RESEARCH PAPER

DOES TECHNOLOGY AFFECT ADOLESCENT MENTAL HEALTH DIFFERENTLY? A COMPARATIVE STUDY

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Abstract

The rapid proliferation of information and communication technology has fundamentally transformed adolescent life, raising concerns about its impact on mental health. However, it remains unclear whether mental health outcomes related to technology usage differ across demographic groups. The present study aimed to compare the mental health status of adolescents with respect to technology usage based on gender, locality, and educational board. A quantitative descriptive survey research design was adopted. The sample consisted of 400 adolescent students selected through stratified convenience sampling from schools in Lucknow city. The Mental Health Battery developed by Singh and Sen Gupta and a self-constructed Technology Usage Scale were used as data collection tools. Independent samples t-test and Cohen's d were employed for data analysis after conducting assumption checks including the Shapiro-Wilk test for normality and the Brown-Forsythe test for homogeneity of variance. The findings revealed no significant differences in mental health scores between boys and girls, rural and urban students, or U.P. Board and CBSE students. The study concludes that adolescent mental health status with respect to technology usage does not differ significantly by gender, locality, or educational board. These findings imply that interventions to promote healthy technology use may be applied uniformly across these demographic groups. However, caution is warranted due to violations of normality and homogeneity of variance in some comparisons.

Keywords: Adolescent Mental Health; Technology Usage; Gender Differences; Urban-Rural Locality; Educational Board Comparison

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Introduction

Adolescence is a critical developmental period characterized by significant physical, emotional, and social transformations. It is also a time when mental health vulnerabilities often emerge (Bhugra, Till, & Sartorius, 2013). The World Health Organization has consistently emphasized that there is "no health without mental health" (Prince et al., 2007). Mental health is not merely the absence of mental illness but includes emotional well-being, psychological resilience, and social functioning (Scheid & Wright, 2017; Shedler, Mayman, & Manis, 1993).

In recent decades, the rapid proliferation of information and communication technology (ICT) has fundamentally transformed adolescent life. Smartphones, social media, online gaming, and digital learning platforms have become ubiquitous (Smahel et al., 2023). While technology offers educational benefits and social connectivity, excessive or problematic use has been linked to anxiety, depression, sleep disturbances, and reduced psychological well-being (Cai et al., 2024; Mensah et al., 2023).

The COVID-19 pandemic accelerated the integration of technology into education and daily life. Ghufron et al. (2024) noted that innovative learning media became essential during the pandemic. Similarly, Onyancha (2023) documented how media and information literacy skills gained unprecedented importance during and after COVID-19.

However, the relationship between technology usage and adolescent mental health is complex and likely moderated by demographic factors. Zhang and Zhou (2023) found that perceived ICT autonomy, relatedness, and competence significantly influence adolescent outcomes. Dobrokhotov et al. (2025) explored gender differences in ICT-integrated STEM education, suggesting that gender may play a role in how technology is experienced (Rastogi, S et al., 2025; Rajput, D., et al., 2026)).

In the Indian context, several gaps remain. First, it is unclear whether mental health outcomes related to technology usage differ between adolescent boys and girls. Second, the urban-rural digital divide may create differential technology experiences (Ofosu-Asare, 2024). Third, educational board affiliation (state board vs. central board) may influence technology exposure and associated mental health outcomes due to differences in curriculum, infrastructure, and pedagogical approaches.

Therefore, the present study was designed to address these gaps by comparing adolescent mental health status across gender, locality, and educational board with respect to technology usage.

Objective

1. To compare the mental health status of adolescent boys and girls with respect to technology usage.
2. To compare the mental health of adolescents belonging to urban and rural areas with respect to technology usage.
3. To compare the mental health of adolescents studying in U.P. Board and C.B.S.E. Board schools with respect to technology usage.

Hypotheses

H_{01}: There will be no significant difference in the mean mental health scores of adolescent boys and girls with respect to technology usage.

H_{02}: There will be no significant difference in the mean mental health scores of adolescents belonging to urban and rural areas with respect to technology usage.

H_{03}: There will be no significant difference in the mean mental health scores of adolescents studying in U.P. Board and C.B.S.E. Board schools with respect to technology usage.

3. Methodology

The present study adopted a quantitative descriptive survey research design to examine the mental health status of adolescents with respect to technology usage and to compare it across gender, locality, and educational board. A quantitative research approach was employed as the study involved the collection of numerical data, statistical analysis, and hypothesis testing, which enabled objective measurement of variables and generalization of findings to the larger population of adolescents (Creswell & Creswell, 2018). A descriptive survey design was selected because the study was non-experimental in nature with no variable manipulation, aimed to describe existing conditions as they naturally occurred, and required data collection from a large sample of 400 students across multiple schools. The study employed a cross-sectional time horizon, meaning data were collected at a single point in time rather than over an extended period. The independent variable of the study was technology usage, the dependent variable was the mental health of adolescents, and the demographic variables included gender (boys and girls), locality (urban and rural), and educational board (U.P. Board and CBSE). The population of the study comprised adolescent students of Lucknow city. A sample of 400 students was selected using a stratified convenience sampling technique, wherein the population was first stratified by board and locality, followed by the convenience selection of available and willing participants. The sample distribution included 213 boys (53.25%) and 187 girls (46.75%); 181 rural (45.25%) and 219 urban (54.75%); and 199 U.P. Board (49.75%) and 201 CBSE (50.25%) students.

