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Validation of a Digital Health Literacy Instrument for Adolescents: From Needs Assessment to a Contextualized Digital Health Promotion Intervention

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ABSTRACT

This study evaluated the validity and reliability of an adolescent digital health literacy instrument and changes following a needs-based intervention. A one-group pretest-posttest-follow-up design involved 100 students in grades 10–12 from five schools in Padang, Indonesia. The 30-item instrument covered six domains. Validity and reliability were assessed using item-total correlations, Cronbach's alpha, composite reliability (CR), AVE, and Pearson correlations; changes were analyzed using paired t-tests. All items were valid ($r = 0.460–0.744$; $p < 0.001$), with acceptable reliability ($\alpha = 0.779–0.883$; CR = 0.748–0.842). However, AVE was below 0.50 in five domains, indicating limited convergent validity. Most participants (91%) had moderate literacy. Mean scores increased from 3.24 ± 0.31 at pretest to 3.78 ± 0.39 at posttest ($p < 0.001$; $dz = 3.20$), then declined slightly to 3.69 ± 0.38 at four-week follow-up but remained above baseline ($p < 0.001$). The instrument showed acceptable item-level validity and reliability, although further refinement is needed. Improvements were largely maintained; however, the absence of a control group limits causal interpretation.

Keywords : *Digital Health Literacy, Adolescents, Instrument Validation, Health Promotion, Digital Intervention*

INTRODUCTION

Digital transformation has fundamentally changed the way people, including adolescents, access and utilize health information. Today's adolescents are growing up as digital natives who spend a significant portion of their time interacting with digital devices and media, including seeking health-related information. This makes digital health literacy a crucial competency for the 21st century. Digital health literacy is defined as an individual's ability to search for, find,

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understand, assess, and apply health information obtained from electronic sources to address or solve health problems (Ban, Kim, & Seomun, 2024). This concept is multidimensional, encompassing not only the technical ability to operate digital devices but also the cognitive and social skills to evaluate the credibility of information and apply it to everyday health decision-making.

Recent evidence positions digital health literacy as an important determinant of adolescent health. Adolescence is a critical period for the formation of long-term health behaviors, and digital and interactive approaches are considered strategic for strengthening health literacy in this age group (Mancone, Corrado, Tosti, Spica, & Diotaiuti, 2024). Access to and the ability to use digital information has even been proposed as a new determinant of health alongside classic socioeconomic determinants (Ong, Fernández, Hicklent, Obeles, Rocimo, & Celi, 2023). Among adolescents, digital health literacy has been associated with self-efficacy (Taba et al., 2022) and with health-promoting behaviors (Kartal, Turan, & Kocakabak, 2021). At the same time, digital health literacy is not evenly distributed: a representative study in Germany found that it varied with sociodemographic factors among children and adolescents (Stauch et al., 2025). This variation means that the level and pattern of digital health literacy in one population cannot simply be assumed for another, which is why measurement instruments that are sensitive to the context of a specific population are needed before interventions are planned.

Conceptually, digital health literacy measurement often refers to the eHealth Literacy Model, which integrates the dimensions of access, understanding, evaluation, and application of digital health information (El Benny, Kabakian-Khasholian, El-Jardali, & Bardus, 2021). However, available instruments show three recurring limitations supported by recent methodological literature. First, a scoping review by Faux-Nightingale, Philp, Chadwick, Singh, and Pandyan (2022) found that many digital health literacy instruments do not comprehensively cover all dimensions of the construct. Second, many have not been adequately validated in adolescent populations outside their home-country contexts, and validation efforts in new contexts have often involved other groups, for example the digital health technology literacy questionnaire developed and validated by Yoon et al. (2022) in an adult population in South Korea. Third, instruments developed elsewhere may not fit the language, social media use, and access to digital devices of Indonesian adolescents, and instruments validated specifically in adolescent populations with local sociocultural characteristics are still very limited. Existing instruments are therefore insufficient as a basis for planning health promotion for Indonesian adolescents, because valid and reliable instruments are an absolute prerequisite for digital health literacy data to inform health promotion program planning.

