

Digital Growth Mindset as a Catalyst for Team Collaboration and Communication Skills in Higher Education

Afriska Yuni Anggraini^{1*}, A. Sobandi², Selvi Permata Groda³

^{1,2} Faculty of Economics and Business Education, Universitas Pendidikan Indonesia, Indonesia

³ Faculty of Social, Cultural and Political Sciences, Universitas Pembangunan Nasional Veteran Jawa Timur, Indonesia

*Corresponding author, e-mail: afriska.anggraini28@upi.go.id

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A B S T R A C T

This study explores the impact of a Digital Growth Mindset (DGM) on Digital Communication Skills (DCS) and Team Collaboration Skills (TCS) among undergraduate students in East and Central Java, Indonesia. In an era where digital competence is integral to higher education, examining how mindset-oriented dispositions influence key soft skills is essential. Utilizing a purposive sampling approach, data were collected from 214 university students via an online questionnaire and analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). The results demonstrate that DGM has a statistically significant positive effect on both DCS and TCS, although the model's explanatory power is moderate. These findings highlight the critical role of fostering a growth mindset to enhance students' capabilities in digital communication and collaborative work. The study extends the existing body of knowledge by contextualizing DGM within a developing country setting, offering empirical evidence from an underrepresented educational environment. It further emphasizes the pedagogical value of embedding DGM principles into curriculum development to support digital skill acquisition. Future research is recommended to incorporate additional variables such as prior digital experience and learning context, and to adopt longitudinal or mixed-method designs to deepen theoretical understanding and practical application in digital education.



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INTRODUCTION

The rapidly evolving digital landscape has significantly transformed the nature of communication and collaboration, rendering these competencies essential in both academic and professional domains. Information technology has emerged as a pivotal instrument for knowledge dissemination and a catalyst for educational innovation (Haleem et al. 2022). In the context of the digital economy, individuals are increasingly required to demonstrate strong teamwork abilities and effectively navigate digital communication platforms (Sarwar et al. 2024). Consequently, educational institutions face increasing pressure to develop students' digital communication and collaboration skills—capabilities that have become indispensable for thriving in interconnected, team-oriented environments (Sigmundsson and Haga 2024; Zhu et al. 2023). One promising pedagogical approach to nurturing these skills is cultivating a digital growth mindset, emphasizing adaptability, continuous learning, and resilience in collaborative, technology-mediated settings (Krskova and Breyer, 2023).

However, developing digital collaboration skills among university students in Indonesia faces unique challenges. The national digital literacy index recorded a moderate score of 3.54 in 2023 (out of 5), with tertiary education only slightly higher at 3.70 (Ministry of Communication and Information Technology 2022). Although the Indonesian Digital Society Index (IMDI) showed progress from 37.80 in 2022 to 43.34 in 2024, a substantial gap in digital competency persists, particularly within the education sector (Ministry of Communication and Information Technology 2023). Many university students lack consistent access to digital training, face uneven infrastructure across regions, and are often exposed to curricula prioritizing technical skills over digital collaboration's interpersonal and mindset aspects. These conditions reinforce the concept of the digital divide, as students from underdeveloped areas face substantial challenges in accessing adequate digital resources (Sumarno 2023). These contextual barriers signal a pressing need to explore new approaches to preparing Indonesian students for digital teamwork environments.

A “digital growth mindset,” adapted from Carol Dweck's growth mindset theory, offers a compelling solution. It refers to an individual's belief in their capacity to develop digital competencies through effort and persistence. In this context, it nurtures resilience, adaptability, and a proactive approach to using digital tools and platforms (Han and Stieha 2020). Specifically, students with a digital growth mindset tend to approach collaboration more openly and confidently, believing they can continuously improve their digital communication abilities (Morales-Navarro, Fields, and Kafai 2021). Research has shown that growth-minded individuals are more likely to embrace challenges, persist through setbacks, and maintain motivation in learning environments (Hu and Zhang 2024). This strongly suggests that cultivating a digital growth mindset could significantly benefit students by enabling them to effectively navigate technological challenges, engage collaboratively, and communicate proficiently in digital environments.