Table 1: Sample Distribution of Adolescent Students Based on Gender, Locality, and Educational Board

Variable	Category	N	Percentage
Gender	Boys	213	53.25%
	Girls	187	46.75%
Locality	Rural	181	45.25%
	Urban	219	54.75%
Board	U.P. Board	199	49.75%
	CBSE	201	50.25%

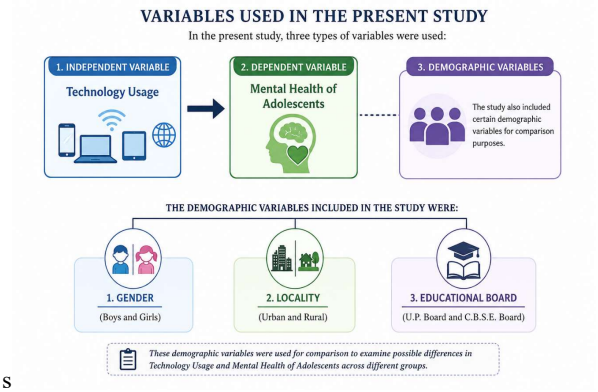

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Figure 1: Variables used in the present Study

Primary data were collected personally by the researcher from adolescent students in selected schools of Lucknow, wherein the purpose of the study was explained, confidentiality was assured, and written consent was obtained from parents along with assent from students. For data analysis, descriptive statistics (mean and standard deviation) were computed to summarize the data, and assumption checks including the Shapiro-Wilk test for normality and the Brown-Forsythe test for homogeneity of variance were performed before conducting inferential statistics. Independent samples t-test was employed to compare the mean mental health scores between the groups (boys vs. girls, rural vs. urban, and U.P. Board vs. CBSE), and Cohen's d was calculated to determine the effect size. All null hypotheses were tested at the 0.05 level of significance, with $p < 0.05$ considered statistically significant.

Table 2: Tools Used for Data Collection

Tool	Source	Reliability	Validity
Mental Health Battery	Singh & Sen Gupta (standardized)	Temporal stability: 0.72 to 0.93; Internal consistency: 0.68 to 0.91	Validated against Emotional Stability Test, HSAI, Bell's Adjustment Inventory, Neuroticism Scale of MPI, and Jalota Group General Mental Ability Test
Technology Usage Scale (TUS)	Self-constructed	Cronbach's Alpha (α = 0.678); Split-half reliability (Spearman-Brown = 0.704)	Face validity (expert panel), Content validity (expert review), Construct validity (Exploratory Factor Analysis)

Two tools were used for data collection. The first tool was the Mental Health Battery developed by Singh and Sen Gupta, a standardized tool designed to assess mental health across six dimensions: emotional stability, overall adjustment, autonomy, security-insecurity, self-concept, and intelligence. The reliability of the Mental Health Battery ranged from 0.72 to 0.93 for temporal stability and 0.68 to 0.91 for internal consistency, and its validity was established against the Emotional Stability Test, High School Adjustment Inventory (HSAI), Bell's Adjustment Inventory, Neuroticism Scale of MPI, and Jalota Group General Mental Ability Test. The second tool was a self-constructed Technology Usage Scale (TUS) developed by the researcher to assess the level of technology usage among adolescent students across five dimensions: technology usage behaviour, cognitive and academic impact, emotional well-being, social behaviour and peer relationships, and physical and mental health. The reliability of TUS was established through Cronbach's Alpha ($\alpha = 0.678$) indicating acceptable internal consistency, and split-half reliability using the Spearman-Brown formula ($r = 0.704$) demonstrating robust internal consistency. The validity of TUS was established through face validity (expert panel review), content validity (expert evaluation of item relevance), and construct validity using Exploratory Factor Analysis (EFA). The EFA results yielded a Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy of 0.721, indicating meritorious factorability. Bartlett's Test of Sphericity was significant ($\chi^2 = 1892.46$, $df = 861$, $p < .001$), confirming that the correlation matrix was suitable for factor analysis. The total variance explained by the extracted factors was 58.32%, and factor loadings for the 42 items ranged from 0.412 to 0.789, indicating that all items loaded adequately onto their respective dimensions.

4. Results

H_{01}: There will be no significant difference in the mean mental health scores of adolescent boys and girls with respect to technology usage.

Before conducting the independent samples t-test, assumption checks were performed. The Shapiro-Wilk test of normality for residuals yielded a value of $W = 0.964$, $p < .001$, indicating a violation of the normality assumption. However, the Brown-Forsythe test for equality of variances was found to be non-significant, $F(1,398) = 0.088$, $p = .767$, confirming that the assumption of homogeneity of variance was met.

Table 3: Comparison of Mental Health Scores Between Male and Female Adolescents

Group	N	Mean	SD	t	df	p	Mean Difference	Cohen's d
Female	**187**	**143.4**	**13.30**	**-1.555**	**398**	**.121**	**-2.247**	**-0.156**
Male	**213**	**145.6**	**15.33**					

The table 3 presents the comparison of mean mental health scores between female and male adolescent students with respect to technology usage. The mean mental health score for female students (N = 187) was found to be 143.4 with a standard deviation of 13.30, whereas for male students (N = 213), the mean mental health score was 145.6 with a standard deviation of 15.33. The obtained t-value is -1.555 at 398 degrees of freedom, which is not statistically significant at the 0.05 level as the p-value is .121, which is greater than .05. The mean difference between the two groups is -2.247, and the effect size measured by Cohen's d is -0.156, which is considered a small effect size. Since the calculated p-value is greater than the significance level ($p > .05$), the null hypothesis (H_{01}) is accepted. Therefore, it can be concluded that there is no significant difference in the mental health status of adolescent boys and girls with respect to technology usage. In other words, both male and female adolescents exhibit similar levels of mental health in relation to their technology usage patterns.

