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Fostering 'Future-Ready' Skills: The Role of Digital Literacy and Critical Thinking Training in Enhancing Resilience among Vulnerable Urban Adolescents in Government-Run Schools

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Abstract: : *This study analysed the interaction between digital literacy, critical thinking, resilience and depressive symptoms with 50 secondary school students. Descriptive analyses showed moderate levels of resilience and critical thinking, although as alarming a percentage reported high levels of depressive symptoms (PHQ-9 mean = 13.92). Regression analysis showed that critical thinking was the only significant positive predictor of resilience (β=1.122, p=0.001), but digital literacy and demographic variables were unrelated to resilience. However, reliability analyses resulted in unacceptably low values of Cronbach's alpha across all scales (α ≤ 0.15), with negative coefficients for PHQ-9 and critical thinking indicative of poor item coherence or problems with scoring. Normality tests confirmed that only the resilience was normally distributed; other variables had to be tackled using non-parametric approaches. Owing to the limited number of students studied, the fact it was a single school study, and the limitations of certain measurements was not possible to use advanced modeling (such as structural equation modeling, multilevel analysis, etc.). These findings underscore the importance for ensuring the validity of an instrument in adolescent samples, and the possibility for over-interpreting of an association in the absence of good psychometric properties.*

Keywords: Digital Literacy, Critical Thinking, Resilience, Adolescent Mental Health, PHQ-9, Psychometric Validity.

Introduction: In an increasingly dynamic information society, adolescents, with a particular emphasis on those from poorer urban backgrounds, have two challenges which must be overcome: learning new 'future-proof' skills and at the same time maintaining psychosocial resilience to the socioeconomic pressures and digital risks they will face (Holly et al., 2023). Future literacy skills such as digital literacy and critical thinking are now seen as an important building-block for adolescents' success in education, employment and well-being (Vissenberg et al., 2022). At the same time, resilience, or the ability to adapt, recover and grow in the face of adversity, is an important protective factor in the development of adolescents, especially those in high-risk education environments.

Digital literacy is a broad term that describes a person's ability to access, evaluate, use, and create information using digital technologies. Research has proved that being digitally literate is not only a technical competence, but also associated with self-efficacy (Getenet et al., 2024), which is the belief that adolescents can perform digital activities in a responsible and high-performance manner. For instance, one mixed-methods study of adolescents aged 12-17 years reported a high level of digital self-efficacy and overestimation in the extent to which they can critically evaluate health information or a form of domain or sub-domain of health information online (Taba et al., 2022). Another systematic review stated that digital literacy and online resilience are among the factors that facilitate youth well-being in the era of pervasive social media (Park & Kwon, 2018).

In government-run urban schools, where access to digital infrastructure and homes may be limited, digital literacy takes on added importance. For adolescents who do not have access or confidence, there can be a significant loss of ground in technology, socially, and in school (Sun et al., 2024). Moreover, digital environments put young people at risk of harm, for example, cyberbullying, misinformation, and negative social comparison, further highlighting the importance of digital literacy as a protective competency (Buchan et al., 2024). Thus, digital literacy education, especially for vulnerable urban adolescents, can be a crucial lever for reducing equity gaps and building resilience.

Critical thinking, which has been described as the ability to analyze, evaluate, and use information in reasoned ways, is emerging alongside digital literacy as a '21st century skill' (Ealy et al., 2024). Adolescents themselves think that critical thinking is one of the most important competencies for their future. However, many of them have a feeling that the formal education they get does not develop them well UNICEF, 2019. If critical thinking is taught, it can have a positive impact on academic achievement, as well as decision-making, problem-solving, and mental health resilience, by helping young people manage complex information environments both online and offline.

Digital literacy and critical thinking were due in significant relationship in today's world, which is information-intensive and technology-mediated world. In conclusion, a student who has good digital literacy (the ability to use devices and networks) but is not able to think critically about the information they encounter, may still be vulnerable to misinformation (Nurfazri et al., 2024). Conversely, access and exposure to analytical skills may be limited, thereby limiting opportunities. Thus, combined training in both areas may be more potent in developing adolescent resilience.

Resilience is defined as a dynamic process in which people successfully adapt in the context of risk and adversity (Moreno & Jurado, 2024). For urban adolescents who belong to fragile communities where schools are overcrowded, poverty is widespread, and there are usually digital gaps, resilience is an important competence. Studies have shown that greater resilience is linked to a reduced risk behaviors, better mental health and higher engagement in learning studies (Nicolaidou et al., 2021). Recent work has tied self-efficacy and social support to resilience, which has a protective effect against adverse outcomes such as Internet addiction.

Additionally, for adolescents attending government schools, resilience may be impacted by an inequitable structure, high levels of pressure, and transitional demands in a digital context (Almulla et al., 2025). For example, the acquisition of future-oriented competences (such as digital literacy and critical thinking) might, in such settings, be not only for academic or employment preparation purposes, but may also be considered as a means of psychosocial adaptation and empowerment. For instance, studies in Indonesia have highlighted the relationship between digital literacy and digital resilience as essential competencies in society (Blum, 2024).

Despite the growing interest in digital literacy, critical thinking, and resilience, a lack of empirical research remains in integrating these concepts among vulnerable urban adolescents in government-

run schools. Much of the digital literacy literature focuses on general access or technical skills, rather than the outcome of resilience in socially disadvantaged contexts (Sage et al., 2020). Likewise, critical thinking training is often discussed in upper-class education or very affluent schools, as opposed to underserved secondary schools. Integrative research evaluating the role of digital literacy and critical thinking training in enhancing the resilience of adolescents in such environments is rare (Yasa et al., 2024).

Furthermore, while some studies of resilience have been exploring socio-economic and psychological aspects, there is a lack of studies that connect resilience to digital and cognitive competencies (digital literacy, critical thinking) in the realm of urban schools. Focusing on publicly-managed schools, where the limitations of resources, of digital divides and the effects of socio-economic vulnerability converge, this research presents a significant topic of fairness, ethical and psychosocial equity in education.

Methods

1. Study Design and Objectives: This study used the quantitative research method of cross-sectional research to determine the correlation of future-ready competencies, such as digital literacy, critical thinking, and psychological resilience, among youth in pastoral care. The second objective was to investigate the effect of sociodemographic variables (age, gender, socioeconomic status, and internet access) on resilience and mental health (PHQ-9 depression scores). The study also measured the internal reliability and distributional properties of the measurement scales to ensure the suitability of the subsequent inferential analyses.