Beyond measurement issues, evidence on digital-based interventions for improving health literacy is promising but heterogeneous. Positive findings have been reported across age groups: a meta-analysis in older adults concluded that digital health literacy interventions were consistently effective in improving health-related digital competencies (Dong, Liu, Liu, Yang, & Liu, 2023), and a school-based program and an e-learning course improved digital health literacy in elementary

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and school-aged children (Hyman et al., 2020; König, Marbach-Breitrück, Engler, & Suhr, 2022). Among adolescents, the studies cited here mostly target specific health outcomes, such as HPV vaccination coverage (Choi, Tamí-Maury, Cuccaro, Kim, & Markham, 2023) and mental health (Lehtimaki, Martic, Wahl, Foster, & Schwalbe, 2021), rather than digital health literacy itself, and they differ in target population, outcomes, and design, which limits direct comparison. One consistent message across this literature is that contextualization matters: Lewis et al. (2024) emphasized co-designing educational resources with adolescents so that interventions are relevant and accepted by the target audience, while Çetin and Gümüş (2023) found a positive relationship between digital health literacy and healthy lifestyle behaviors across generations, and Pisano Gonzalez (2025) emphasized that digital health literacy is a key factor in realizing the value of digital transformation in the health sector.

Taken together, the literature shows that digital health literacy matters for adolescents and that digital interventions are promising, but two gaps remain. First, as described above, instruments validated for Indonesian adolescents that cover the full range of digital health literacy domains remain limited. Second, few studies systematically link the validation of a measurement instrument with a needs assessment and the design of a contextualized health promotion intervention, particularly for adolescent populations in Indonesia, so interventions are rarely planned and evaluated with a measure that has been tested in the same population. The novelty of this study lies in the contribution generated by integrating these components, rather than in the sequence of research procedures. Scientifically, it provides a digital health literacy instrument for Indonesian adolescents whose six domains are used consistently to describe literacy profiles, to identify needs, and to evaluate change after an intervention, together with a transparent report of the psychometric strengths and weaknesses of that instrument. Practically, the needs assessment findings are translated into the content and methods of a contextualized intervention whose outcomes and sustainability are then monitored with the same instrument at three measurement points.

Based on this description, this study aims to: (1) test the validity and reliability of digital health literacy instruments in adolescents; (2) describe adolescents' digital health literacy profiles in each domain and their variations based on sociodemographic characteristics; and (3) evaluate changes in digital health literacy following a digital health promotion intervention developed based on the needs assessment results, including whether these changes were maintained at follow-up.

METHODS

This research used a quantitative approach combining two stages within a single study. The first stage was a cross-sectional instrument validation study to test the validity and reliability of the digital health literacy questionnaire. The second stage was a pre-experimental study with a one-group pretest-posttest-follow-up design to assess changes in digital health literacy following a digital health promotion intervention designed based on the results of a needs assessment in the

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same population. The same 100 students participated in both stages. The instrument validation data were obtained from the pretest administration of the questionnaire, so that the pretest served both as the data source for the validation analysis and as the baseline of the intervention evaluation. The two stages were combined so that the instrument used to measure intervention outcomes was tested for validity and reliability in the same population and context in which it was applied.

The study was conducted in Padang City, Indonesia. The study population comprised senior high school students in grades 10 to 12. Five schools participated (3 public and 2 private), selected purposively based on school agreement and availability of digital infrastructure. Individual students were selected purposively based on eligibility criteria, which included active student status, ownership or regular access to a smartphone/digital device, and willingness to participate. A total of 250 students were initially recruited at baseline. During the study flow, 50 students were excluded at the pretest stage due to incomplete questionnaire completion, 50 were lost to follow-up at the posttest stage owing to school absenteeism during intervention sessions, and 50 were lost at the 4-week follow-up measurement. Consequently, 100 respondents completed all three evaluation stages (pretest, posttest, and 4-week follow-up) and were included in the final analysis (overall completion rate: 40%). Although a final sample of $N = 100$ is constrained for complex structural modeling, it satisfies the minimum ratio of 3–5 respondents per item for Confirmatory Factor Analysis (CFA) on a 30-item scale in preliminary validation contexts, as recommended in psychometric literature.

The instrument used in this study was a digital health literacy questionnaire consisting of 30 items measured on a five-point Likert scale (1 = strongly disagree/never to 5 = strongly agree/always). The questionnaire assessed six domains of digital health literacy, with five items assigned to each domain: (1) information access, (2) information evaluation, (3) information application, (4) digital communication, (5) privacy and safety, and (6) health-promoting behavior. The development of these domains was based on an integration of the eHealth Literacy Model (El Benny et al., 2021) and the contemporary digital health literacy conceptual framework (Ban et al., 2024), while methodological recommendations for instrument validation were also incorporated (Faux-Nightingale et al., 2022; Yoon et al., 2022).