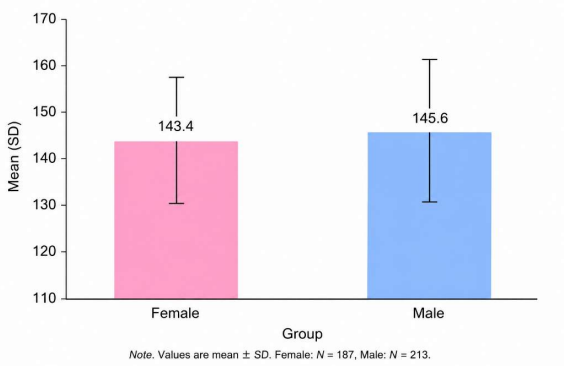


Figure 2: Comparison of Mean Mental Health Scores Between Male and Female Adolescents

H_{02}: There will be no significant difference in the mean mental health scores of adolescents belonging to urban and rural areas with respect to technology usage.

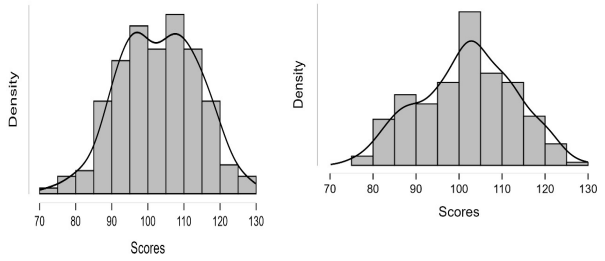
Before conducting the independent samples t-test, assumption checks were performed. The Shapiro-Wilk test of normality for residuals yielded a value of $W = 0.994$, $p = .162$, indicating that the normality assumption was met as the p-value is greater than .05. Additionally, the Brown-Forsythe test for equality of variances was found to be non-significant, $F(1,398) = 0.304$, $p = .581$, confirming that the assumption of homogeneity of variance was also met.

Table 4: Comparison of Mental Health Scores Between Rural and Urban Adolescents

Group	N	Mean	SD	t	df	p	Mean Difference	Cohen's d
Rural	181	103.1	10.97	1.012	398	.312	1.115	0.102
Urban	219	102.0	10.96					

The table 4 presents the comparison of mean mental health scores between rural and urban adolescent students with respect to technology usage. The mean mental health score for rural students (N = 181) was found to be 103.1 with a standard deviation of 10.97, whereas for urban students (N = 219), the mean mental health score was 102.0 with a standard deviation of 10.96. The obtained t-value is 1.012 at 398 degrees of freedom, which is not statistically significant at the 0.05 level as the p-value is .312, which is greater than .05. The mean difference between the two groups is 1.115, and the effect size measured by Cohen's d is 0.102, which is considered a small effect size. Since the calculated p-value is greater than the significance level ($p > .05$), the null hypothesis (H_{02}) is accepted. Therefore, it can be concluded that there is no

significant difference in the mental health status of rural and urban adolescents with respect to technology usage. In other words, both rural and urban adolescents exhibit similar levels of mental health in relation to their technology usage patterns.



RURAL **URBAN**

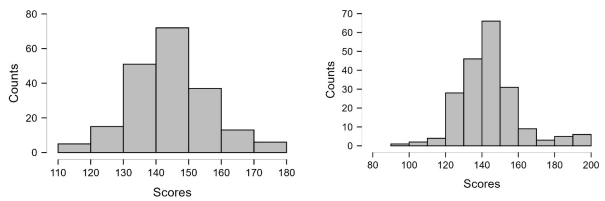
Figure 3: Density Distribution of Scores Across Rural and Urban Groups

H_{03}: There will be no significant difference in the mean mental health scores of adolescents studying in U.P. Board and C.B.S.E. Board schools with respect to technology usage.

Table 5: Comparison of Mental Health Scores Between U.P. Board and CBSE Adolescents

Group	N	Mean	SD	t	df	p	Mean Difference	Cohen's d
U.P. Board	199	144.8	12.24	0.243	398	.808	0.351	0.024
CBSE	201	144.4	16.37					

The above table presents the comparison of mean mental health scores between U.P. Board and CBSE adolescent students with respect to technology usage. The mean mental health score for U.P. Board students (N = 199) was found to be 144.8 with a standard deviation of 12.24, whereas for CBSE students (N = 201), the mean mental health score was 144.4 with a standard deviation of 16.37. The obtained t-value is 0.243 at 398 degrees of freedom, which is not statistically significant at the 0.05 level as the p-value is .808, which is greater than .05. The mean difference between the two groups is 0.351, and the effect size measured by Cohen's d is 0.024, which is considered a negligible effect size. Since the calculated p-value is greater than the significance level ($p > .05$), the null hypothesis (H_{03}) is accepted. Therefore, it can be concluded that there is no significant difference in the mental health status of U.P. Board and CBSE adolescents with respect to technology usage. In other words, both U.P. Board and CBSE students exhibit similar levels of mental health in relation to their technology usage patterns. However, it is important to note that the assumption of normality was violated ($p < .001$) and the assumption of homogeneity of variance was also violated ($p = .029$), so these results should be interpreted with caution.



UP **CBSE**

Figure 4: Density Distribution of Scores Across CBSE and UP Board

Discussion

The present study aimed to compare the mental health status of adolescents with respect to technology usage across gender, locality, and educational board. The findings revealed no significant differences in any of the three comparisons, leading to the acceptance of all three null hypotheses. These results suggest that technology usage may have a uniform impact on adolescent mental health across these demographic groups in the studied population.