While extensive literature exists on the general growth mindset and its impact on academic outcomes, there remains a significant gap in research focusing specifically on its influence in enhancing digital collaboration and communication skills, particularly in the Indonesian higher education context (Krskova and Breyer 2023; Zhu et al. 2023). Prior efforts such as interactive learning environments and digital literacy training often fall short: they may boost engagement or technical ability but do not necessarily instill the sustained interpersonal skills needed for effective online teamwork (Campbell, Craig, and Collier-Reed 2020; Meng, Hu, and Jia 2024). While interactive learning environments can enhance student engagement and group dynamics, digital literacy programs emphasize technical proficiency and often neglect the motivational, attitudinal, and resilience components essential for effective team interaction in digital contexts (Harumi and Darmo 2023). In contrast, mindset-based interventions have shown promise in cultivating long-term collaborative behaviours and soft skills (Calvete et al. 2022; Meng et al. 2024), there remains a significant and underexplored gap in understanding its specific role in enhancing students' digital collaboration and digital communication skills (Krskova and Breyer 2023; Zhu et al. 2023), empirical evidence on how a digital growth mindset explicitly contributes to the development of team collaboration and digital communication competencies is scarce, particularly among university students who are preparing for careers in increasingly digital and collaborative work environments (Bogdány, Kiglics, and Obermayer 2024).

Recent studies suggest integrating a digital growth mindset into educational strategies yields positive outcomes. Mindset-based digital assessments can enhance student motivation and openness to feedback, which is

essential for effective collaboration (Cutumisu 2019). Studies among business students in China demonstrate that a digital growth mindset is associated with greater adaptability and engagement in group activities, suggesting its relevance across cultural contexts (Meng et al. 2024). Additionally, the development of mindset measurement tools has provided a foundation for evaluating resilience and growth-oriented attitudes in digital environments

Students adopting a growth mindset are likely to approach digital problem-solving with perseverance and confidence (Morales-Navarro et al. 2021). Furthermore, it showed that the digital growth mindset among Chinese business students was linked to increased adaptability and engagement in group activities, suggesting the potential for cross-cultural application (Meng et al. 2024). These studies indicate that mindset-based interventions can be strategically applied to develop students' collaboration and digital communication skills (Sigmundsson and Haga 2024).

However, a significant gap remains in the literature regarding the role of a digital growth mindset in developing communication and collaboration skills among university students in Indonesia. Existing studies rarely consider the influence of cultural, infrastructural, and institutional differences in shaping students' digital engagement (Sarwar et al. 2024; Zhu et al. 2023). This is particularly relevant in resource-constrained regions like Central and East Java, where mindset-based interventions have yet to be systematically explored or implemented.

This study addresses this critical gap by empirically examining the relationship between the digital growth mindset and students' digital collaboration and communication skills in Indonesian higher education. By integrating psychological theory with digital skill development, the research contributes a novel perspective to the discourse on 21st-century education. The findings are expected to inform educational policy and curriculum design that prioritize resilience, adaptability, and teamwork in digital learning environments—competencies essential for success in the future of work.

RESEARCH METHODOLOGY

This study investigates the effect of a digital growth mindset on team collaboration and digital communication skills among university students in East and Central Java, Indonesia. To guide the structural model, the study proposed two hypotheses grounded in theoretical and empirical research:

H₁: A digital growth mindset positively impacts team collaboration skills,

H₂: A digital growth mindset positively impacts digital communication skills.

A quantitative research design was employed to empirically test the proposed hypotheses and examine the structural relationships among latent variables. This methodological approach allows for a rigorous and systematic evaluation of construct interdependencies, aligning with established practices in investigating psychological and behavioral constructs within educational settings (Sigmundsson and Haga 2024). Given the study's objective to assess the impact of mindset-oriented interventions on the development of digital skills, the survey method was selected for its efficiency in capturing data from a large and demographically diverse sample of university students across multiple academic disciplines (Zhu et al. 2023). The design supports generalizability of findings to the broader population of Indonesian university students, particularly within digitally mediated academic contexts. This is especially pertinent as institutions seek scalable strategies to foster relevant competencies for the demands of 21st-century digital learning and collaboration.

