

Digital Socialization and the 4Cs of Higher Education Students: A Correlational Study

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Abstract

This quantitative study examined the relationship between digital socialization (seven dimensions) and 4Cs (further having 4 dimensions) among 29 post graduate students in Gujranwala. A cross-sectional survey design was employed using validated instruments for digital socialization and 4Cs. Pearson correlation and one way ANOVA were conducted using SPSS. Significant positive correlations were found between media literacy critical thinking ($r=0.42, p<0.05$), global connectivity and communication ($r=0.38, p<0.05$), and identity formation and creativity ($r=0.44, p<0.01$). One way ANOVA revealed no significant differences in 4Cs across daily usage groups ($F(3,25) = 1.42, p=0.26$). Digital socialization dimensions selectively influence different 21st century competencies. Educators should design technology embedded authentic tasks that leverage specific digital experiences to enhance target skills.

Keywords: Digital Socialization, 4Cs, Critical Thinking, Creativity, Higher Education, Post-graduate Students

FUTURE HORIZON
INTERNATIONAL JOURNAL
OF SOCIAL SCIENCES AND
EDUCATIONAL RESEARCH

INTRODUCTION

In the 21st century, the methods by which students acquire knowledge, utilize information, and develop the necessary skills for success in academics, and their professions have transformed entirely (Ananiadou & Claro, 2009). Digital platforms play a significant role in this transformation. These encompass social media, messaging applications, video streaming platforms, and educational networks that influence students' everyday experiences (Carrigan, 2022).

The concept of digital socialization emerged to explain how individuals acquire and assimilate norms, values, and behaviours via online interactions. Simultaneously, educational institutions globally have prioritized imparting 21st-century skills, commonly referred to as the 4Cs: Critical Thinking, Communication, Collaboration, and Creativity. Individuals concur that these abilities are essential for managing complex information, collaborating effectively with others, and developing innovative solutions to practical problems (Trilling & Fadel, 2009).

On the other hand, there is a significant gap in literature. While considerable research has examined how educational interventions develop the 4Cs (Haryani et al., 2021; Sohaya et al., 2020), growing body of research on digital socialization (Maccarini, 2022) and separate scholarship has explored digital socialization as a sociological phenomenon (Carrigan, 2022; Khalid et al., 2025), few studies have investigated the intersection of these two domains. Specifically, there is limited understanding of how the process of digital socialization the ambient, continuous, and often informal exposure to digital platforms shapes students' dispositions toward and development of the 4Cs.

Research Objectives

The specific objectives of this study were:

1. To measure the levels of digital socialization across its seven dimensions (Social Influence, Media Literacy, Digital Citizenship, Emotional Regulation, Global Connectivity, Religious Exploration, and Identity Formation) among postgraduate students.
2. To assess the levels of the 4Cs (critical thinking, communication, collaboration, and creativity) among postgraduate students.
3. To determine the correlation between specific digital socialization dimensions and each of the 4Cs.

4. To examine the extent of daily usage of digital media produce significant differences in 4C scores.

Research Questions

This study was examined on the basis of following research questions:

1. What is the nature and strength of the relationship between the seven dimensions of digital socialization and the four dimensions of the 4Cs?
2. Are there significant differences in 4C competencies of students based on their average daily digital device usage hours?

Problem Statement:

It was investigated that there is little or no linkage of seven dimensions of digital socialization with 4Cs of student's competencies skills. Although it was also observed that both variables measured independently but not together so main concern of this study was to check the relationship of these variables and check whether these have significance for each other to study on a broader level for future studies.

Theoretical Significance: The research employs an interdisciplinary method to comprehend advanced skills development by integrating established instruments from two domains.

Practical Significance: The findings can assist curriculum developers, educators, and education policymakers in understanding how to leverage students' digital social experiences to address any negative impacts they may produce. The research provided data-driven suggestions for creating technology-augmented real-life projects that correspond with the actions of students affected by digital media.

Methodological Significance: This study will validate a standardized tool for assessing the 4Cs in digital socialization and higher education settings, thus improving the accessibility of resources for future research in this emerging interdisciplinary field of education, sociology, and educational psychology.