5.1 Gender Differences in Mental Health with Respect to Technology Usage

The first objective of the study was to compare the mental health status of adolescent boys and girls with respect to technology usage. The findings indicated no significant difference between the mean mental health scores of male (M = 145.6, SD = 15.33) and female (M = 143.4, SD = 13.30) adolescents, $t(398) = -1.555$, $p = .121$, with a small effect size (Cohen's $d = -0.156$).

This finding aligns with the research of Cai et al. (2024), who reported multidimensional ICT impacts that did not consistently differ by gender. Similarly, Zhang and Zhou (2023) found that perceived ICT autonomy, relatedness, and competence were more influential than gender itself in determining adolescent outcomes. The present study supports the Integrative Model of ICT Effects on Adolescents' Well-Being (iMEW) proposed by Smahel et al. (2023), which suggests that ICT effects are mediated by individual and contextual factors rather than demographic characteristics alone (Gupta, S., & Singh, V., 2024).

However, the present finding contradicts studies that have reported higher technology-related mental health risks for girls, such as increased social media-induced anxiety and depression (Febro-Naga & Tinam-isan, 2022). This discrepancy may be attributed to the Indian cultural context, where gender roles and technology access patterns may differ from Western or other Asian countries. Additionally, the significant violation of normality for male scores (Shapiro-Wilk $p < .001$) and positive skewness (1.003) indicate that a subset of male adolescents may have very high mental health scores, warranting further investigation into within-group variability among boys.

5.2 Locality Differences in Mental Health with Respect to Technology Usage

The second objective compared the mental health status of adolescents from rural and urban areas. The results revealed no significant difference between rural (M = 103.1, SD = 10.97) and urban (M = 102.0, SD = 10.96) adolescents, $t(398) = 1.012$, $p = .312$, with a small effect size (Cohen's $d = 0.102$). This finding is noteworthy given the persistent discourse on the digital divide between urban and rural areas. Ofosu-Asare (2024) documented severe ICT limitations in rural Ghana, and Danzan et al. (2025) found significant urban-rural disparities in Mongolia. However, the present study found comparable mental health scores between rural and urban adolescents, suggesting that the digital divide may be narrowing in the Indian context (Gupta, S., et. al., 2025).

Several explanations are possible for this finding. First, the rapid expansion of mobile internet connectivity in India, even in rural areas, may have bridged the digital divide to a significant extent (Mensah et al., 2023). Second, Zuhri et al. (2024) noted that ICT education is progressively reaching rural elementary schools, ensuring that rural adolescents are not entirely disconnected from technology. Third, the COVID-19 pandemic compelled students from all localities to rely

heavily on e-resources, potentially accelerating digital adoption among rural students (Ghufron et al., 2024; Onyancha, 2023).

The absence of significant locality differences implies that mental health interventions related to technology usage can be applied uniformly across rural and urban settings, though the slightly higher variability in rural scores suggests that some rural students may still face unique challenges.

5.3 Educational Board Differences in Mental Health with Respect to Technology Usage

The third objective compared the mental health status of adolescents studying in U.P. Board and CBSE schools. The results revealed no significant difference between U.P. Board ($M = 144.8$, $SD = 12.24$) and CBSE ($M = 144.4$, $SD = 16.37$) students, $t(398) = 0.243$, $p = .808$, with a negligible effect size (Cohen's $d = 0.024$).

This finding suggests that board affiliation does not influence adolescent mental health in relation to technology usage. This is consistent with Lorenz, Heldt, and Eickelmann (2022), who found that teacher training relevance—not board affiliation—predicted ICT use in classrooms. Similarly, Gutiérrez-Martín, Pinedo-González, and Gil-Puente (2022) emphasized that ICT and media competencies of teachers may be more important than the board curriculum itself.

However, the violation of equal variance (Brown-Forsythe $p = .029$) is notable. CBSE students showed greater variability in mental health scores ($SD = 16.37$) compared to U.P. Board students ($SD = 12.24$). This suggests that while average mental health scores are nearly identical, CBSE schools may have a more heterogeneous student population in terms of mental health outcomes. This could be due to differences in socioeconomic composition, urban concentration, or pedagogical approaches between the two boards. The violation of normality (Shapiro-Wilk $p < .001$) further indicates that the distribution of scores within groups was not perfectly normal, warranting cautious interpretation of the t-test results.

5.4 Integration with Theoretical Framework

The findings of the present study support the Integrative Model of ICT Effects on Adolescents' Well-Being (iMEW) proposed by Smahel et al. (2023). According to this model, ICT effects on adolescent well-being are not uniform but are mediated by individual, social, and contextual factors. In the present study, gender, locality, and educational board did not emerge as significant moderators, suggesting that other factors—such as family environment, peer relationships, individual resilience, and actual usage patterns—may be more influential in determining mental health outcomes related to technology usage.

From a constructivist learning perspective (Mann & MacLeod, 2015; Novak & Gowin, 1984), how adolescents actively engage with technology (purposeful vs. passive use, educational vs. entertainment use) may matter more than their demographic characteristics. The present study measured mental health in relation to technology usage broadly, without quantifying specific usage patterns, which may explain the lack of demographic differences.

Implications of the Findings

The findings of the present study have several important implications. First, the absence of significant differences across gender, locality, and educational board suggests that interventions to promote healthy technology use can be applied uniformly across these demographic groups. Second, educators and policymakers need not develop separate programs for boys and girls, rural and urban students, or different educational boards when addressing technology-related mental health concerns.

However, the greater variability in mental health scores among male students and CBSE students suggests that targeted support may still benefit specific subgroups within these populations. Schools and mental health professionals should be aware that while average scores are similar, individual differences within groups may be substantial.

