Flores.

✉ primagistrauniflor@gmail.com

INTRODUCTION

The massive development of digital technology over the past two decades has fundamentally changed the way humans learn, work, and communicate (Sołtysik-Piorunkiewicz & Zdonek, 2021). This change is manifested, among other things, through the Industrial Revolution 4.0, an era in which artificial intelligence and the Internet of Things (IoT) are the primary drivers of transformation that permeates all sectors of life, including education (Rahmat et al., 2025). The central role of technology in education was further demonstrated when the COVID-19 pandemic forced more than 1.5 billion students worldwide to abruptly shift to online learning (UNESCO, 2020). The OECD (2024) noted that the current generation of children is growing up in a far more complex digital environment than any previous generation, with both opportunities and risks present simultaneously. This situation emphasizes that mere mastery of technology is not enough; what is truly needed is the ability to use it intelligently, ethically, and responsibly, a skill known as digital literacy.

Digital literacy is a concept that goes far beyond simply the ability to operate devices; UNESCO defines it as the ability to access, manage, understand, integrate, communicate, evaluate, and create information securely through digital technology (Law et al., 2018). This concept is multidimensional, encompassing cognitive, social, ethical, and cultural dimensions simultaneously (Chan & Sung, 2025). Livingstone et al. (2023) caution that technical proficiency without ethical understanding can actually increase a person's vulnerability to digital risks, rather than protect them. The Ministry of Communication and Informatics of the Republic of Indonesia formulates this concept into four complementary pillars: digital skills, digital culture, digital ethics, and digital security (Kominfo, 2020). A balance between these four pillars is necessary so that individuals are not only functionally competent but also possess ethical awareness and the capacity to protect themselves in the digital space (Isabella & Agustian, 2023). This framework

should ideally be instilled early in every student, including those who are now growing up as the first generation born and raised entirely within the digital ecosystem, known as Generation Alpha.

Generation Alpha, children born since 2013, is the first generation to grow up fully immersed in the digital ecosystem, and Indonesia is among the countries with the largest populations of this generation worldwide (Höfrová et al., 2024). Data from APJII Indonesia (2024) shows that Indonesian internet users have reached 229.4 million, with a penetration rate of 80.66%, and that Generation Alpha accounts for 23.19% of total users. Unfortunately, this widespread access is not necessarily accompanied by adequate digital literacy maturity. Research by Rideout & Robb (2020) found that children aged 8–12 years spend an average of 5.5 hours per day in front of a screen, but most of this time is spent on entertainment rather than on activities that build meaningful digital competence. Furthermore, Masyhura & Ramadan (2021) emphasized that the implementation of digital literacy in Indonesian elementary schools has not been optimal, while Purnama et al. (2021) found that students with low digital literacy tend to be more vulnerable to hoaxes, cyberbullying, and data security threats, even though they are skilled at operating devices. This gap between the intensity of technology use and digital literacy maturity indicates that students' digital literacy skills are not solely shaped by their exposure to technology but are also influenced by a number of accompanying contextual factors.

The contextual factor that has received the most attention in studies of children's digital literacy is personal device ownership. Children who own their own devices tend to have more space to practice and explore the digital ecosystem independently than children who access technology through parental devices (Biney & Richard Adade, 2024). Tejada-Garitano et al. (2024) reported that two-thirds of 11–12-year-old students in Spain already own their own smartphone, and one-third received it before entering their final year of elementary school, reflecting the rapid adoption of technology among children. Beyond device ownership, Setiana & Eliasa (2024) explain that the 9–12-year age period is a critical period for the formation of children's digital character, as cognitive and moral development occurs rapidly and is interconnected during this period. Safari et al. (2024) identified gender differences in digital device use based on PISA 2018 data, where male students tended to demonstrate higher levels of technical activity, although their depth of contextual understanding was not necessarily equal. These variables, namely device ownership, age, grade level, and gender, interact to form a layered digital literacy profile, but this condition has not been mapped in an integrated manner in empirical research at the Indonesian elementary school level.