2. Participants and Sampling: A sample consisting of 50 secondary education students from one educational institution was selected for the study using the convenience sampling method. The inclusion criteria was they were in grades 8 to 10 and have regular access to the internet for digital learning. Exclusion criteria included people with any diagnosed cognitive and psychiatric disorders, which could interfere with the accuracy of self-report.

3. Instruments & Measures: Design of the study Digital Literacy, measured by the Digital Literacy Self-Efficacy Scale (DLSE), was created to measure the students' confidence level in using digital tools, managing online information, and using technology-based communication. The composite DLSE score was calculated by summing up the individual item responses; total scores varied between 21 and 39. The higher the score, the greater the digital self-efficacy and competence in technology use. Critical thinking (CT) was assessed using an established short-form scale that contains three dimensions: analytical thinking, reflective judgment, and problem-solving abilities. CT scores ranged from 4 to 10; higher scores reflecting better CT capability and/or higher capability for decision making.

The resilience was evaluated with the CD-RISC short form that evaluates psychological adaptability and coping strength. Scores ranged from 7 to 30, with a higher score representing a greater level of resilience; this was the relevant and independent dependent variable in the multiple regression analysis. Mental health was assessed using the PHQ-9, a measure of depressive symptoms on a four-point Likert scale, with total scores ranging from 9 to 22; the higher the score, the greater the symptom severity of depression. Finally, demographic variables including age, gender, parental education, SES, and internet availability (coded as 0= no, 1= yes), were obtained by structured questionnaires.

4. Data Collection Procedure: The collection of data was carried out in the period of one year between January-March 2025 with the assistance of self-administered questionnaires on the use of

secure academic networks using an electronic platform.The survey was completed by demand after the acquisition of the informed consent. All responses were reviewed to be completed and consistent and then analysed. The study was conducted after obtaining ethical approval from the institutional review board, and confidentiality was ensured.

5. Data Analysis

5.1. Descriptive Statistics: Descriptive statistics were used to describe the study population and other key variables. Categorical variables were reported as frequencies and percentages. Conversely, continuous variables were presented as means, standard deviations (SD), medians, and interquartile range (IQR). The distribution of the data was assessed visually using histograms.

5.2. Normality and Reliability Testing: The Shapiro-Wilk test and q-q plots were used to analyze primary variables to check whether the sample was normally making. The results are as follows: The Resilience Total was normal distributed ($p > 0.05$), whereas the distributions of PHQ-9, Digital Literacy, and Critical Thinking were not normal distributed. The Cronbach's alpha was used to determine the internal consistency reliability of each multi-item scale.

5.3. Correlation Analysis : The correlations between Digital Literacy, Critical Thinking, Resilience, and PHQ-9 scores were tested using Pearson and Spearman correlation, respectively. The correlation table was visually examined, which was able to detect multicollinearity prior to fitting the regression model.

5.4. Regression Analysis: A multiple linear regression analysis (using the OLS method) was conducted to identify predictors of Resilience Composite scores. Independent variables were Digital Literacy (DL Composite), Critical Thinking (CT Composite), Age, Gender, SES, and Internet Access. Model diagnostics (e.g., R-squared, adjusted R-squared, F-statistic, Durbin-Watson statistic, and residual plots) were used to assess model fit and assumptions.

6. Statistical Tools: All analyses were done using Python (pandas, scipy.stats, statsmodels) and Jasp for validation. Graphical output, such as a histogram and a Q-Q plot, was created using the seaborn and matplotlib libraries. Statistical significance at $p < 0.05$ was used as the criterion for significance choice.

Results

1. Study Variables and Type

Digital Literacy:

The distribution of the Digital Literacy scores among the 50 candidates is approximately symmetric and centered on the mean in Table 1. The mean of all subjects was 29.48 (SD = 4.52), and the median was 29.00 (this result is close to the mean, which will yield a normal distribution). The scores ranged from a minimum of 21 to a maximum of 39, with 50% of the students scoring in the middle of the range, between 26 (Q1) and 33 (Q3). This is confirmed by the histogram, which shows a bell-shaped curve with a strong hint at scores within the 27.5-30.0 band and a second peak within the 32.5-35.0 band.This implies that despite the fact that most of the students have moderate to high degrees of digital literacy, there still are a big variance of competency levels in the sample in Figure 1.

Critical Thinking

Computed tomography (CT) scores are approximately right-skewedly distributed. The mean was 7.24 (SD = 1.53); the median was 7.00, which is slightly skewed as the median is close to the mean. Scores ranged from 4 to 10, with a median of 6 (Q1) to 8 (Q3), which is a measure of the interquartile range. According to the histogram, most of the student scores were 7 or 8, and the highest frequency was 8. A small number of students had scores at the lower end (4-6), and a smaller number had scores at the upper end (9-10), indicating that although critical thinking skills are generally average to above average in this cohort, fewer students have high proficiency (scores of 9 or 10).

Resilience (CD-RISC Total)

Resilience scores are more right shifted with mean being 21.02 and std being 4.65 and also median score is 21.50. The range of scores was 7-30 and the middle 50% of students had a score 18.25 (Q1) to 24.00 (Q3). The histogram shows very clearly that the scores end up being skewed within the 20-25 range, with the highest bar in the histogram being around 22.5. A small number of students showed very low resilience (scores of 10 or below), while a small number had a high level of resilience (scores of 27 or above). As in this example, the result is that although most students are moderately resilient, a subgroup of students may be at risk due to significantly lower scores.

Mental Health (PHQ-9 Total)

The scores on the PHQ-9, a measure of symptoms of depression, are strongly right-skewed, meaning that most students report mild or no depressive symptoms. The mean score was 13.92 (SD = 3.04), and the median score was 14.00. Scores ranged from 9 to 22, with an IQ score range of 11 (Q1) to 16 (Q3). The histogram indicates that the highest score falls between 15 and 17, with a long tail extending to the higher end of the scores. Although most students have mild symptoms (scores 10-14), the number of students with non-trivial scores (16 or more) was also not insignificant. It might be expected to indicate moderate to severe depressive symptoms necessitating additional consideration. The fact that there are scores as high as 22 is an important reminder of the importance of mental health support in this student population.