Conclusion

The present study was conducted to compare the mental health status of adolescents with respect to technology usage across gender, locality, and educational board. A quantitative descriptive survey research design was employed, and data were collected from 400 adolescent students (213 boys and 187 girls; 181 rural and 219 urban; 199 U.P. Board and 201 CBSE) studying in schools of Lucknow city (Mishra., U & Gupta, S., 2024). The Mental Health Battery developed by Singh and Sen Gupta and the self-constructed Technology Usage Scale (TUS) were used as data collection tools. The data were analyzed using descriptive statistics (mean and standard deviation), independent samples t-test, and Cohen's d for effect size, after conducting assumption checks including the Shapiro-Wilk test for normality and the Brown-Forsythe test for homogeneity of variance.

The findings of the study are summarized as follows:

1. **Gender Comparison:** There was no significant difference in the mean mental health scores of adolescent boys ($M = 145.6$, $SD = 15.33$) and girls ($M = 143.4$, $SD = 13.30$), $t(398) = -1.555$, $p = .121$, with a small effect size (Cohen's $d = -0.156$). The null hypothesis (H_{01}) was accepted, indicating that both male and female adolescents exhibit similar levels of mental health in relation to their technology usage patterns.
2. **Locality Comparison:** There was no significant difference in the mean mental health scores of rural ($M = 103.1$, $SD = 10.97$) and urban ($M = 102.0$, $SD = 10.96$) adolescents, $t(398) = 1.012$, $p = .312$, with a small effect size (Cohen's $d = 0.102$). The null hypothesis (H_{02}) was accepted, indicating that both rural and urban adolescents exhibit similar levels of mental health in relation to their technology usage patterns.
3. **Educational Board Comparison:** There was no significant difference in the mean mental health scores of U.P. Board ($M = 144.8$, $SD = 12.24$) and CBSE ($M = 144.4$, $SD = 16.37$) students, $t(398) = 0.243$, $p = .808$, with a negligible effect size (Cohen's $d = 0.024$). The null hypothesis (H_{03}) was accepted, indicating that both U.P. Board and CBSE students exhibit similar levels of mental health in relation to their technology usage patterns.

Based on the findings of the present study, it can be concluded that **adolescent mental health status with respect to technology usage does not differ significantly by gender, locality, or educational board**. All three null hypotheses were accepted. These findings imply that technology usage may have a uniform impact on adolescent mental health across these demographic groups in the studied population.

However, certain cautionary observations must be noted. The significant violation of normality for male scores ($p < .001$) and positive skewness (1.003) indicate that a subset of male

adolescents may have very high mental health scores, warranting further investigation into within-group variability among boys. Similarly, the violation of equal variance for the educational board comparison ($p = .029$) suggests that CBSE students have more heterogeneous mental health scores compared to U.P. Board students. These violations do not invalidate the findings but suggest that the results should be interpreted with caution.

In light of these findings, it can be concluded that interventions to promote healthy technology use may be applied uniformly across adolescent boys and girls, rural and urban students, and U.P. Board and CBSE students. However, the greater variability in mental health scores among male students and CBSE students suggests that targeted support may still benefit specific subgroups within these populations. Schools, parents, and policymakers should focus on promoting balanced and purposeful technology use among all adolescents while remaining attentive to individual differences that may exist within demographic groups.

Conclusion

The present study was conducted to compare the mental health status of adolescents with respect to technology usage across gender, locality, and educational board. A quantitative descriptive survey research design was employed, and data were collected from 400 adolescent students (213 boys and 187 girls; 181 rural and 219 urban; 199 U.P. Board and 201 CBSE) studying in schools of Lucknow city. The Mental Health Battery developed by Singh and Sen Gupta and the self-constructed Technology Usage Scale (TUS) were used as data collection tools. The data were analyzed using descriptive statistics (mean and standard deviation), independent samples t-test, and Cohen's d for effect size, after conducting assumption checks including the Shapiro-Wilk test for normality and the Brown-Forsythe test for homogeneity of variance.

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Recommendations

1. **Future research** should include actual technology usage metrics (screen time, platform type) rather than assuming technology as a contextual variable.
2. **Longitudinal studies** are needed to determine whether technology causes mental health changes or vice versa.
3. **Qualitative studies** can explore why boys show greater variability in mental health scores.
4. **Schools** should implement digital wellness programs for all adolescents regardless of board or locality.

Limitations

1. **Non-normal distributions** for male and board comparison groups may affect t-test validity, though t-tests are generally robust to moderate violations.
2. **Cause-effect relationship** cannot be established due to the cross-sectional design.
3. **Technology usage** was not quantified (hours per day, type of technology) – only mental health was measured in relation to technology usage.
4. **Single region** (likely Uttar Pradesh) limits generalizability.

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Conflict of Interest Statement

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References

Acosta-Enriquez, B. G., Villena Zapata, L. I., Huamaní Jordan, O., López Roca, C., Cabrera Cipirán, B. M., Saavedra Villacrez, W., & Arbulu Perez Vargas, C. G. (2025). Acceptance of Artificial Intelligence as a Teaching Strategy Among University Professors: The Role of Habit, Hedonic Motivation, and Competence for Technology Integration. *Human Behavior and Emerging Technologies*, *2025*(1). https://doi.org/10.1155/hbe2/5933157

Al-Motrif, A., Aseery, A. Y., Almalhy, K. M., Alfayez, A. A., & Omar, S. A. (2025). Exploring the Use of Social Media for Informal Learning in Professional Development in Saudi Arabian Higher Education. *Educational Technology Research and Development*, *73*(4), 2213–2250. https://doi.org/10.1007/s11423-025-10511-z

Bailey-Belafonte, S., & Buchanan-Grayer, C. (2025). Digital Transformative Practice: Considerations for Preparing Jamaican Social Work Practitioners for Effective Technology Use. *International Journal of Education and Development Using Information and Communication Technology*, *21*(1), 174–186.