This uncharted situation reflects a significant gap in the empirical literature on digital literacy at the elementary school level. Research conducted by Bahasoan (2026) using a descriptive, quantitative approach and a survey method with 60 upper elementary school students found that students' digital literacy was distributed across the high (68%), medium (25%), and low (7%) categories. Although the majority of students have strong digital literacy skills, the results also show that safe and responsible technology use remains suboptimal, underscoring the need for more comprehensive efforts to strengthen digital literacy. Research conducted by Salsabila & Rukli (2025) using a quantitative approach found that the digital literacy of elementary school students was in the high category, with an average of 82.81%. In more detail, the aspect of digital ethics had the highest percentage at 84.90%, followed by information evaluation at 83.85% and information access at 82.29%, while technology utilization remained the lowest at 79.17%. This indicates that although students' digital literacy skills are considered good, gaps remain between aspects, particularly in optimal technology utilization. This lack of adequate data presents a significant obstacle for educational institutions in designing targeted intervention programs, as valid assessment instruments and comprehensive evaluation data are not yet readily available (Alfian et al., 2025). Mapping digital literacy profiles through initial assessments is a crucial step in understanding variations in student competency levels. The results of this mapping can serve as a basis for designing digital literacy development efforts that are more aligned with user needs and characteristics (UNESCO, 2018). This situation suggests that although empirical data on the low digital literacy of elementary school students is beginning to become available, studies that comprehensively map their profiles based on demographic



variables in the Indonesian context remain an unanswered gap.

This gap prompted this study to formulate two main questions: (1) What is the digital literacy level of senior high school students in one of the public elementary schools in Cimahi City based on the four pillars of digital skills, digital culture, digital ethics, and digital security? (2) How do students' digital literacy profiles differ based on gender, grade level, age, and digital device ownership? Therefore, this study aims to (1) analyze the digital literacy level of senior high school students based on the four pillars of digital literacy, and (2) compare students' digital literacy profiles based on gender, grade level, age, and digital device ownership.

RESEARCH METHODS

This study used a quantitative approach with a descriptive survey design (Sugiyono, 2013). The study was conducted at a public elementary school in Cimahi City, West Java, in December 2025, during the 2025/2026 academic year. The study population comprised all fourth, fifth-, and sixth-grade students at the school. The sample was selected using a purposive sampling technique with two criteria: (1) active participation in learning activities, and (2) willingness to participate in the study. The sample comprised 150 students ($N = 150$), including 72 male students (48%) and 78 female students (52%), with a distribution by grade shown in Table 1.

Table 1. Distribution of Research Samples

Class	Male	Female	Total
4 (Four)	17	17	34
5 (Five)	47	46	93
6 (Six)	8	15	23
Total	72	78	150

The age range of respondents was 9 to 12 years, with the highest distribution among 11-year-olds ($N = 79$, 52.7%). Based on device ownership, 106 students (70.7%) used their own devices, and 44 students (29.3%) used their parents' devices. Most students recorded daily internet access ($N = 104$, 69.3%), and 86 students (57.3%) completed the questionnaire independently, while 64 students (42.7%) received assistance from their parents.

The data collection instrument was a closed-ended questionnaire developed based on the Ministry of Communication and Informatics' National Digital Literacy Framework (Kominfo, 2020) and adapted to the cognitive characteristics of elementary school students. The questionnaire consists of 20 statements covering four pillars with the following distribution: 6 digital skills items, 6 digital culture items, 5 digital ethics items, and 3 digital security items. The measurement scale uses a three-point Likert as in Table 2, with a maximum score of 60.

Table 2. Questionnaire Measurement Scale

Score	Description
1	Never
2	Sometimes
3	Always

Data collection was conducted using Google Forms distributed via a link sent to students by the class teacher. The questionnaire completion procedure consisted of four stages: (1) obtaining permission from the school and approval from parents or guardians; (2) explaining the study objectives and completion procedures to students; (3) monitoring the completion of the questionnaires within the school environment during designated class hours; and (4) checking the completeness of the data before entering the analysis phase. All 150 questionnaires collected were deemed complete and eligible for analysis.

Data analysis used descriptive statistics, including calculating the average score and achievement percentage for each variable (Gall et al., 2014). Achievement percentages were interpreted using four categories: very good ($\geq 85\%$), Good (70–84%), Sufficient (55–69%), and Poor ($< 55\%$). Very Categorization per competency domain used the predicates Proficient ($\geq 85\%$), Developing (70–84%), Beginning (55–69%), and Needs Assistance ($< 55\%$). Achievement percentages were categorized into four groups. A comparative analysis was conducted to examine

digital literacy profiles by gender, grade level, age, and digital device ownership. The entire analysis process was conducted using Microsoft Excel.

RESULTS AND DISCUSSION

1. Overall Digital Literacy Level of Students

The average digital literacy score for 150 senior students was 50.13 out of a maximum of 60 (SD = 5.35), with an achievement percentage of 83.56%, which falls within the good category. The distribution of students by category shows that 74 students (49.3%) are in the very good category, 66 students (44.0%) are in the good category, and 10 students (6.7%) are in the sufficient category. No students are in the poor category. Achievements per pillar are presented in Table 3 and Figure 1.