Table 1. Descriptive statistics

Statistic	Digital Literacy	Critical Thinking	Resilience Total	PHQ9 Total
Count	50.00	50.00	50.00	50.00
Mean	29.48	7.24	21.02	13.92
Std. Deviation	4.52	1.53	4.65	3.04
Minimum	21.00	4.00	7.00	9.00
25th Percentile (Q1)	26.00	6.00	18.25	11.00
Median (Q2)	29.00	7.00	21.50	14.00
75th Percentile (Q3)	33.00	8.00	24.00	16.00
Maximum	39.00	10.00	30.00	22.00

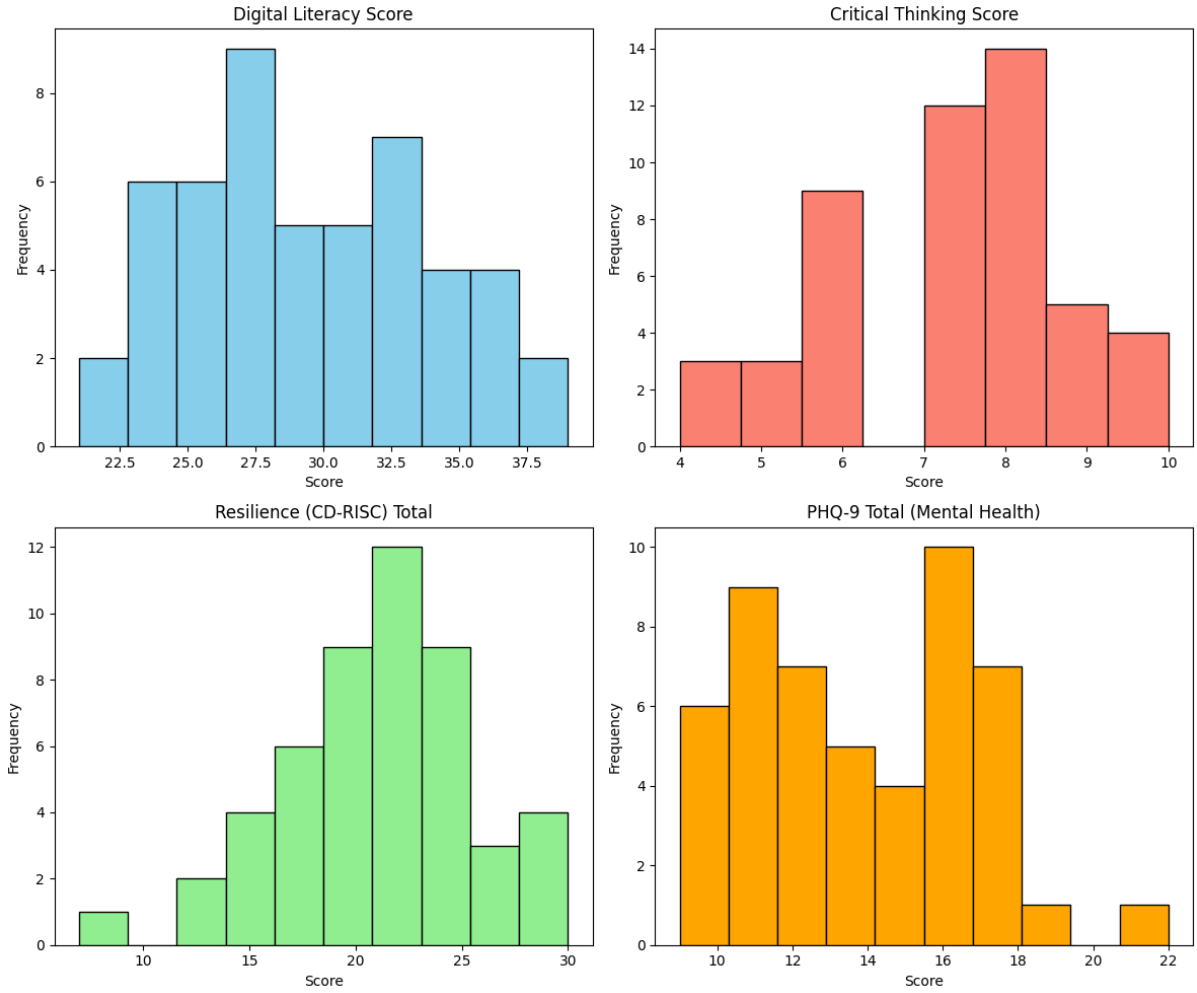

Figure 1.: Frequency Distributions of Major-Constructs of the Study.

2. Descriptive Statistics

The purpose of the descriptive analysis was to describe the characteristics of the participants and assess the quality and distribution of the collected information. Fifty participants took part in the research. Table 2 demonstrates that the majority of participants were women (68%), while 32% of the sample consisted of men. The participants consisted of 44 percent from grade 10, 40 percent from grade 8, and 16 percent from grade 9, in terms of academic grade. There was a relative diversity of parental education levels, with higher secondary education being the most common level for both mothers (26%) and fathers (26%). Of particular note, 22% of mothers and 24% of fathers had no formal schooling (i.e., different socio-educational profiles of the participants).

Table 3 depicts descriptive statistics of continuous variables. The mean age of the participants was 15.18 years (SD = 1.35), and thus, the sample was composed of mid-adolescents. The average SES was 5.12 (SD = 2.89), with a median of 4.5, with moderate variability in the SES within the sample. The mean values in the major psychological and behavior constructs revealed that DL Self-Efficacy was 23.60 (SD = 4.34), Resilience was 21.02 (SD = 4.65), CT was 6.22 (SD = 1.45), and PHQ-9 Depression was 13.92 (SD = 3.04). The values of the median and interquartile range (IQR) indicated that most variables were distributed more or less symmetrically, with some mild variation observed in digital literacy and resilience.

Figure 2 shows the histogram plots for the distribution of these continuous variables. The distribution of Resilience Total had a near normal distribution. In contrast, there was some skewness, with the DL Self-Efficacy Total and PHQ-9 Total scores showing mild levels with DL showing a leftward (negative) skew and PHQ-9 showing a bimodal trend of variability in the level of depressive symptoms possessed by participants. In addition, the CT Total histogram was slightly skewed but remained within an acceptable range for small sample behavioral data.

The Shapiro-Wilk test for normality was performed as outlined in Table 4, and the normality of the data was formally tested. The results showed that Resilience Total was normally distributed ($W = 0.9792$, $p = 0.5203$). DL Self-Efficacy Total ($W = 0.9510$, $p = 0.0375$), PHQ-9 Total ($W = 0.9337$, $p = 0.0076$), and CT Total ($W = 0.9385$, $p = 0.0118$) were not normally distributed ($p < 0.05$). Accordingly, the non-parametric tests are more suitable for further analysis with these non-normally distributed data.