The target population was undergraduate students from multiple universities in Surabaya, Indonesia. This demographic is relevant to the study objectives, as university students are increasingly required to master digital collaboration and communication competencies essential for academic and professional success (Sarwar et al. 2024). A purposive sampling strategy was employed to recruit participants who met predefined inclusion criteria: undergraduate (S1) students residing in East or Central Java and actively participating in digitally mediated academic activities. This non-probability sampling approach was deemed appropriate for its capacity to identify information-rich cases aligned with the study's conceptual and analytical objectives. Purposive sampling involves intentionally selecting individuals based on specific characteristics relevant to the research focus, enabling the researcher to gather nuanced insights from a targeted population (Etikan 2016). Although non-random, this method offers methodological rigour when the aim is to explore constructs within a defined context

rather than achieve statistical representativeness. The criteria for the sample are Undergraduate (S1) students living in East Java and Central Java.

A total of 225 online questionnaires were distributed via Google Forms. To ensure data quality, a systematic data cleaning protocol was applied. Responses with more than 5% missing values, straight-lining patterns, or identified as multivariate outliers through Mahalanobis distance were excluded. The cleaning process was conducted sequentially, beginning with missing data detection, followed by response pattern screening, and then multivariate outlier analysis. Consequently, 214 valid responses (approximately 95% of the total) were retained for final analysis. This sample size exceeds the recommended minimum for structural equation modelling, enhancing the results' statistical power and robustness (Calvete et al. 2022).

The structured questionnaire comprised three latent constructs—Digital Growth Mindset (DGM), Team Collaboration Skills (TCS), and Digital Communication Skills (DCS)—each measured through theoretically derived dimensions. DGM included four dimensions: fundamental beliefs about digital skill improvement, perseverance in digital tasks, embracing challenges, and resilience in digital environments. TCS was measured through three dimensions: communication and idea-sharing, conflict resolution, and a combined dimension of supportiveness and flexibility in team roles. DCS encompassed three dimensions as well: confidence in using digital tools, effectiveness in digital messaging, feedback responsiveness, and adaptability to diverse communication contexts. Each dimension was operationalized using two reflective indicators, resulting in a total of 24 items.

Indicator development was guided by established theoretical frameworks and prior validated instruments (Krkova and Breyer, 2023; Calvete et al., 2022; Meng, 2023). Item statements were adapted to align with the study context and carefully reviewed for semantic consistency and conceptual relevance. The questionnaire was evaluated for content validity by subject-matter experts in educational psychology and digital learning. A pilot study was conducted with 30 students outside the main sample to examine item clarity, linguistic appropriateness, and initial internal consistency. Items demonstrating ambiguity or low item-total correlation were revised or removed.

In addition to content validation and pilot testing, construct validity was assessed during the measurement model evaluation through convergent and discriminant validity analysis, which was consistent with PLS-SEM methodological standards. Convergent validity was examined via factor loadings and Average Variance Extracted (AVE), while discriminant validity was tested using the Fornell–Larcker criterion and cross-loadings.

Data analysis was conducted using Partial Least Squares Structural Equation Modeling (PLS-SEM), an appropriate technique for exploring complex causal relationships involving latent variables. The study followed three main steps: evaluation of the measurement model (outer model), assessment of the structural model (inner model), and hypothesis testing.

In the outer model analysis, convergent validity was assessed by examining indicator loadings (≥ 0.7 preferred), AVE values (> 0.5), and Composite Reliability (CR > 0.7). Discriminant validity was confirmed through the Fornell–Larcker criterion and cross-loading comparisons. Internal consistency reliability was also verified using Cronbach's alpha, with all constructs exceeding the 0.7 threshold, indicating strong reliability (Sigmundsson and Haga 2024).

The inner model analysis evaluated the magnitude and significance of the hypothesized relationships. R-squared (R^2) values were used to determine explanatory power, with 0.67 considered substantial, 0.33 moderate, and 0.19 weak. Q-squared (Q^2) values, generated through the Blindfolding procedure, were used to assess predictive relevance, with values exceeding 0.35 indicating strong predictive accuracy.