Content validity was rigorously evaluated prior to field administration by a panel of three independent experts (one expert in health promotion and education, one expert in digital health technologies, and one public health epidemiologist). The experts evaluated each item on a 4-point ordinal scale for relevance and clarity. The Item-level Content Validity Index (I-CVI) ranged from 0.83 to 1.00, and the overall Scale-level Content Validity Index based on the Scale-level CVI Average (S-CVI/Ave) was 0.94, indicating excellent content validity. No separate pilot sample was used; the questionnaire was administered to the same 100 respondents from five secondary schools in Padang City. The pretest data from these respondents were subsequently used for item validity, reliability, and construct validity analyses.

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The research was conducted in sequential stages. First, a needs assessment was conducted through a preliminary survey and two focus group discussion (FGD) sessions involving a total of 16 participants (10 students across grades 10–12 and 6 school health/counseling teachers). Each FGD session lasted approximately 60–75 minutes and was conducted using a semi-structured interview guide focusing on digital health information seeking, difficulties in detecting health misinformation, and privacy management. Qualitative FGD data were analyzed using thematic analysis to identify priority learning needs, which directly informed the module content and delivery channels.

Second, the digital health literacy instrument was developed based on the identified domains and verified via expert judgment. Third, the instrument was administered as a baseline pretest to the study respondents. Fourth, a contextually designed digital health promotion intervention was delivered over a 2-week period, consisting of four 60-minute interactive sessions (two sessions per week) via a blended learning approach (synchronous web-based modules and asynchronous WhatsApp group guided discussions facilitated by certified health educators). The module covered three key topics: navigating credible health portals, critical evaluation of social media health claims, and online privacy/security protocols. Intervention fidelity was monitored using standardized session checklists and participant attendance logs.

Fifth, a posttest was administered immediately after completion of the 2-week intervention to assess immediate gains in digital health literacy. Sixth, a follow-up measurement was conducted 4 weeks (1 month) post-intervention using the same 30-item instrument to assess retention of literacy scores over time.

Data were analyzed in several stages. First, respondent characteristics and domain scores were analyzed descriptively using frequencies, percentages, means, and standard deviations. Item validity was assessed using corrected item-total correlation ($r > 0.30$; $p < 0.05$). Internal consistency reliability for each domain was evaluated using Cronbach's alpha (≥0.70).

Construct validity was assessed using Confirmatory Factor Analysis (CFA). The evaluation included standardized factor loadings, composite reliability (CR ≥ 0.70), and average variance extracted (AVE ≥ 0.50). Overall CFA model fit was evaluated against established goodness-of-fit thresholds: normed chi-square ($x^2/df < 3.0$), Comparative Fit Index (CFI ≥ 0.90), Tucker-Lewis Index (TLI ≥ 0.90), Root Mean Square Error of Approximation (RMSEA ≤ 0.08), and Standardized Root Mean Square Residual (SRMR ≤ 0.08).

Relationships among the six domains were examined using Pearson's correlation coefficient. The effect of the intervention was evaluated by comparing pretest and posttest scores using a paired-sample t-test, with Cohen's d_z quantifying effect size. Maintenance of the intervention effect was evaluated by comparing posttest versus 4-week follow-up scores, as well as baseline pretest versus 4-week follow-up scores, using paired-sample t-tests.

Differences in total scores across sociodemographic characteristics were analyzed using independent-samples t-tests and one-way ANOVA. All statistical tests were two-tailed ($p < 0.05$).

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All statistical analyses were executed using IBM SPSS Statistics for Windows, Version 26.0 (IBM Corp., Armonk, NY, USA) and IBM SPSS AMOS, Version 24.0.

The study protocol was reviewed and approved by the Ethics Committee of Poltekkes Kemenkes Padang (Approval No. 128/KEPK/POLTEKKES-PDG/2024). Written informed consent was obtained from parents or legal guardians of all participating students, and written informed assent was obtained directly from the adolescents prior to data collection. Participation was entirely voluntary, and data confidentiality was strictly maintained using anonymous participant identification codes.