Bhugra, D., Till, A., & Sartorius, N. (2013). What is mental health? *International Journal of Social Psychiatry*, *59*(1), 3–4. https://doi.org/10.1177/0020764012463315

Bloom, L. K. (2017). *New Faculty Mentoring in Higher Education: An Integrative Literature Review* [ProQuest Dissertations & Theses]. https://www.proquest.com/docview/2496536859/50D319B126C8411DPQ/4

Boorse, C. (1976). What a theory of mental health should be. *Journal for the Theory of Social Behaviour*. https://psycnet.apa.org/record/1977-28559-001

Boud, D., Cohen, R., & Walker, D. (1993). *Using experience for learning*. McGraw-Hill Education (UK). https://books.google.com/books?hl=hi&lr=&id=BSrlAAAAQBAJ&oi=fnd&pg=PP1&dq=learning&ots=abiAlDlNsr&sig=7OCIIvHBZyePhLMvjOtUvqjv_mI

Cai, M., Luo, H., Meng, X., & Liu, J. (2024). Exploring the Multidimensional Impact of ICT on Academic Achievement and Mental Health: Evidence from a Large-Scale Survey of Higher Vocational Students in China. *Journal of Computer Assisted Learning*, *40*(4), 1898–1921. https://doi.org/10.1111/jcal.12995

Chen, X. (2024). *A Phenomenological Study of Teachers' Perception of Professional Development Sessions Focused on Artificial Intelligence: Utilizing the TPACK Framework to Address the Professional Development Needs of Teachers* [ProQuest Dissertations & Theses]. https://www.proquest.com/docview/3143149817/BAD39ED4389B40A2PQ/10

D'Alfonso, S. (2020). AI in mental health. *Current Opinion in Psychology*, *36*, 112–117.

Danzan, T., Sambuu, U., Chuluunbat, M., Avkhinsukh, T., & Sandag, E. (2025). ICT Readiness of Secondary School Teachers: Mongolian Case Study. *Contemporary Educational Technology*, *17*(3). https://eric.ed.gov/?id=EJ1481572

Deng, X., & Yu, Z. (2023). A meta-analysis and systematic review of the effect of chatbot technology use in sustainable education. *Sustainability*, *15*(4), 2940.

Dobrokhotov, D. A., Sayapina, A. E., Khairullina, E. R., Khafizova, A. A., Prokopyev, A. I., & Erokhova, N. S. (2025). Exploring Gender in ICT Integrated STEM Education: A Bibliometric Study. *Contemporary Educational Technology*, *17*(3). https://eric.ed.gov/?id=EJ1481560

Dontu, S. (2025). *The Effects of Untrained Healthcare Professionals in Utilizing Artificial Intelligence* [ProQuest Dissertations & Theses]. https://www.proquest.com/docview/3204519894/BAD39ED4389B40A2PQ/12

Downes, S. (2005). E-learning 2.0. *eLearn*, *2005*(10), 1. https://doi.org/10.1145/1104966.1104968

Eileen R. Parsons, E., Kenne A. Dibner, E., Heidi Schweingruber, E., Committee on Equity in PreK-12 STEM Education, C., Board on Science Education, C., & Division of Behavioral and Social Sciences and Education, C. (2025). Equity in K-12 STEM Education: Framing Decisions for the Future. Consensus Study Report. In *National Academies Press*. National Academies Press. https://doi.org/10.17226/26859

Febro-Naga, J.-D., & Tinam-isan, M.-A.-C. (2022). Exploring Cyber Violence against Women and Girls in the Philippines through Mining Online News. *Comunicar: Media Education Research Journal*, *30*(70), 121–133.

Frank, R. G., & McGuire, T. G. (2000). Economics and mental health. *Handbook of Health Economics*, *1*, 893–954.

Ghufron, S., Nafiyah, Djuwari, Rulyansah, A., & Saputri, T. (2024). Effectiveness of Innovative Learning Media in Elementary Schools during the COVID-19 Pandemic. *Pegem Journal of Education and Instruction*, *14*(3), 230–242.

Gutiérrez-Martín, A., Pinedo-González, R., & Gil-Puente, C. (2022). ICT and Media Competencies of Teachers. Convergence towards an Integrated MIL-ICT Model. *Comunicar: Media Education Research Journal*, *30*(70), 19–30.

Gupta, S. et al., (2025, June 6). Environmental concerns in the present scenario and future works of education. International Journal of Environmental Sciences, 11(7), 697-709.

Gupta, S., & Mishra, U. (2024). Economic value impact analysis of Hindi vs. English medium schools in Kanpur Nagar: A comparative study. *Educational Metamorphosis*, 3(1), 167-174.

Gupta, S., Shukla, P., Singh, V., Sonwani, S., & Dixit, M. (2025, September). A review of the evolution of educational frameworks: Pedagogy 1.0 to 7.0. *International Journal for Research Trends and Innovation*, 10(9), b119-b137.