Table 3. Digital Literacy Achievement by Pillar

Pillar	Mean	Max Score	%	Category	Domain
Digital security	8,15	9	90,59	Very Good	Proficient
Digital culture	15,60	18	86,67	Very Good	Proficient
Digital ethics	12,97	15	86,44	Very Good	Proficient
Digital skills	13,41	18	74,52	Good	Developing
Total	50,13	60	83,56	Good	—

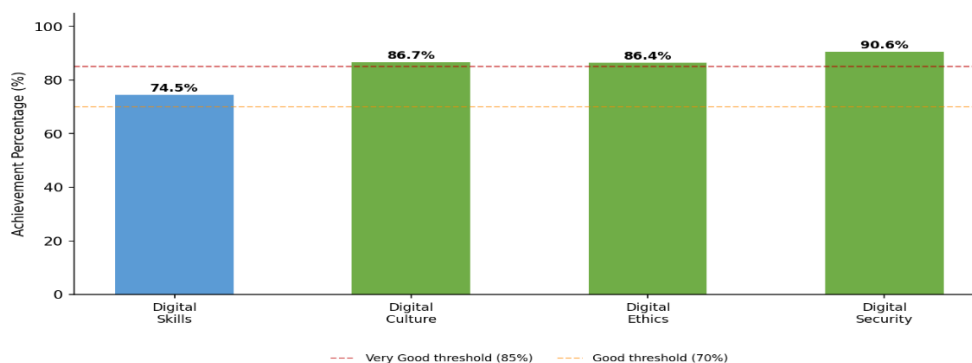


Figure 1. Percentage Achievement by Digital Literacy Pillar

The overall achievement of 83.56% indicates that the senior students at this school have an adequate digital literacy foundation, including the ability to access. Manage and evaluate digital information (Law et al., 2018), and create and share content responsibly (Hobbs, 2010). The result aligns with the findings of Sajidan et al. (2023), who reported that Indonesian elementary school students' average digital literacy skills are in the good category. This achievement is also consistent with the Ministry of Communication and Digital (Kominfo, 2020)'s argument that generations who grow up with technology from an early age tend to develop digital competencies organically, though not always balanced across all dimensions.

2. Analysis by Digital Literacy Pillar

The variation in achievement across pillars was the most significant finding in this study, reflecting the multidimensional nature of digital literacy (Chan & Sung, 2025). The three pillars of digital security (90.59%), digital culture (86.67%), and digital ethics (86.44%) were classified as very good, while digital skills (74.52%) lagged considerably, reaching only the good category (Kominfo, 2020). This asymmetric pattern indicates that students are more proficient in normative and protective dimensions, such as maintaining privacy, behaving politely, and thinking critically, than in productive and technical dimensions (Chan & Sung, 2025). Livingstone et al. (2023) caution that technical proficiency without a balanced ethical understanding can actually increase digital vulnerability. This finding suggests the opposite: an equally problematic situation, high ethical and security awareness, but still weak productive abilities.

Weaknesses in the digital skills pillar are particularly evident in the items "using Canva, Word, or PowerPoint for schoolwork" (64.7%) and "creating useful digital work" (67.1%), reflecting a gap between passive consumption and active digital production that Hobbs (2010) identifies as the core challenge in digital literacy education, students can access information but



struggle to create and share it meaningfully. This low level of productive skills aligns with the findings of [Masyhura & Ramadan \(2021\)](#), who identified that digital literacy implementation in Indonesian elementary schools focuses more on passive technology use than on content creation. This suggests that students are only at the "developing" level of digital skills, meaning they require more intensive guidance to reach advanced levels.

3. Analysis by Gender

A comparison of digital literacy achievement by gender is presented in [Table 4](#).

Table 4. Digital Literacy Comparison by Gender

Pillar	Male (N=72)	Female (N=78)	Difference
Digital skills	73,92%	75,07%	+1,15%
Digital culture	86,57%	86,75%	+0,18%
Digital ethics	86,57%	86,32%	-0,25%
Digital security	89,81%	91,31%	+1,50%
Total	83,26%	83,82%	+0,56%
Category	Good	Good	—

The achievement gap between boys and girls was very small across all pillars, with the largest gap being only 1.50 percentage points in the digital security pillar. There were no categorical differences between groups; both groups consistently remained in the same category across all pillars. This pattern suggests that students' digital access and experiences at this school are relatively equal between boys and girls, which differs from [Safari et al. \(2024\)](#) findings based on PISA 2018 data, which identified a more pronounced gender difference in digital device use. Differences in context may explain this gap: the PISA study was cross-country and included large socioeconomic variations ([OECD, 2024](#)), whereas this study was limited to a single school with more homogeneous characteristics ([Höfrová et al., 2024](#)).