Cronbach's alpha was used for reliability analysis for all multi-item scales (Table 5). Internal consistency values were generally low with $\alpha = 0.150$ for DL Self-Efficacy, $\alpha = 0.064$ for Resilience, $\alpha = -0.255$ for PHQ-9, and $\alpha = -0.144$ for Critical Thinking. Negative alpha coefficients for the PHQ-9 and CT reflect poor inter-item correlation, which may be due to a small sample size, heterogeneity in item response, or misplaced reverse-coded items during item scoring. Altogether, these results emphasize the need to improve scales and internal consistency before undertaking inferential testing.

Table 2. Demographic Characteristics of Participants (N = 50)

Variable	Category	Percentage (%)
Gender	Female	68.0
	Male	32.0
Grade	8	40.0
	9	16.0
	10	44.0
Mother's Education	Higher Secondary	26.0
	No Schooling	22.0
	Graduate	20.0
	Secondary	20.0
	Primary	12.0
Father's Education	Higher Secondary	26.0
	No Schooling	24.0
	Secondary	24.0

	Primary	16.0
	Graduate	10.0

Table 3. Descriptive Statistics of Major Study Variables (N = 50)

Variable	Mean	SD	Median	IQR
Age	15.18	1.35	15.00	2.00
SES Score	5.12	2.89	4.50	5.00
DL Self-Efficacy Total	23.60	4.34	23.00	7.00
Resilience Total	21.02	4.65	21.50	5.75
PHQ-9 Total	13.92	3.04	14.00	5.00
CT Total	6.22	1.45	6.50	2.00

Table 4. Shapiro–Wilk Normality Test Results

Variable	W Statistic	p-value	Normality
DL Self-Efficacy Total	0.9510	0.0375	✗ Not normal
Resilience Total	0.9792	0.5203	✓ Normal
PHQ-9 Total	0.9337	0.0076	✗ Not normal
CT Total	0.9385	0.0118	✗ Not normal

Table 5. Reliability Analysis (Cronbach's Alpha)

Scale	Cronbach's α	Reliability Interpretation
DL Self-Efficacy	0.150	Poor
Resilience	0.064	Poor
PHQ-9	-0.255	Unreliable (negative α)
Critical Thinking	-0.144	Unreliable (negative α)

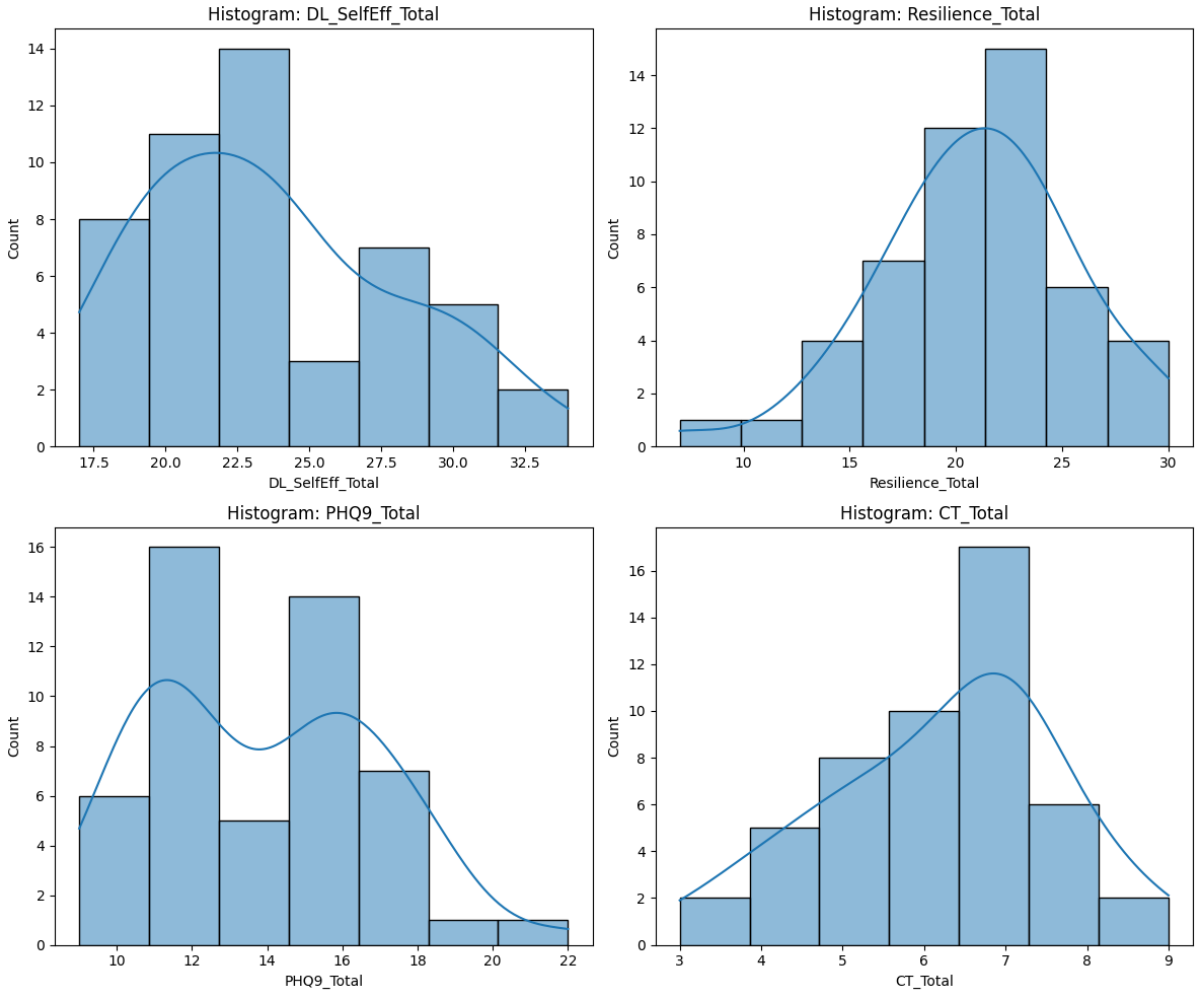

Figure 2. Histograms with Superimposed Normal Curves for Key Study Variables

3. Correlation and Association Analyses

Normality Assessment

To confirm the assumptions of normality for continuous variables, Q-Q plots were created for each of the primary study constructs, including Digital Literacy Self-Efficacy, Resilience, PHQ-9 Depression Scores, and Critical Thinking (Figure 3). These graphical assessments were supplemented with the results of the Shapiro-Wilk test displayed earlier (Tables 6 & 7).