Gupta, S., et. al., (2026). Cognitive load in the age of artificial intelligence: A bibliometric analysis (2021–2025). *Annals of Neurosciences*, *33*(1), 20. https://doi.org/10.1177/09727531261443089

Gupta, S., & Singh, V. (2024). Trajectories of collective intelligence. *Collective Intelligence*, 1, 97-107.
Gupta, S., & Singh, V. (2024). Future proofing education: The critical role of ICT in bridging the global educational gap. In *Role of ICT & educational technology in higher education* (2nd ed., pp. 187–198). Suryam Publication.
Hania, A., Waqas, M., & Chunyan, X. (2025). Enhancing Teaching Competency in Higher Education: The Role of AI Efficacy, Social Media Use and Classroom Dynamics. *European Journal of Education*, *60*(3). https://doi.org/10.1111/ejed.70197
Health, W. H. O. D. of M., & Abuse, S. (2005). *Mental health atlas 2005*. World Health Organization. https://books.google.com/books?hl=hi&lr=&id=2SXuXnlz3PgC&oi=fnd&pg=PA11&dq=mental+health&ots=KJMkfLDhov&sig=95veobtbN0uLs9dmlEPXtSEUZs0
Inostroza, R. N. P., Adiego, J. A. L., & Labrín, S. M. (2025). Online Environments, Social Networks and Pornography: The Role of Teachers and Managers in the Provision of Sex and Sexuality Education in Chilean Schools. *Sex Education: Sexuality, Society and Learning*, *25*(5), 758–772. https://doi.org/10.1080/14681811.2024.2384041
Johann Engelbrecht, E., Greg Oates, E., & Marcelo de Carvalho Borba, E. (2025). Social Media in the Changing Mathematics Classroom. Advances in Mathematics Education. In *Springer*. Springer. https://doi.org/10.1007/978-3-031-82837-9
Kickham-Samy, M. (2013). *Worked examples in teaching queries for searching academic databases* [ProQuest Dissertations & Theses]. https://www.proquest.com/docview/1447018160/B8F7F0CACBC24EFBPQ/54
Knowles, R. T., Camicia, S., & Nelson, L. (2023). Education for Democracy in the Social Media Century. *Research in Social Sciences and Technology*, *8*(2), 21–36.
Kozma, R. B. (1991). Learning with Media. *Review of Educational Research*, *61*(2), 179–211. https://doi.org/10.3102/00346543061002179
Kumar, S. S., & Ragini. (2024). Entrepreneurial Intention of Students: The Effect of Social Media and Entrepreneurship Education. *International Journal of Learning and Change*, *16*(6), 595–611. https://doi.org/10.1504/IJLC.2024.141943
Kyriakides, C. (2014). *The Cyprus University of Technology students' attitudes towards technology and the frequency and type of educational technology used during academic courses* [ProQuest Dissertations & Theses]. https://www.proquest.com/docview/1564765651/50D319B126C8411DPQ/1
Langer, E. J. (2000). Mindful Learning. *Current Directions in Psychological Science*, *9*(6), 220–223. https://doi.org/10.1111/1467-8721.00099
Lee, J., & Suh, S. (2024). AI Technology Integrated Education Model for Empowering Fashion Design Ideation. *Sustainability*, *16*(17), 7262-. https://doi.org/10.3390/su16177262
Lewis, Y. E. (2010). *Literacy in elementary school in Jamaica: The case of the Grade Four Literacy Test* [ProQuest Dissertations & Theses]. https://www.proquest.com/docview/757372581/50D319B126C8411DPQ/3
Lohman, L. (2025). *A Qualitative Analysis of U.S. Higher Education Student Academic Integrity Policies Focusing on Florida* [ProQuest Dissertations & Theses]. https://www.proquest.com/docview/3219488250/BAD39ED4389B40A2PQ/20
Lorenz, R., Heldt, M., & Eickelmann, B. (2022). Relevance of Pre-Service Teacher Training to Use ICT for the Actual Use in Classrooms—Focus on German Secondary Schools. *Technology, Pedagogy and Education*, *31*(5), 563–577. https://doi.org/10.1080/1475939X.2022.2129772
Machado, C., Hsiao, P. Y., Vaccaro, C., & Baker, C. (2024). Entering the Social Media Stratosphere: Higher Education Faculty Use of Social Media with Students across Four Disciplines. *Journal of Interactive Media in Education*, *2024*(1). https://eric.ed.gov/?id=EJ1427519
Madronero, E. T., & Torres-Madronero, M. C. (2025). The Use of Information and Communication Technologies in Teaching-Learning Processes of Social Science in Higher Education: A Systematic Review. *Innovations in Education and Teaching International*, *62*(2), 731–744. https://doi.org/10.1080/14703297.2024.2333387
Mann, K., & MacLeod, A. (2015). Constructivism: Learning theories and approaches to research. In J. Cleland & S. J. Durning (Eds.), *Researching Medical Education* (1st ed., pp. 49–66). Wiley. https://doi.org/10.1002/9781118838983.ch6
Marble, J. (2025). *Public Perceptions of the Use of Artificial Intelligence and Technology Based Resources in Psychotherapy* [ProQuest Dissertations & Theses]. https://www.proquest.com/docview/3232554638/BAD39ED4389B40A2PQ/17
Mazurek, J. (2025). *TPACK Components Contributing to Teachers' Ethical Use of AI for Teaching and Learning: A Mixed-Methods Study* [ProQuest Dissertations & Theses]. https://www.proquest.com/docview/3244627800/BAD39ED4389B40A2PQ/7
Mensah, R. O., Quansah, C., Oteng, B., & Nii Akai Nettey, J. (2023). Assessing the Effect of Information and Communication Technology Usage on High School Student's Academic Performance in a Developing Country. *Cogent Education*, *10*(1). https://doi.org/10.1080/2331186X.2023.2188809
Mezirow, J. (1996). Contemporary Paradigms of Learning. *Adult Education Quarterly*, *46*(3), 158–172. https://doi.org/10.1177/074171369604600303
Michel, F. (2025). *Adult Education Students' Perceptions of Artificial Intelligence: Exploring Knowledge, Trust, and Its Role in Learning and Career Preparation* [ProQuest Dissertations & Theses]. https://www.proquest.com/docview/3237092042/BAD39ED4389B40A2PQ/5
Mudavanhu, Y. (2014). *The Contribution of Theory and Practice to the Professional Development of Students Learning to Become Secondary Teachers in Zimbabwe* [ProQuest Dissertations & Theses]. https://www.proquest.com/docview/1774249560/50D319B126C8411DPQ/2
Novak, J. D., & Gowin, D. B. (1984). *Learning how to learn*. cambridge University press. https://books.google.com/books?hl=hi&lr=&id=8jkBcSDQPXcC&oi=fnd&pg=PR9&dq=learning&ots=nCrUnuyM27&sig=USOqcuSId4keoAAOzadq9GC1AXU
Odoom, D., Agyepong, L., Dick-Sagoe, C., & Mensah, E. O. (2025). Unveiling the Social Media Landscape: Exploring Factors Influencing Usage Patterns among Tertiary Education Students in Ghana. *Education and Information Technologies*, *30*(3), 3861–3883. https://doi.org/10.1007/s10639-024-12944-0