This finding is also consistent with the argument by [Biney & Adade \(2024\)](#) that the increasing prevalence of personal digital device ownership among elementary students reduces gender-based access barriers. With 71% of students in this sample owning their own device, it is unsurprising that gender-based differences are minimized. From a policy perspective, this finding suggests that digital literacy interventions at this school need not differentiate between male and female students, but can instead be designed inclusively for all students.

4. Analysis by Grade Level

A comparison of achievement by grade level, along with its visualization, is presented in [Table 5](#) and [Figure 2](#).

Table 5. Digital Literacy Comparison by Grade Level

Pillar	Grade 4 (N=34)	Grade 5 (N=93)	Grade 6 (N=23)
Digital skills	65.20% (Beginning)	76.11% (Developing)	81.88% (Developing)
Digital culture	89.54% (Proficient)	86.68% (Proficient)	82.37% (Developing)
Digital ethics	82.75% (Developing)	87.38% (Proficient)	88.12% (Proficient)
Digital security	83.99% (Developing)	91.40% (Proficient)	97.10% (Proficient)
Total	79,71%	84,39%	85,87%
Overall category	Good	Good	Very Good

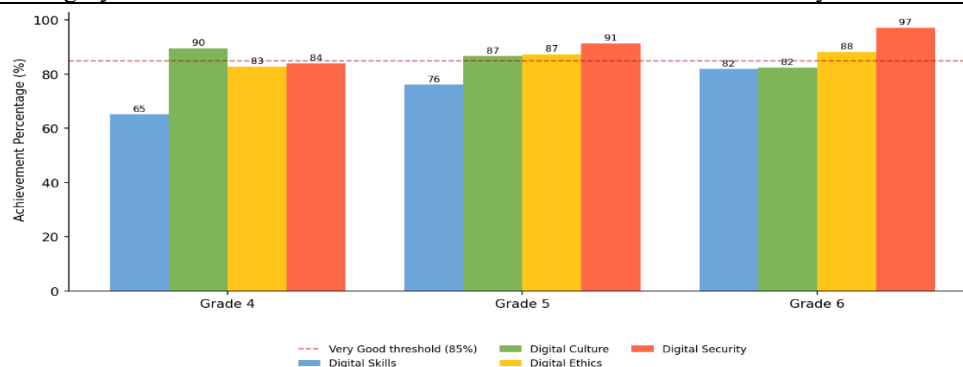


Figure 2. Achievement Comparison by Pillar and Grade Level



Overall, there is a consistent upward trend from Grade 4 to Grade 6, with Grade 6 being the only group to reach the very good category (85.87%). This pattern aligns with Piaget's theory of cognitive development, which identifies the concrete operational stage (ages 7-11) and the transition to formal operations (age 11 and above) as critical periods for the maturation of logical thinking and contextual understanding (Jean & Inhelder, 1969; Setiana & Eliasa, 2024). As students' cognition matures, they become increasingly capable of understanding the nuances of digital ethics, assessing information security, and using technology more purposefully.

The digital skills pillar shows the most dramatic and consistent improvement from Grade 4 to Grade 6, progressing from the Beginning category (65.20%) to the Developing category (81.88%). This indicates that digital technical skills accumulate progressively with increasing learning experience and exposure to technology-based tasks in school (Sajidan et al., 2023). This is consistent with Sajidan et al. (2023), who found that productive digital capabilities, such as creating presentations and using creative applications, develop significantly among more senior students.

A different pattern was observed in the digital culture pillar, which declined from Grade 4 (89.54%) to Grade 6 (82.37%), although both remain within a good range. This decline may be interpreted as evidence that Grade 6 students, who use technology more intensively for various purposes, including social media and digital communication, face greater challenges in adhering to device usage schedules and maintaining a balance between digital and non-digital activities (Höfrová et al., 2024). This is consistent with Rideout & Robb (2020), who found that increased screen time intensity among upper elementary students correlates with reduced compliance with parents' screen time rules.

The digital security pillar shows the greatest improvement, with Grade 6 achieving a near-perfect score of 97.10%. This finding suggests that as students advance through grades, they become increasingly aware of the importance of protecting their privacy and securing their digital accounts. Livingstone & Blum-Ross (2020) explain that children's digital security awareness develops through a combination of direct experience, including negative experiences such as near encounters with online fraud, and explicit guidance from parents and teachers.