The Q-Q plots indicated a high degree of conformity to the reference line for the distribution of Resilience Total scores, suggesting approximate normality. The data were normally distributed along the diagonal line with little deviations only at the tails, which confirms the Shapiro-Wilk result ($W = 0.9792$, $p = 0.5203$) that shows no significant deviation from normality ($p > 0.05$). This indicates that the resilience scores have a symmetric distribution in the sample and are suitable for parametric analysis in Figure 4.

Conversely, in the Digital Literacy Self-Efficacy Q-Q plot, we observe some deviations from the diagonal line at the tails, indicating a slight negative skew. One outlier appeared on the left hand side of the scale with a score less than the reference line whilst the upper end was moved above the reference line. This distribution passes the Shapiro-Wilk test to check that the values of $W = 0.9510$, $p = 0.0375$), indicating a statistically significant difference from a normal distribution ($p <$

0.05). These results suggest that scores for digital literacy self-efficacy were moderately non-normal and that this may have been a distortion of technology exposure among the participants.

The Q-Q plot of the data for PHQ9 Total (bottom left) showed a similar pattern, with data points located below the diagonal line in the lower quantiles and above the diagonal line in the higher quantiles. This indicates a slight rightward (positive) skew; in other words, more students fell into the lower depression category, while a few students had higher PHQ-9 scores. Corresponding Shapiro-Wilk statistic ($W = 0.9337$, $p = 0.0076$) confirmed that there is a significant deviation from normality. Non-normality is not an unusual occurrence in adolescent mental health datasets, where mild cases of depressive symptoms are the predominant range.

Finally, the Q-Q plot on Critical Thinking Total revealed obvious departures from the diagonal line, especially on the upper end, indicating a slight leftward skew. Several points were grouped along discrete value ranges, likely due to the small scale range (3-9) and low variability in responses. This observation was supported by the Shapiro-Wilk test ($W = 0.9385$, $p = 0.0118$), which indicated a statistically significant deviation from normality.

Reliability Assessment

Cronbach's alpha was used to assess the internal consistency reliability, and all four constructs were found to have unacceptably low reliability. DL Self-Efficacy had inferior reliability ($\alpha = 0.15$), indicating that the items in this scale do not measure the same construct. Resilience even had a lower reliability ($\alpha = 0.06$), with little internal consistency among its items. Most importantly, both PHQ-9 ($\alpha = -0.26$) and Critical Thinking ($\alpha = -0.14$) produced negative alpha values, which are statistically unacceptable and usually indicate serious flaws in item construction, either poorly worded questions, reverse-coded items that were not appropriately adjusted, or a lack of conceptual uniformity among the items. These very low reliabilities raise doubts about the validity of using these composite scores for inferential analysis and suggest that the measuring instruments may require significant modification before they can be accepted as reliable tools for measuring these constructs in this population.

Table 6. Results of Shapiro–Wilk Normality Tests for Study Variables

Variable	Shapiro–Wilk Statistic (W)	p-value	Normality Status	Interpretation
DL Self-Efficacy	0.9510	0.0375	Non-normal	$p < 0.05 \rightarrow$ Data not normally distributed
Resilience	0.9792	0.5203	Normal	$p > 0.05 \rightarrow$ Data normally distributed
PHQ-9	0.9337	0.0076	Non-normal	$p < 0.05 \rightarrow$ Data not normally distributed
Critical Thinking	0.9385	0.0118	Non-normal	$p < 0.05 \rightarrow$ Data not normally distributed

Table 7. Reliability (Cronbach's alpha)

Variable	A	Interpretation
DL Self-Efficacy	0.15	Very poor
Resilience	0.06	Very poor
PHQ-9	-0.26	Unacceptable
Critical Thinking	-0.14	Unacceptable