Ofosu-Asare, Y. (2024). Developing Classroom ICT Teaching Techniques, Principles and Practice for Teachers in Rural Ghana without Access to Computers or Internet: A Framework Based on Literature Review. *International Journal of Information and Learning Technology*, *41*(3), 262–279. https://doi.org/10.1108/IJILT-04-2023-0045

Onyancha, O. B. (2023). Mapping Media and Information Literacy Skills during and after COVID-19, with Special Reference to Online Education, and Commerce and Trade. *Journal of Media Literacy Education*, *15*(3), 93–109.

Prince, M., Patel, V., Saxena, S., Maj, M., Maselko, J., Phillips, M. R., & Rahman, A. (2007). No health without mental health. *The Lancet*, *370*(9590), 859–877.

Puja, T., Digar, S. F., Anjana, B., & Rakhi, T. (2025). AI in classrooms: Impact on teacher identity and autonomy. *I-Manager's Journal on School Educational Technology*, *20*(4), 39-. https://doi.org/10.26634/jsch.20.4.21964

Rajput, D., Gupta, S., & Singh, V. (2026, May). Are digital resources meeting student needs? A study of e-resource satisfaction at CSJM University. International Journal of Scientific Research Studies, 3(5), 264-273.

Rastogi, S., Gupta, S., Deepak, D., & Singh, V. (2025). Spiritual intelligence: A systematic review. International Journal of Arts and Humanities, 3(1), 35-52.

Singh, V., et. al., (2025, November 24). Unveiling the global rise of chatbot-assisted learning: A 2020–2025 bibliometric study. Scientific Culture, *11*(4), 3042-3060. https://sci-cult.net/index.php/cult/article/view/2758/1594

Scheid, T. L., & Wright, E. R. (2017). A handbook for the study of mental health. Cambridge university press. https://books.google.com/books?hl=hi&lr=&id=ws8oDwAAQBAJ&oi=fnd&pg=PR1&dq=mental+health&ots=uyCwGSmZBQ&sig=Mv6VOYVoXre_zwkkFw5Wifl0d3g

Gupta, S., & Singh, V. (2025, August 27). CBCS in higher education: An impact analysis. Omniscient, 3(1), 43-55.

Shukla, P., Gupta, S., & Sharma, M. (2025). From happiness curriculum to skill development: A critical evaluation of Delhi's NEEEV programme. International Journal for Multidisciplinary Research, 7(3), 12.

Sharma, S., Mittal, P., Kumar, M., & Bhardwaj, V. (2025). The role of large language models in personalized learning: A systematic review of educational impact. *Discover Sustainability*, *6*(1), 243–24. https://doi.org/10.1007/s43621-025-01094-z

Shedler, J., Mayman, M., & Manis, M. (1993). The illusion of mental health. *American Psychologist*, *48*(11), 1117.

Smahel, D., Gulec, H., Lokajova, A., Dedkova, L., & Machackova, H. (2023). The Integrative Model of ICT Effects on Adolescents' Well-Being (iMEW): The Synthesis of Theories from Developmental Psychology, Media and Communications, and Health. *European Journal of Developmental Psychology*, *20*(6), 944–961. https://doi.org/10.1080/17405629.2022.2135501

Tripsa, M. V. (2025). *Leading Change and Learning During the Generative Artificial Intelligence Disruption in Qatar Foundation Schools: A Basic Qualitative Study* [ProQuest Dissertations & Theses]. https://www.proquest.com/docview/3205837818/BAD39ED4389B40A2PQ/1

Ulukok, N., & Saygili, N. (2024). The Role of Technology, Education, and Social Media in Tourism Marketing. *Turkish Online Journal of Educational Technology - TOJET*, *23*(3), 130–138.

Usmani, S. S., Sharath, M., & Mehendale, M. (2022). Future of mental health in the metaverse. *General Psychiatry*, *35*(4), e100825.

Zhang, X., & Zhou, M. (2023). Adolescents' Perceived ICT Autonomy, Relatedness, and Competence: Examining Relationships to Intercultural Competence in Great China Region. *Education and Information Technologies*, *28*(6), 6801–6824. https://doi.org/10.1007/s10639-022-11463-0

Zuhri, R. S., Wilujeng, I., Haryanto, H., & Ibda, H. (2024). Information Communication Technologies Education in Elementary School: A Systematic Literature Review. *Journal of Education and Learning (EduLearn)*, *18*(3), 1078–1090.