RESULTS

1. Respondent Characteristics

This study involved 100 respondents with an average age of 17.05 ± 1.30 years (range 15–19 years). Most respondents were female (53%) and came from public schools (69%). Based on grade level, the proportion of respondents was relatively even between 10th grade (33%), 11th grade (37%), and 12th grade (30%). Almost all respondents (92%) owned personal smartphones. The participant flow from initial recruitment ($n = 250$) to final analysis ($n = 100$) proceeded with 50 exclusions at pretest, 50 drop-outs during the intervention/posttest stage, and 50 lost to follow-up. Complete respondent characteristics are presented in Table 1.

Table 1. Demographic Characteristics of Respondents (n = 100)

Variable	Category	n	%
Gender	Male	47	47.0
	Female	53	53.0
Age (years)	Mean ± SD	17.05 ± 1.30	
	Range	15–19	
Grade Level	Grade 10	33	33.0
	Grade 11	37	37.0
	Grade 12	30	30.0
School Type	Public	69	69.0
	Private	31	31.0
Smartphone Ownership	Yes	92	92.0
	No	8	8.0

2. Digital Health Literacy Score Description

The highest mean score was found in the health promotion behavior domain (3.32 ± 0.63), followed by information applications (3.30 ± 0.66) and privacy/security (3.29 ± 0.75), while the lowest mean score was found in the digital communication domain (3.12 ± 0.64). The total digital health literacy baseline score showed an average of 3.24 ± 0.31 on a maximum scale of 5. Based on the categorization of the total score (low < 2.34; moderate 2.34–3.67; high > 3.67), the majority of

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respondents (91%) were in the moderate category, while 9% were in the high category, and no respondents were found in the low category.

Table 2. Description of Digital Health Literacy Domain Scores (Scale 1–5, n = 100)

Domain	Mean	SD	Min	Max
Information Access	3.24	0.62	1.6	4.8
Information Evaluation	3.24	0.69	1.6	4.8
Information Application	3.30	0.66	1.2	4.6
Digital Communication	3.12	0.64	1.6	4.8
Privacy and Safety	3.29	0.75	1.6	5.0
Health-Promoting Behavior	3.32	0.63	1.8	5.0
Total DHL Score	3.24	0.31	2.40	4.16

3. Validity and Reliability of Instruments

The validity test showed that all 30 items across the six domains had corrected item-total correlation coefficients ranging from 0.460 to 0.744, with $p < 0.001$; therefore, all items were considered valid. The reliability test showed Cronbach's alpha values ranging from 0.779 to 0.883 across the six domains, all above the threshold of 0.70, and thus categorized as reliable. A summary of the validity and reliability results is presented in Table 3 and Table 4.

Table 3. Summary of Item Validity per Domain (Corrected Item-Total Correlation)

Domain	Number of Items	r Range	p-value	Remarks
Information Access	5	0.460–0.631	< 0.001	Valid
Information Evaluation	5	0.601–0.719	< 0.001	Valid
Information Application	5	0.602–0.691	< 0.001	Valid
Digital Communication	5	0.579–0.665	< 0.001	Valid
Privacy and Safety	5	0.695–0.744	< 0.001	Valid
Health-Promoting Behavior	5	0.503–0.637	< 0.001	Valid

Table 4. Internal Reliability of the Digital Health Literacy Domain

Domain	Number of Items	Cronbach's Alpha	Remarks
Information Access	5	0.779	Reliable
Information Evaluation	5	0.834	Reliable
Information Application	5	0.845	Reliable
Digital Communication	5	0.825	Reliable
Privacy and Safety	5	0.883	Reliable
Health-Promoting Behavior	5	0.800	Reliable

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4. Construct Validity

Confirmatory factor analysis indicators show that factor loadings in the six domains ranged from 0.600–0.744, and composite reliability (CR) values ranged from 0.748–0.842, all of which were above the threshold of 0.70, indicating good internal consistency of the construct. However, the average variance extracted (AVE) value only met the threshold of 0.50 in the privacy and security domain (AVE = 0.516), while the other five domains (information access, information evaluation, information application, digital communication, and health promotion behavior) had AVE values below 0.50 (0.373–0.426), indicating that convergent validity in these domains still needs to be improved through item refinement. The complete results are presented in Table 5.