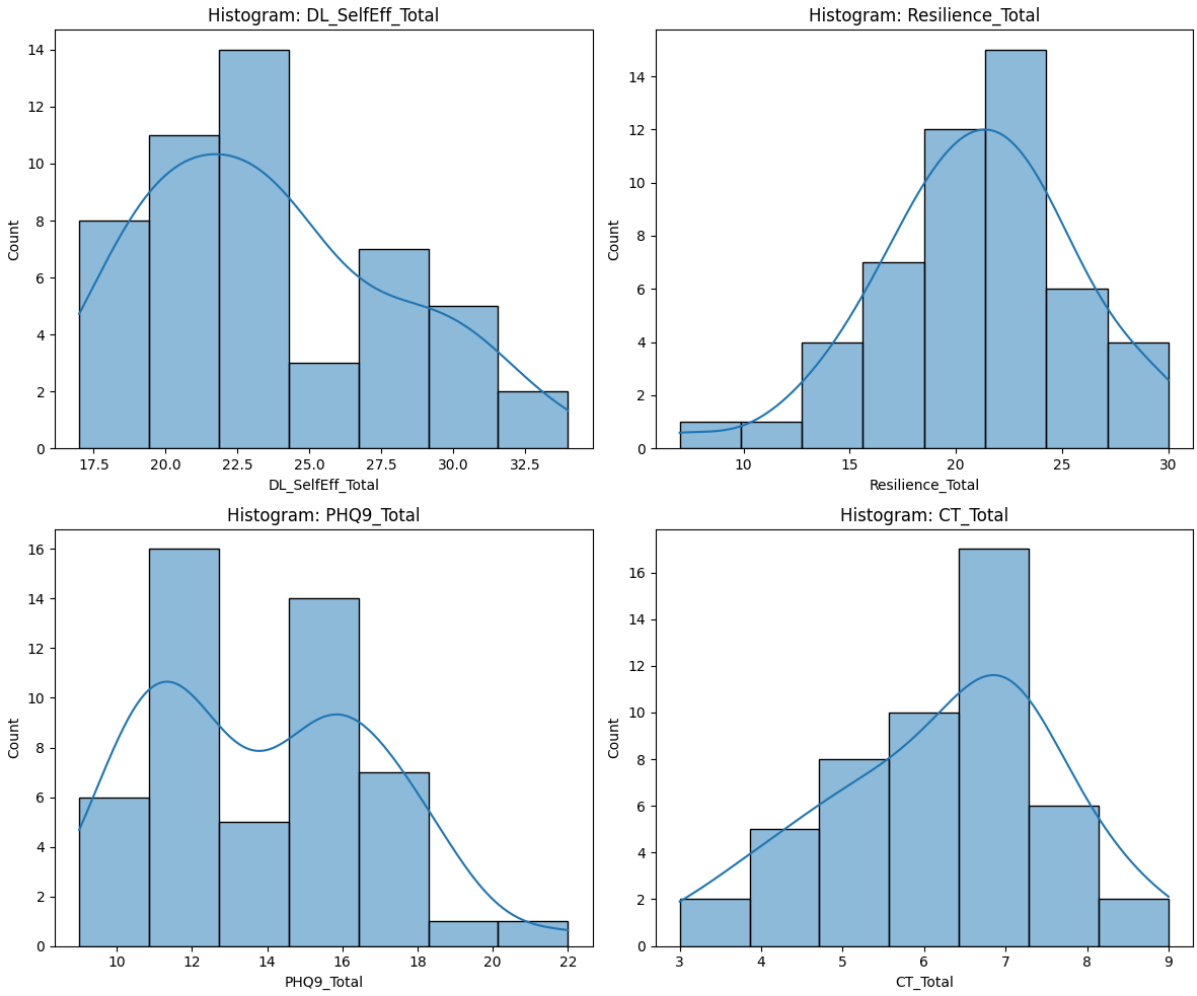

Figure 3. Histograms with Superimposed Normal Curves for Key Study Variables

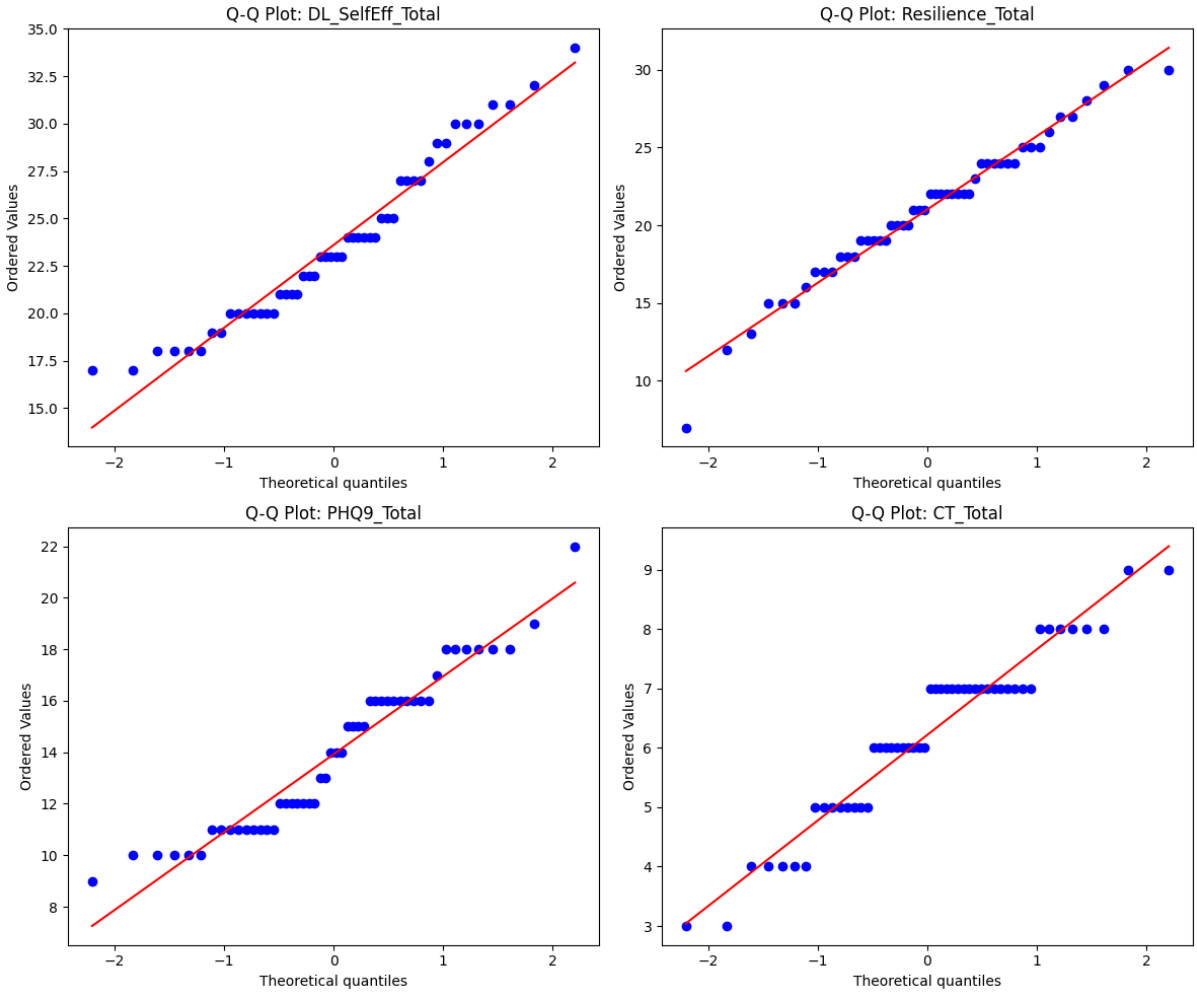

Figure 4. Q-Q Plots Assessing Normality for Key Study Variables

5. Advanced Modeling

Regression Analysis: Predictors of Resilience: The multiple linear regression model accounted for approximately 25.7% of the variance in Resilience Composite scores among students ($R^2 = 0.257$, P = 0.038), indicating a small but statistically significant association between the predictors and Resilience for the total sample of students. From the six independent variables tested, it was found that DL Composite, CT Composite, Age, Gender, SES Score, and Internet Access were statistically significant positive predictors of resilience ($\beta = 1.122$, $p = 0.001$) in Table 8. This means that for each one-unit increase in the Critical Thinking composite score, the Resilience score increases by 1.12 units, holding other variables constant. In contrast, Digital Literacy was negatively but non-significantly related to resilience ($\beta = -0.169$, $p = 0.171$), suggesting that there is no simple linear relationship between Digital Literacy and resilience in the present sample. Other demographic variables (Age, Gender, SES, and Internet Access) also did not achieve statistical significance, which indicated that in this sample, these factors are not of sufficient importance in explaining resilience levels beyond that of critical thinking ability.