5. Analysis by Age

Digital literacy achievement by age group is presented in Table 6.

Table 6. Digital Literacy Achievement by Age

Age	N	Mean Score	%	Category
9 years	3	46,00	76,67	Good
10 years	39	48,10	80,17	Good
11 years	79	50,91	84,85	Good
12 years	20	51,10	85,17	Very Good
Unidentified	9	–	–	–

There is a consistent upward trend in digital literacy achievement with increasing age, from 76.67% at age 9 to 85.17% at age 12. Students aged 12 are the only age group to reach the very good category. This pattern is consistent with cognitive development theory, which asserts that the 9–12 age range represents a critical period for the maturation of logical thinking and contextual understanding (Setiana & Eliasa, 2024). The cognitive maturity that develops with age enables students to better understand the consequences of digital activities, evaluate information more carefully, and exercise greater discipline in managing technology use.

A similar pattern was also found in the grade-based analysis, confirming that the improvement in achievement is not merely an artifact of increasing biological age, but also reflects the accumulation of structured learning experiences at school. This aligns with Biney & Adade (2024) argument that longer and more directed technology exposure correlates positively with overall digital literacy competence. It is important to note that the age-9 group consisted of only 3 students, and 9 age entries were unidentifiable due to inconsistent formatting in the response form; therefore, age-based comparisons should be interpreted with caution.

6. Analysis by Digital Device Ownership

A comparison of achievement by digital device ownership status is presented in Table 7.



Table 7. Digital Literacy Achievement by Device Ownership

Pillar	Own Device (N=106)	Parental Device (N=44)	Difference
Digital skills	76.31% (Developing)	70.20% (Developing)	+6,11%
Digital culture	86.22% (Proficient)	87.75% (Proficient)	-1,53%
Digital ethics	86.67% (Proficient)	85.91% (Proficient)	+0,76%
Digital security	92.66% (Proficient)	85.61% (Proficient)	+7,05%
Total	84,32%	81,70%	+2,62%
Overall category	Good	Good	—

Students with their own devices showed higher overall achievement (84.32% vs 81.70%), with more pronounced differences in the digital skills (+6.11 percentage points) and digital security (+7.05 percentage points) pillars. The difference in digital skills can be explained by independent access, which allows students to practice using productive applications more frequently, engage in digital creation, and explore technology features without depending on parental device availability (Biney & Adade, 2024). Tejada-Garitano et al. (2024), who reported that personal device ownership significantly expands opportunities for digital exploration, further support this interpretation.

The relatively large difference in digital security (+7.05 percentage points) is particularly noteworthy. Students who use their own devices are likely to encounter situations requiring independent digital security decisions more frequently, such as managing passwords, responding to friend requests from strangers, and deciding what is safe to share, thereby accumulating more practical experience in developing digital security awareness (Livingstone & Blum-Ross, 2020).

The most notable finding concerns the digital culture pillar, where students using parental devices scored slightly higher (87.75% vs 86.22%). Livingstone & Blum-Ross (2020) explain that parental mediation in digital device use, whether through time restrictions, active co-use, or discussions about digital content, has been shown to contribute to the internalization of positive digital behavioral norms in children. This implies that independent device ownership should be accompanied by adequate guidance from parents and teachers to prevent a potential decline in students' digital culture quality.

CONCLUSIONS AND SUGGESTIONS

Upper-grade students in the elementary schools studied had good levels of digital literacy, but their development was not balanced across pillars. The pillars of digital safety, culture, and ethics were more developed than the pillar of digital skills, suggesting that early exposure to technology is more successful in shaping digital awareness and attitudes than the ability to use technology creatively and independently. Gender, grade level, age, and device ownership were shown to shape digital literacy profiles in a non-linear pattern: cognitive maturity supported general improvement, device ownership fostered technical competence, but parental mediation played a greater role in shaping digital culture, and gender-based differences showed no significant pattern. These findings open up opportunities for broader follow-up research to test the effectiveness of pillar-based interventions, map digital literacy profiles across different school contexts, and explore the role of teachers and parents as mediating variables in the development of elementary school students' digital literacy.

Schools and teachers need to explicitly integrate digital productivity activities into learning, especially in early grades and beyond, through approaches that are embedded within existing subjects. Parents should continue to actively mediate even when children have their own devices, as mentoring contributes to the quality of children's digital culture. Further research is recommended using comparative or correlational designs with a broader sample size and considering the variables of teacher role and family background.

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