Table 5. Construct Validity Indicators: Factor Loading, Composite Reliability, and AVE

Domain	Loading Min	Loading Max	CR	AVE	Remarks
Information Access	0.600	0.631	0.748	0.373	Needs review
Information Evaluation	0.601	0.719	0.772	0.405	Needs review
Information Application	0.602	0.691	0.787	0.426	Needs review
Digital Communication	0.600	0.665	0.763	0.392	Needs review
Privacy and Safety	0.695	0.744	0.842	0.516	Adequate
Health-Promoting Behavior	0.600	0.637	0.748	0.373	Needs review

5. Inter-Domain Correlation

Pearson correlation analysis between digital health literacy domains showed generally weak to moderate relationships, ranging from r = -0.143 to r = 0.286. The highest positive correlation was found between the privacy/security domain and health-promoting behaviors (r = 0.286), followed by the digital communication domain and health-promoting behaviors (r = 0.255), and information evaluation and health-promoting behaviors (r = 0.233). The information access domain showed a weak negative correlation with the privacy and security domain (r = -0.143). The weak correlation pattern between most domains indicates that the six domains measure relatively distinct and complementary, rather than overlapping, aspects of digital health literacy. The complete correlation matrix is presented in Table 6 and Figure 3.

Table 6. Pearson Correlation Matrix Between Digital Health Literacy Domains

Domain	Access	Evaluation	Application	Communication	Privacy	Behavior
Information Access	1.000	-0.010	0.071	0.050	-0.143	0.015
Information Evaluation	-0.010	1.000	0.063	0.038	-0.013	0.233
Information Application	0.071	0.063	1.000	0.002	0.155	0.112

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Digital Communication	0.050	0.038	0.002	1.000	0.005	0.255
Privacy and Safety	-0.143	-0.013	0.155	0.005	1.000	0.286
Health-Promoting Behavior	0.015	0.233	0.112	0.255	0.286	1.000

6. Effectiveness of Digital Health Promotion Interventions

Before the intervention, the respondents' mean total digital health literacy score was 3.24 ± 0.31. After the digital health promotion intervention designed based on the needs assessment results was implemented, the mean score increased significantly to 3.78 ± 0.39 in the posttest measurement ($t = 32.003; p < 0.001$), with a Cohen's d_z effect size of 3.20, which is considered very large. In the follow-up measurement, the mean score decreased slightly to 3.69 ± 0.38; further paired-sample t-test analysis between the posttest and the 4-week follow-up revealed a statistically significant slight decrease ($t = 2.412; p = 0.018$), yet the follow-up score remained significantly higher than the baseline pretest score ($t = 11.450; p < 0.001$). This suggests that the increase in digital health literacy observed after the intervention tended to be maintained (effect retention), although the one-group design does not allow this change to be attributed solely to the intervention. The trend of score changes across the three measurement times is presented in Table

Table 7. Comparison of Total Digital Health Literacy Scores at Three Measurement Times

Measurement	Mean	SD	t	p
Pretest	3.22	0.34	-	-
Posttest	3.78	0.39	-	-
Follow-up	3.69	0.38	-	-
Paired t-test (Posttest vs Pretest)	-	-	32.003	< 0.001
Effect Size (Cohen's dz)	3.20	-	-	-

7. Differences in Digital Health Literacy Scores Based on Demographic Characteristics

Further analysis showed that the total digital health literacy scores did not differ significantly by gender (females 3.28 ± 0.32 vs. males 3.19 ± 0.31; t = -1.469; p = 0.145), nor by grade level (grade 10 = 3.28 ± 0.27; grade 11 = 3.21 ± 0.29; grade 12 = 3.23 ± 0.38; F = 0.524; p = 0.594). Differences based on school type showed a tendency for higher scores in public school students (3.28 ± 0.30) compared to private school students (3.15 ± 0.33), although this difference did not reach statistical significance at the 0.05 threshold (t = 1.816; p = 0.072). Meanwhile, personal smartphone ownership was significantly associated with higher digital health literacy scores (respondents with smartphones: 3.26 ± 0.31 vs. without smartphones: 3.00 ± 0.20; t = 2.279; p = 0.025), indicating the importance of access to digital devices as a prerequisite for developing digital health literacy in adolescents.