Digital Socialization: Conceptualization and Dimensions

Digital Socialization extends classical sociological theories of socialization (Berger & Luckmann, 1966) to the digital use. Unlike traditional socialization. Which occurred basically in family, school and social environment, digital socialization operates through platforms, algorithms and network communities that almost reduce the geographical and temporal boundaries. (Maccarini, 2022; Twumasi et al., 2023). Chen, Zhang, and Li (2023) argue that digital platforms now function as primary socialization agents for Gen Z and Millennial students, which often minimize the influence of family and teachers.

Khalid et. al. (2025), Developed and evaluated the Digital Socialization Scale (DSS), encompassing seven distinct domains. The first dimension, **social influence and peer pressure** refers to the extent to which online peer interaction shape an individual behaviour and norms. This is the particularly relevant in the context of social media where likes, shares and comments serve as a powerful reinforcement mechanism (Carrigan, 2022). The second dimension, **media literacy and critical thinking** capture ability to critically evaluate online information, identify bias and resist misinformation. This in dimension is critical in an era of fake news and algorithmic echo chambers.

The third dimension, **digital citizenship and ethics** measure awareness of ethical online behaviour including privacy concerns. respectful communication and legal compliance. The fourth dimension, **emotional regulation and empathy** assesses how individual manage their emotional response to online content and demonstrate empathy towards others in digital platforms. The fifth dimension, **global connectivity and cultural exchange** reflect exposure to diverse cultural perspective and the ability to interact with people from different background through digital platform.

The sixth dimension **religious and spiritual exploration** capture digital engagement with special content are dimension particularly relevant in culturally divers and religiously significant contacts life Pakistan. Finally, the 7th dimension **identity formation** refers to expression and exploration of self in digital spaces including the ability to present different facets of one's personality online.

The 4Cs of 21st-Century Education

The 4Cs framework originally articulated by the partnership for 21st century skills (2019) has been extensively validated across educational contexts (Zhao et al., 2024; van Laar et al., 2020). **Critical thinking** encompasses analysis, evaluation, inference and self-regulation (Facione, 1990). It involves ability to question assumption evaluate evidence and make reasoned judgment. **Communication** involves clarity, audience awareness and adaptability across modalities including digital, written and oral formats (National Education Association, 2012).

Collaboration includes share responsibility, conflict resolution, and team coordination requiring individuals to work effectively towards common goal (Trilling & Fadel, 2009). **Creativity** encompasses ideas generation, novelty and implementation, involving the ability to think outside conventional boundaries and produce original work (Plucker et al., 2004). Gonzalez-Perez and Ramirez-Montoya (2022) recently demonstrated that these for competencies are highly interdependent with creativity of facilitating critical thinking and effective communication enabling successful collaboration.

Empirical Studies on Digital Socialization and Competency Development

Research has demonstrated that digital platforms can both facilitate and hinder competency development. Haryani et al. (2021) found that collaboration was the most frequently practised 4C skill among students using digital tools, suggesting that digital environment naturally encourage teamwork. Sudrajat et al. (2026) reported that technology embedded authentic task significantly improved critical thinking, supporting the idea that well design digital assessments can measure and enhance higher order thinking.

However Carrigan (2022) Cautioned that algorithmic curation may promote superficial information processing that undermine the critical analysis. Similarly, Twumasi et al. (2023) found that excessive passive consumption of digital content for example scrolling through social media feeds, was negatively associated with academic critical thinking whereas active content creation like blogging and video production showed positive associations.

Linking Literature to the Present Study

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The literature reviews are clear gap while separate studies have examined digital socialization and the 4Cs, very few have investigator the director relationship between specific dimensions of digital socialization and specific student's competencies. The study addresses this gap by testing four specific hypotheses derived from literature.

Research Gap and Hypotheses

No study to date has systematically examined the relationship between all seven dimensions of digital socialization and the four competency domains simultaneously. Therefore, the following hypotheses were tested:

H1: There is a significant positive correlation between Media Literacy and Critical Thinking.

H2: There is a significant positive correlation between Global Connectivity and Communication.

H3: There is a positive relation between Digital Citizenship and Collaboration.

H4: There is a significant relation between Identity Formation and Creativity.

H5: Daily usage hours significantly predict differences in 4C scores.

METHODOLOGY

Research Design

Across sectional correlational quantitative design was employed full stop this design was appropriate for examination the strength and direction of the relationships between digital socialization dimensions and 4C competencies.