Hypothesis testing was conducted using bootstrapping with 5,000 resamples, applying a significance threshold of $p < 0.05$. Statistically significant path coefficients were interpreted as evidence to reject the null hypothesis in favor of the alternative. In addition, control variables, such as academic discipline and year of study, were included to isolate the unique contribution of the digital growth mindset to team collaboration and digital communication outcomes (Zhu et al. 2023).

RESULTS AND DISCUSSION

This section presents the results and interprets the findings of the study titled Digital Growth Mindset in Enhancing Team Collaboration and Digital Communication Skills Among University Students. The objective of the analysis is to examine the extent to which a Digital Growth Mindset (DGM) contributes to the development of Digital Communication Skills (DCS) and Team Collaboration Skills (TCS) among university students in Indonesia. The findings are systematically organized into four core components: Outer Model Analysis, Inner Model Analysis, Hypothesis Testing, and Predictive Relevance. Each component provides both statistical results and a theoretically grounded discussion of their implications. This structure ensures clarity and coherence while maintaining academic rigor and alignment with established literature in educational psychology and digital pedagogy.

Outer Model Analysis

The analysis of the outer model is essential for evaluating the measurement model, which defines the relationship between observed indicators (such as items in the questionnaire) and latent variables (constructs). In this study, the key constructs include Digital Growth Mindset (DGM), Digital Communication Skills (DCS), and Team Collaboration Skills (TCS). To assess the outer model using SmartPLS 4, three criteria are applied:

1. Convergent validity, which is evaluated based on the loading factor and Average Variance Extracted (AVE),
2. Discriminant validity, which is assessed by examining the square root of the AVE and the correlation between latent constructs and
3. Reliability is measured using composite reliability and Cronbach’s alpha.

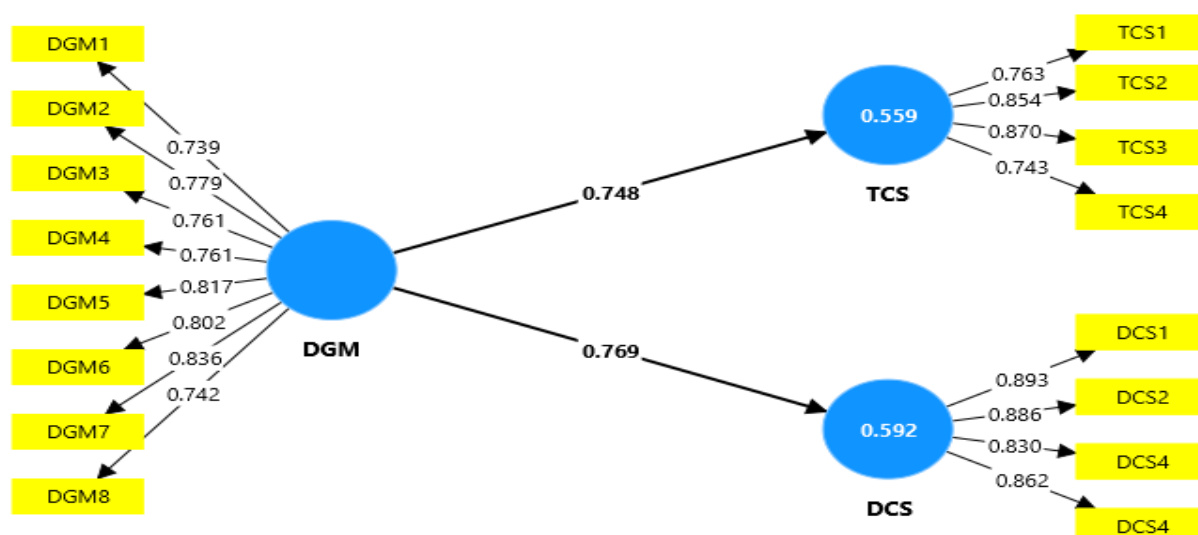


Figure 1. Outer Model Measurement

Source: Process by SEM-PLS 2024

The loading factor results for each item were assessed. As presented in Figure 1, all loading factors were more significant than 0.70, the minimum threshold indicating that the items are highly correlated with their respective latent variables (Sarstedt, Ringle, and Hair 2017). This high loading factor confirms the convergent validity of the constructs, meaning that each item effectively measures the underlying concept it was intended to assess.