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DISCUSSION

The results of this study indicate that the developed digital health literacy instrument has good item validity and internal reliability across all domains, with item-total correlation coefficients and Cronbach's alpha values consistently meeting recommended psychometric criteria. This finding aligns with the importance of developing comprehensive digital health literacy instruments, as emphasized in the scoping review by Faux-Nightingale et al. (2022) and the validation efforts of similar instruments in other population contexts by Yoon et al. (2022). However, a more critical examination of the psychometric properties reveals that confirmatory factor analysis yielded average variance extracted (AVE) values below the standard 0.50 threshold in five of the six domains (ranging from 0.373 to 0.426), with only the privacy and safety domain achieving adequate convergence (0.516). This indicates that measurement error accounts for a substantial portion of variance relative to the variance explained by the latent constructs, pointing to potential item ambiguity or multidimensionality within those domains. Although internal reliability remained acceptable and the tool serves initial screening purposes, these low AVE figures necessitate caution and future item refinement. Furthermore, the observed weak-to-moderate inter-domain correlations (ranging from $r = -0.143$ to $r = 0.286$) highlight that digital health literacy dimensions operate relatively independently. While this reinforces the multidimensional nature of the eHealth Literacy Model (El Benny et al., 2021), the modest correlation magnitudes—such as the weak associations between information access and health-promoting behaviors—suggest that possessing search skills does not automatically translate into behavioral outcomes. Consequently, claims regarding the direct interplay between these domains must be interpreted conservatively rather than overstating their predictive capability.

The digital health literacy score profile in this study, with the majority of respondents (91%) in the moderate category, aligns with the pattern reported in a representative study by Stauch et al. (2025), which also found variations in children's and adolescents' digital health literacy based on sociodemographic factors. In this study, personal smartphone ownership was significantly associated with higher digital health literacy scores, while gender and grade level showed no significant differences. This finding strengthens the argument of Taba et al. (2022) and Kartal et al. (2021), who found that access to digital devices is a fundamental prerequisite for developing more complex digital health literacy competencies. This also indicates a potential digital divide that needs to be addressed when designing digital-based health promotion programs, particularly for adolescents with limited device access. Nevertheless, given the small subgroup of students without smartphones ($n = 8$), this association must be interpreted cautiously, and broader representative studies are required to confirm the impact of hardware accessibility.

Regarding intervention outcomes, the post-intervention score increases must be interpreted strictly within methodological boundaries. While scores increased significantly from pretest to posttest and remained above baseline at the 4-week follow-up, the absence of a randomized control group means these improvements cannot be causally attributed to the intervention alone. Confounding factors such as testing effects, maturation, or external information exposure over the

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study period cannot be ruled out. Despite this design limitation, the positive trends are broadly consistent with global evidence on digital health interventions across populations, including meta-analytic findings in older adults (Dong et al., 2023), digital literacy programs in school-aged children (Hyman et al., 2020; König et al., 2022), and adolescent health initiatives (Choi et al., 2023; Lehtimaki et al., 2021). The apparent score retention at follow-up also aligns with the co-design framework advocated by Lewis et al. (2024) and the integrative interactive strategies highlighted by Mancone et al. (2024), suggesting that locally contextualized educational content is well-received by adolescents.

While these promising trends support broader perspectives on digital health transformation (Çetin & Gümüş, 2023; Pisano Gonzalez, 2025), they should be viewed as preliminary associations pointing toward the potential utility of tailored school programs rather than definitive proof of efficacy.

This study has several limitations. First, the one-group pretest-posttest-follow-up design without a control group means that changes in scores may also reflect maturation, repeated testing, or other concurrent influences, so causal conclusions cannot be drawn. Second, participants were selected purposively from 5 schools, which limits the generalizability of the findings to other adolescents. Third, a sample of 100 respondents is relatively small for a confirmatory factor analysis of a 30-item instrument, and the instrument validation and intervention evaluation used the same sample; the AVE results should therefore be interpreted with caution, and validation in a larger, independent sample is recommended.

CONCLUSIONS

The digital health literacy instrument developed in this study demonstrated acceptable item-level validity and internal consistency across all domains. However, because average variance extracted (AVE) values fell below the acceptable threshold in five of the six domains, convergent validity remains insufficient, indicating that the instrument cannot yet be considered fully validated and requires substantial item refinement. The digital health literacy profile of adolescents in this study was mostly in the moderate category, with personal smartphone ownership showing a significant statistical association with higher digital health literacy scores, though this observation warrants cautious interpretation due to the small subgroup of respondents without devices. A digital health promotion intervention designed based on the results of the needs assessment was followed by a significant increase in digital health literacy scores that was largely maintained at follow-up measurements; however, given the limitations of the one-group pretest-posttest design without a control group, this change must be strictly interpreted as a preliminary association rather than definitive proof of intervention effectiveness. These findings highlight both the preliminary utility and the current psychometric limitations of the tool, underscoring the necessity for further development and testing using more robust research designs (such as randomized controlled trials) and broader, independent populations.

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