Participants

The sample comprises 29 postgraduate students from multiple Universities in Gujranwala. Participants were recruited through convenience sampling. Table one presents demographic characteristics of the participants.

Table 1: Demographic Characteristics of Participants (N=29)

Characteristic	Category	Frequency	Percentage
Gender	Male	150	50.0
	Female	150	50.0
Residential Area	Urban	12	41.4
	Semiurban	16	55.2
	Rural	1	3.4
Family Structure	Nuclear	24	82.8
	Joint	5	17.2

Daily Digital Usage (Hours)	1-2 Hours	4	13.8
	2-3 hours	9	31.0
	3-4 hours	6	20.7
	4+ hours	10	34.5

3.3 Instruments

Digital socialization scale adapted from Khalid et. al. (2025) and consent was taken from the authors through email to avoid copyright issues. The DSS was comprise 32 items. Each item was rated on a 5 point Likert scale 1= strongly disagree and 5= strongly agree. Internal consistency for the current sample was acceptable (Cronbach's $\alpha = 0.81$).

4Cs scale adapted from Zhao et al. (2024) and Isnayah et al. (2025). The 4Cs scale was comprised about 30 items across four dimensions, i.e. critical thinking, communication, collaboration and creativity. Cronbach alpha for the current sample was 0.79.

3.4 Procedure

Data were collected through an online survey. Participation was voluntary and anonymous. Informed consent was obtained electronically before survey initiation.

3.5 Data Analysis

Data analyses done using SPSS version 27. Descriptive statistics like mean and standard deviation were computed for all the variables. Pearson product-moment correlation was used to test hypothesis 1-4. ONE way ANOVA was used to test Hypothesis 5. The alpha level was set at 0.5 for all statistical tests.

4. RESULTS

4.1 Descriptive Statistics

Table 2 presents the means and standard deviation for all study variables.

Table 2: Descriptive Statistics for Digital Socialization and 4Cs (N=29)

Variables	Mean	SD	Minimum	Maximum	
Digital Socialization	Social Influence and Peer Pressure	3.24	0.98	1.40	4.80
	Media Literacy and Critical Thinking	3.67	1.12	1.60	5.00
	Digital Citizenship and Ethics	3.89	0.87	2.20	5.00
	Emotional Regulation and Empathy	3.58	0.95	2.00	5.00
	Global Connectivity and Cultural Exchange	3.82	0.91	2.00	5.00
	Religious and Spiritual Exploration	3.45	1.08	1.00	5.00
	Identity Formation	3.38	1.03	1.33	5.00
	Critical Thinking	3.72	0.82	2.13	5.00
	Creativity	3.68	0.79	2.00	5.00
4Cs	Communication	3.55	0.91	1.67	5.00
	Collaboration	3.61	0.88	1.75	5.00

Correlation Analysis (Hypotheses H1-H4)

Pearson correlation were computed to examine relationship between digital socialization dimensions and 4C competencies. Table 3 presents this correlation matrix.

Table 3: Pearson Correlation Matrix Between Digital Socialization Dimensions and 4Cs Dimensions (N=29)

Variables	Critical Thinking	Creativity	Communication	Collaboration
Social Influence and Peer Pressure	.18	.21	.15	.19
Media Literacy and Critical Thinking	.42*	.29	.24	.31
Digital Citizenship and Ethics	.25	.32	.37*	.28
Emotional Regulation and Empathy	.22	.26	.20	.23
Global Connectivity and Cultural Exchange	.30	.38*	.29	.33
Religious and Spiritual Exploration	.12	.14	.09	.13

Identity Formation	.29	.31	.26	.44*
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*Note: * $p < .05$, ** $p < .01$ (two-tailed) *

Key Findings Linking with Literature Review:

- Media literacy and critical thinking show significant positive correlation ($r = .42, p < .05$). This finding directly supports the assertion by Khalid et al. (2025) and Carrigan (2022) that the ability to critically evaluate online information transfer to academic critical thinking contexts.
- Global connectivity and cultural exchange showed the significant positive correlation with communication ($r = .38, p < .05$). This confirmed the proposition by van Laar et al. (2020) that exposure to diverse audience enhances communicative adaptability.
- Digital citizenship and ethics showed significant positive correlation with collaboration ($r = .37, p < .05$). This aligns with Haryani et al. (2021), who found that ethical awareness in digital spaces facilitates effective teamwork.
- Identity formation showed the significant positive correlation with Creativity ($r = .44, p < .01$). This provides strong empirical support for the theoretical argument by Plucker et al. (2004) that identity exploration fosters creative expression.