As shown in Table 3, Convergent validity was further supported by the Average Variance Extracted (AVE) scores. The AVE for DCS (0.754), DGM (0.609), and TCS (0.655) all exceeded the recommended threshold of 0.50 (Claes Fornell and David F. Larcker 1981). These values indicate that each construct accounts for a substantial portion of the Variance in its indicators, further confirming the robustness of the measurement model. Discriminant validity was assessed using the Fornell-Larcker criterion, which compares the square root of the AVE for each construct with the correlations between constructs. The results, as shown in Table 1, demonstrate that the square roots of the AVEs for DCS (0.924), DGM (0.926), and TCS (0.883) are larger than the

correlations between the constructions. This confirms the discriminant validity of the constructs, suggesting that the constructs are distinct from one another and measure unique aspects of students' digital skills and mindset (Claes Fornell and David F. Larcker 1981). These values demonstrate sufficient convergent validity, suggesting that a latent variable can explain more than half of the variability in its indicators (Indah et al. 2022).

Table 1. Discriminant validity

	DCS	DGM	TCS
DCS1	0.893	0.646	0.669
DCS2	0.886	0.635	0.678
DCS3	0.83	0.681	0.692
DCS4	0.862	0.702	0.597
DGM1	0.528	0.739	0.523
DGM7	0.649	0.836	0.596
DGM8	0.603	0.742	0.61
DGM2	0.582	0.779	0.558
DGM3	0.545	0.761	0.552
DGM4	0.595	0.761	0.558
DGM5	0.687	0.817	0.648
DGM6	0.592	0.802	0.606
TCS1	0.606	0.545	0.763
TCS2	0.689	0.648	0.854
TCS3	0.642	0.657	0.87
TCS4	0.512	0.563	0.743

Source: Process by SEM-PLS 2024

Based on Table 1, each indicator demonstrates a higher correlation with its respective construct than any other, thereby satisfying the Fornell-Larcker criterion for discriminant validity. This result indicates that all questionnaire items possess adequate discriminant validity, confirming that each item reliably measures its intended latent construct without significant cross-loading on unrelated constructs.

Table 2. Construct Reliability and Validity

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average Variance Extracted (AVE)
DCS	0.891	0.891	0.924	0.754
DGM	0.908	0.91	0.926	0.609
TCS	0.823	0.832	0.883	0.655

Source: Process by SEM-PLS 2024

The reliability of the constructs was evaluated using Cronbach's alpha and composite reliability (rho_c). As presented in Table 2, the results of the composite reliability test are as follows:

1. The digital communication skills variable is reliable because the composite reliability value of digital communication skills is $0.924 > 0.6$.
2. The digital growth mindset variable is reliable because the composite reliability value of the digital growth mindset is $0.926 > 0.6$.
3. The core values variable team collaboration skills is reliable because the composite reliability value of team collaboration skills is $0.883 > 0.6$.

All constructions had values greater than 0.7, indicating good internal consistency and reliability. These findings suggest that the measurement instruments used in this study are robust and valid, providing a solid foundation for further analysis.

Inner Model Analysis

The Inner Model Analysis examines the relationships between the latent constructs, specifically the impact of Digital Growth Mindset (DGM) on Digital Communication Skills (DCS) and Team Collaboration Skills (TCS). The analysis of this model provides insight into the explanatory power of the DGM on these two key outcomes, which are essential skills in the digital age.