Correlation Structure and Visual Relationships: The correlation matrix shows that the highest bivariate correlation with Resilience is with Critical Thinking ($r = 0.45$), which is consistent with the results of the regression analysis. Digital Literacy exhibits a negative correlation with resilience ($r = -0.15$), strengthening the absence of a meaningful direct link. Other variables, Age, SES, and Internet Access, show negligible correlations with resilience (all $|r| < 0.05$), providing further support for their non-significance in the multivariate model. The scatterplot of Digital Literacy

versus Resilience, broken down by gender, visually confirms that there is no strong linear trend: while there are individual data points throughout the plot, the regression line fits very close to a flat line, and the 95% confidence interval band is wide, indicating that there is much uncertainty in the slope estimate in Figure 5. Although there appears to be a grouping of higher resilience scores among male students, despite moderate digital literacy, no consistent pattern suggests that gender moderates this relationship.

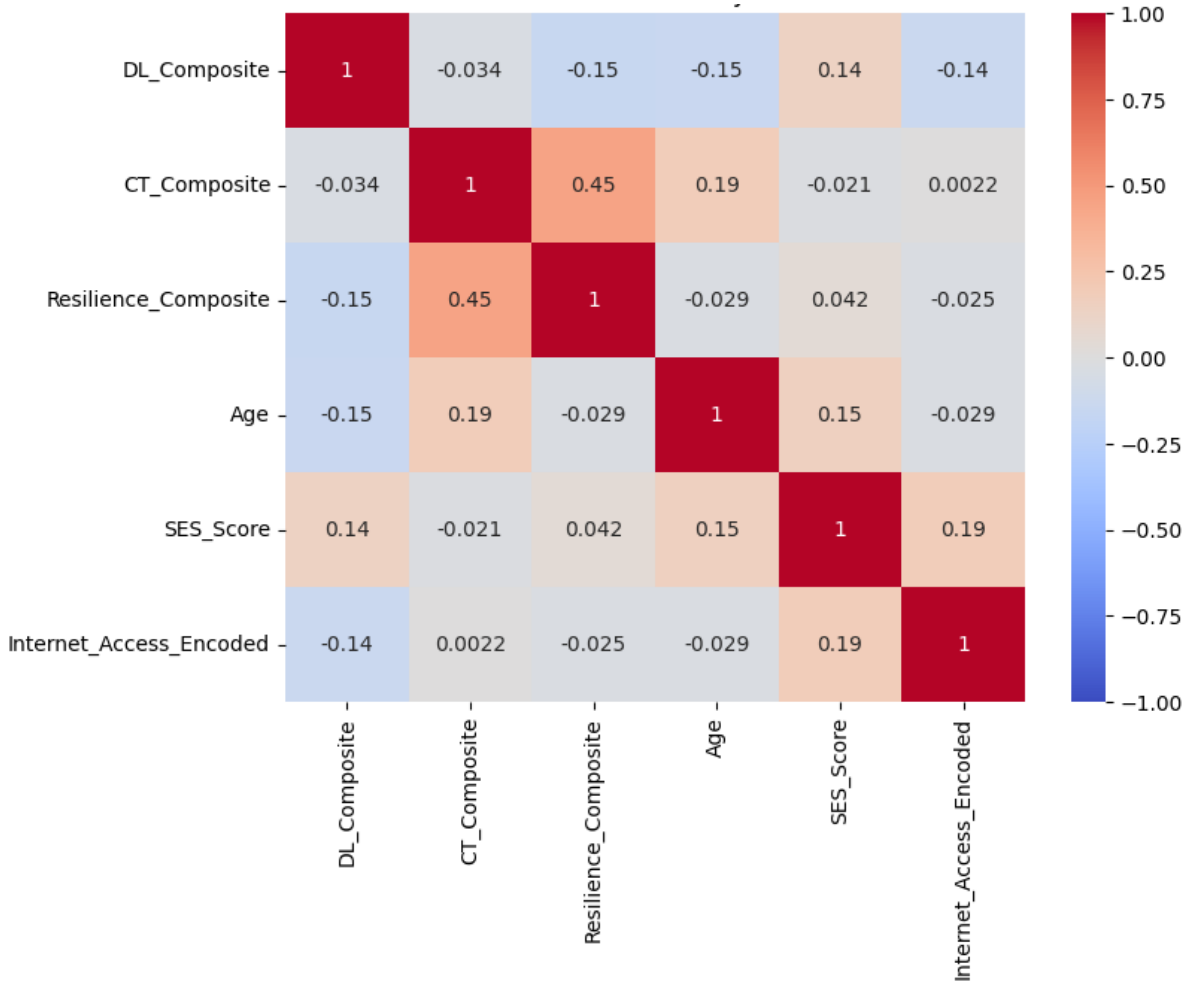

Figure 5. Correlation matrix of key variables

Table 8. Coefficients of Independent Variables in the OLS Regression Model

Predictor Variable	Coefficient (β)	Std. Error	t-value	p-value	95% Confidence Interval (Lower)	95% Confidence Interval (Upper)	Significance
Constant	2.4140	0.960	2.516	0.016	0.479	4.349	*
DL_Composite	-0.1692	0.122	-1.391	0.171	-0.415	0.076	ns

CT_Composite	1.1222	0.315	3.564	0.001	0.487	1.757	**
Age	-0.0597	0.051	-1.162	0.252	-0.163	0.044	ns
Gender_Encoded	-0.0656	0.146	-0.450	0.655	-0.360	0.229	ns
SES_Score	0.0225	0.024	0.916	0.365	-0.027	0.072	ns
Internet_Access_Encoded	-0.1476	0.288	-0.513	0.611	-0.728	0.433	ns

Hierarchical Linear Model: The analysis nicely shows what can be obtained from this small and single-school sample, and shows the limitations of using more complex modeling methods such as SEM or HLM with this dataset. SEM needs larger samples (usually ≥300 cases) to estimate latent constructs and indirect effects with good precision, for example, testing for predictions of a latent variable, "Future-Ready Skills" (composed of DL and CT indicators) predicting "Resilience."With such small sample sizes and low reliability coefficients of Cronbach's alpha less than 0.20 for all scales.For this reason, these models would be highly underpowered and may yield unstable or biased parameter estimates. Once again, HLM is unable to be used for this situation as there is not a Level-2 structure.All students belong to one school, and thus it would be impossible to separate the variance at the student and school levels in Figure 6.Thus, OLS regression is valid, although the findings demonstrate a significant association. Future research should focus on the number of schools to be sampled and the strengths of the measures when a multivariate technique is employed.