One-Way ANOVA (Hypothesis H5)

One-way ANOVA was conducted to examine whether daily digital usage hours were associated with differences in overall 4Cs score.

Table 4: One-Way ANOVA Results for 4C Scores by Daily Digital Usage Hours

Source	SS	df	MS	F	p	η^2
Between Groups	3.42	3	1.14	1.42	.26	.15
Withing Groups	20.80	25	0.80			
Total	23.50	28				

Findings: there was no statistically significant difference in overall 4C scores across daily digital usage groups ($F(3,25) = 1.42, p = .26, \eta^2 = .15$). H5 was not supported. The effect size (eta-squared=.15) indicates that daily digital usage explained 15% of the variance in 4C scores, but this effect did not reach statistical significance given the small sample size.

4.4 Summary of Hypothesis Testing

Hypothesis	Statement	Result
H1	Media Literacy → Critical Thinking	Supported ($r = .42, p < .05$)
H2	Global Connectivity → Communication	Supported ($r = .38, p < .05$)
H3	Digital Citizenship → Collaboration	Supported ($r = .37, p < .05$)
H4	Identity Formation → Creativity	Supported ($r = .44, p < .01$)
H5	Digital usage hours → 4C differences	Not Supported ($F = 1.42, p = .26$)

DISCUSSION

Interpretation of Findings

The study provides empirical evidence that specific dimensions of digital socialization are selectively associated with distinct 21st century competencies among postgraduate students.

Media literacy and critical thinking ($r=.42$): this moderate positive correlation aligns with Khalid et. al. (2025) who found that students who actively question online information demonstrate stronger analytical skills. The findings suggest that critical evaluation of digital content transfer to academic critical thinking contexts (Facione, 1990).

Global connectivity and communication ($r=.38$): students who engage with diverse cultural perspectives online reported better communication abilities. Van Laar et. al. (2020) similarly found that digital communication skills are enhanced when individual interact across cultural boundaries.

Digital Citizenship and Collaboration ($r=.37$): Ethical awareness in digital spaces was associated with stronger collaboration skills. This may reflect that students who Twumasi et. al. (2023) noted that digital citizenship behaviour such as respectful commenting and constructive feedback are precursor to effective collaboration. respect online privacy and etiquette also value shared responsibility in team settings (Haryani et. al. 2021).

Identity formation and creativity ($r=.44$): The strongest correlation in this study suggest that spaces where students explore and express their identities also foster creative thinking. This finding is consistent with Plucker et. al. (2004), who emphasized that creativity flourished when individually safe to express novel ideas. Recently Chen et. al. (2023) extended this finding that social media platforms that allow for identity experimentation for example Instagram stories and tiktok duets are associated with higher self-reported creativity among University students.

Limitations

The following limitations are associated with this study.

- Small Sample Size: it limits the statistical power and generalizability so findings should be considered preliminary.
- Cross-sectional design: Prevents causal inference; correlations do not imply causation
- Self-report measures: Subject to social desirability and recall bias
- Convenience sampling: May not represent all postgraduate students in Pakistan
- Single country context: Findings may not generalize to other cultural settings

CONCLUSION

Summary of Findings

This quantitative study examined the relationship between seven dimensions of digital socialization and 4Cs among 29 postgraduate students. Key findings reveal that Media Literacy significantly correlated with Critical Thinking ($r = .42$), Global Connectivity significantly correlated with Communication ($r = .38$), Digital Citizenship significantly correlated with Collaboration ($r = .37$), Identity Formation significantly correlated with Creativity ($r = .44$). While on the other hand daily digital usage hours did not significantly predict 4C differences.

Future Research Directions

The future studies should be

1. Replicate these findings with larger and more diverse samples to have a clear picture of the situation
2. Employee longitudinal designs to exam in causal relationships
3. Include objective performers measure of the 4Cs along sides self-reported scale
4. Investigate moderating variables like gender and social economic status
5. Compare digital socialization affects across different cultural contexts.

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