Table 3. R Square

	R-square	R-square adjusted
DCS	0.592	0.59
TCS	0.559	0.557

Source: Process by SmartPLS 2024

R-squared (R^2) values were computed to evaluate the explanatory power of the digital growth mindset (DGM) on the two outcome variables: Digital Communication Skills (DCS) and Team Collaboration Skills (TCS). The R^2 value for DCS was 0.592, indicating that DGM accounts for 59.2% of the variance in students' digital communication abilities (Table 3). This reflects moderate explanatory strength, suggesting that while DGM plays a pivotal role in shaping digital communication competence, additional contributing factors—such as prior exposure to digital technologies or individual personality traits—may also exert substantial influence (Meng, 2023). Similarly, the R^2 value for TCS was 0.559, signifying that DGM explains 55.9% of the variance in team collaboration skills. This also denotes moderate predictive capability, implying that although DGM significantly enhances collaborative effectiveness, other contextual or interpersonal variables—such as team composition, group dynamics, or informal learning experiences—may mediate or moderate this relationship. These findings support the argument made by Zhu et al. (2023), who asserted that a growth mindset facilitates increased engagement, flexibility, and adaptability in collaborative learning environments, ultimately contributing to more effective teamwork. While the present study affirms DGM's meaningful role in fostering both DCS and TCS, the moderate R^2 values underscore the necessity of further investigation into complementary variables that may explain the residual variance. Future research could explore integrative models incorporating motivational, contextual, and pedagogical factors to enhance the explanatory depth of digital skill development frameworks.

Hypothesis Testing

Hypothesis testing was conducted to evaluate whether Digital Growth Mindset (DGM) significantly influences both Digital Communication Skills (DCS) and Team Collaboration Skills (TCS). As presented in Table 4, the results provide strong evidence for the relationships proposed in the hypotheses.

Table 4. Hypothesis Testing

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics ((O/STDEV))	P values
DGM -> DCS	0.769	0.77	0.041	18.923	0.00
DGM -> TCS	0.748	0.75	0.041	18.072	0.00

Source: Process by SEM-PLS 2024

For Digital Communication Skills (DCS), the t-statistic was 18.923, more significant than the critical value of 1.97, and the p-value was 0.000, less than 0.05. These results indicate that DGM has a significant positive effect on digital communication skills. Therefore, Hypothesis 1 (H1), which posited that a digital growth mindset positively influences digital communication skills, is accepted. This finding aligns with previous studies, such as

those by Sigmundsson and Haga (2024), which highlighted the role of a growth mindset in improving communication skills, especially in digital contexts.

Similarly, for Team Collaboration Skills (TCS), the t-statistic was 18.072, again greater than 1.97, and the p-value was 0.000, confirming that DGM significantly positively affects team collaboration skills. Thus, Hypothesis 2 (H2), which suggested that a digital growth mindset positively influences team collaboration skills, is also accepted. This is consistent with the findings of Morales-Navarro et al. (2021), who demonstrated that a growth mindset enhances students' ability to engage in collaborative problem-solving, particularly in digital environments.

These results underscore the strategic importance of fostering a digital growth mindset (DGM) among university students, as it demonstrably contributes to enhancing digital communication and team collaboration skills. In an era characterized by increasingly digital, interconnected, and collaborative work environments, developing a growth-oriented mindset emerges as a critical pedagogical lever for equipping students with the competencies to navigate complex professional contexts. By promoting adaptability, openness to feedback, and a willingness to engage with evolving technologies, DGM may serve as a foundational cognitive disposition that supports students' sustained digital competence and collaborative efficacy.

Predictive Relevance

The predictive relevance of the model was assessed using the Q-squared (Q^2) values, which measure the model's ability to predict the endogenous variables. Q^2 values are an essential indicator of a model's predictive capability, especially when assessing the relevance of latent variables as predictors of other variables (Sarstedt et al. 2017).

Table 5. Goodness of fit (GoF)

	Q^2_{predict}	RMSE	MAE
DCS	0.584	0.667	0.466
TCS	0.55	0.682	0.521

Source: Process by SEM-PLS 2024

From Table 5 above, for Digital Communication Skills (DCS), the Q^2 value was 0.584, which indicates that the model has some predictive relevance but falls within the weak category. This suggests that while the digital growth mindset is a valuable predictor of DCS, it does not fully account for all the factors contributing to digital communication skills development. Similarly, for Team Collaboration Skills (TCS), the Q^2 value was 0.55, indicating weak relevance. This further supports the idea that the digital growth mindset is a significant predictor of both skills but that other factors, such as prior experience, teaching methods, or personality traits, may also contribute to these outcomes.