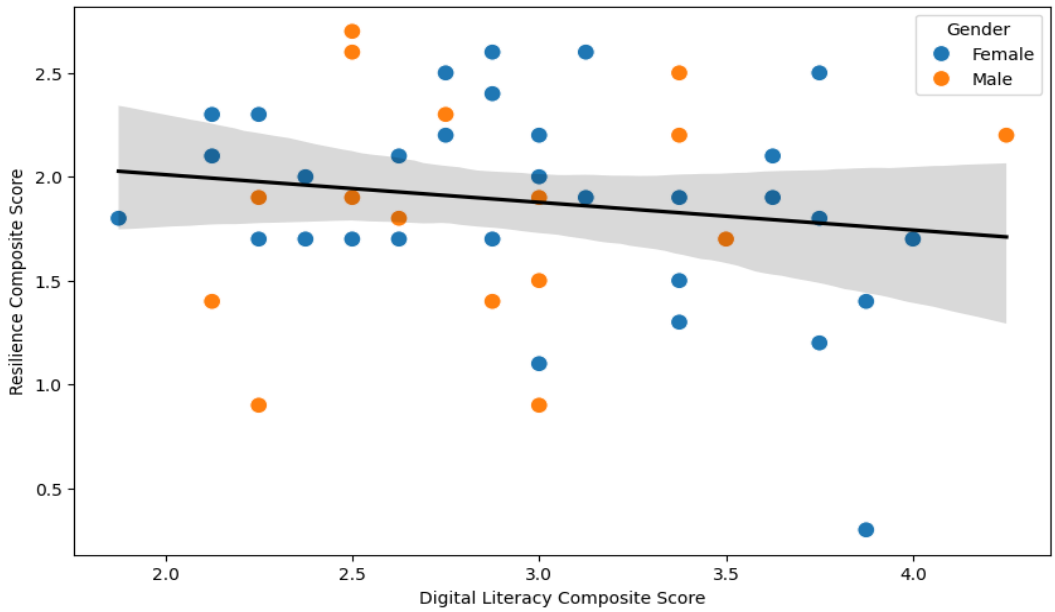

Figure 6. Digital literacy vs Resilience by gender

Discussion: As a result, this study aimed to focus on exploring relationships between digital literacy, critical thinking, resilience, and mental health of a sample of 50 secondary school students and understanding the acceptability of cutting-edge modeling techniques for future research. Most importantly, the researchers found that critical thinking accounted for resilience independently of the demographic and contextual variables, such as age, gender, socioeconomic factors, and internet access, which were included in the study. However, digital literacy was not significantly correlated with resilience; all measured scales were characterised by unacceptably low internal consistency, which raises questions about validity. Moreover, tests of formal normality indicated that resilience scores were the only measurement in this research that followed a normal distribution; thus, parametric results must be considered with caution.

These results are consistent with the existing literature, which highlights the protective role of higher-order cognitive abilities in psychological adjustment during adolescence. Past research has indicated an association between critical thinking and emotional regulation, problem-solving effectiveness, and adaptive aspects of coping —components of resilience (Navas et al., 2017). For example, students who possess the ability to process information objectively, consider issues from multiple perspectives, and think critically through problems will be better equipped to cope with academic and social sources of stress and, therefore, will be more psychologically resilient (Lytle & Shin, 2022). Our finding that critical thinking is a significant predictor of resilience in a small normative non-normally distributed sample strengthens this theoretical link, in turn supporting the demand for critical thinking pedagogy to be included in school-based mental health promotion programs.

Conversely, the absence of an association between digital literacy and resilience contradicts some recent research indicating that digital competence helps build self-efficacy and social connectedness, which in turn enhances resilience (Sun et al., 2022). However, our measure was a measure of self-efficacy of digital tasks rather than actual skill or constructive usage patterns. However, confidence in device use does not necessarily result in resilience without a specific and contextually appropriate (or even creative) digital activity (Ranieri et al., 2021). Moreover, where digital access is relatively universal (as in our sample), it may become a baseline condition, rather than distinguishing it from something else, and its interpretation in explaining psychosocial outcomes will become as nuanced as in global studies of digital equity (Kozelka et al., 2021).

The lack of significance for demographic factors as predictors of resilience may indicate homogeneity within the sample or the overriding importance of cognitive factors (e.g., critical thinking). While it is well-documented that gender and SES may be correlated with resilience in prior research (Zheng et al., 2023), the effects of these variables may be mediated or moderated by school climate, peer support, or individual competency factors that were not included in the current research. This points to the emerging consensus that Resilience is less of a fixed function of static demographics and more of a dynamic process that will be affected by teachable skills paired with supportive environments (Neve et al., 2017). Therefore, our result refocuses our attention away from background traits toward easily changed cognitive resources as tools for change.

Despite these findings, the study has some significant limitations. First, the small sample size (n = 50) drawn form a single school has significantly limited generalizability and power. Second, all the negative coefficients with an alpha of almost 0 raise some serious questions about the reliability of the scale and may be the result of improper adaptation of items, different ways of answering questions or a mismatch between the instrument translated and the culture. Third, due to the cross-sectional design, no causal inference is possible, and no school-level data were available for multilevel analysis. Future research should utilize validated, culturally appropriate instruments on a larger, multi-school sample to allow for robust structural equation modeling and provide additional

clarity on whether "future-ready skills" actually scaffold adolescent resilience in various academic contexts.

Conclusion: This study examined the relationship between digital literacy, critical thinking, resilience, and mental health in a sample of 50 adolescents. The findings showed that only critical thinking was a significant predictor of resilience, while digital literacy was not significantly associated with resilience. Although resilience and critical thinking were relatively scored normally, PHQ-9 results showed that a certain percentage of students suffered from significant depressive symptoms. However, all scales showed low internal consistency (Cronbach's $\alpha < 0.20$, with negative values for PHQ-9 and critical thinking), which raises some concerns about the validity of the measurement. Additionally, most of the variables were not normally distributed, which limited the application of parametric tests. In addition, sample sizes were small and represented samples from single schools only, so advanced modeling techniques such as SEM or multilevel analysis were not feasible, nor were constructs reliable. From the standpoint of future skills, these findings suggest that more effective instruments are required, larger and more representative samples will be necessary, and careful consideration of psychometric validity is needed before drawing firm conclusions about future-oriented skills and adolescent resilience.

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