The Q^2 values, although weak, suggest that the model has a certain level of predictive relevance. This indicates that the digital growth mindset is valuable in predicting digital communication and team collaboration skills. Still, future research should explore additional variables that may provide a more comprehensive explanation of these competencies. For example, integrating digital literacy, intrinsic motivation, and specific pedagogical strategies could thoroughly explain the dynamics of developing digital skills.

Discussion and Implications

This study offers valuable empirical evidence on the role of the Digital Growth Mindset (DGM) in enhancing digital communication and collaborative competencies among university students in Indonesia. The findings not only reinforce global discourses on the necessity of digital skills in both educational and professional settings but also contribute a context-specific perspective from a developing country's higher education landscape. By situating DGM within the Indonesian academic context, the study extends existing theoretical frameworks and highlights how mindset-oriented interventions can be effectively harnessed to improve students' communicative and collaborative performance in digitally mediated environments.

Digital Growth Mindset Enhancing Digital Communication

The findings of this study underscore the pivotal role of a Digital Growth Mindset (DGM) in enhancing students' digital communication competencies in higher education. As digital communication becomes a foundational skill in academic and professional environments, understanding the psychological mechanisms that support its development is increasingly critical.

This study aligns with Cutumisu (2019), who demonstrated that growth mindset interventions foster openness to feedback and collaborative learning in digital contexts. However, while Cutumisu focused on middle school learners, our research reveals that DGM remains a salient factor in higher education settings, where students engage in more autonomous, complex, and asynchronous forms of communication. This extends prior work by showing that the effects of mindset are not limited to early education but may intensify with greater learner independence and demands for digital engagement. Thus, our findings challenge the idea that mindset interventions are primarily effective during the early developmental stages.

Moreover, our study builds upon the findings of Syamiya, Wahab, and Yuningsih (2024), who established a positive correlation between reading frequency and digital literacy, a core component of digital communication. We propose that DGM mediates this relationship by enabling students to transform frequent digital reading practices into improved communication skills. Through the lens of Constructivist Learning Theory, this mediation suggests that learners with a growth-oriented mindset are more inclined to engage with digital content critically, reflect on its meaning, and communicate it effectively to others. Constructivism emphasizes the learner's active role in making meaning from experience, and DGM enhances this process by fostering persistence, curiosity, and cognitive flexibility in navigating digital texts.

Additionally, our findings offer a theoretical and empirical complement to the work of Strauss et al. (2024), who argue for the development of distinct methodological frameworks for digital communication due to its divergence from traditional communication modes. While Strauss et al. focus on digital communication's structural and technical aspects (e.g., platform differences, interactivity, and multimodality), our research emphasizes the learner's psychological adaptability as a critical moderating factor. This suggests that DGM facilitates digital communication and enables learners to adapt to the evolving characteristics of digital platforms, indicating a need to integrate psychological constructs into existing communication models.

The study also aligns with the findings of Ahmed (2016), who explored how digital communication reconfigures social networks and patterns of interaction in the digital era. While Ahmed's research addresses macro-level societal transformations, the present study provides a micro-level psychological lens, illustrating how the Digital Growth Mindset (DGM) enables individuals—particularly students—to engage constructively in these digitally mediated environments. This convergence underscores the interdisciplinary relevance of DGM, bridging sociological and psychological perspectives. The findings are further supported by Bandura's Social Cognitive Theory, which emphasizes the centrality of self-efficacy in shaping adaptive behaviors. In this context, DGM appears to foster students' perceived competence in navigating digital spaces, thereby enhancing their initiative, problem-solving capacity, and interactive engagement within virtual academic and social communities.

The practical implications of this relationship are particularly relevant for educators. As communication increasingly occurs via digital platforms, higher education institutions must equip students with the technical skills and mindsets necessary for digital fluency. This calls for pedagogical strategies integrating mindset development into curricula, such as reflective learning, iterative feedback cycles, and technology-enhanced collaborative tasks. These approaches are consistent with the recommendations of Sigmundsson and Haga (2024), who advocate for growth-oriented teaching methods that build both technical and interpersonal skills in digital environments.

Furthermore, students from Generation Z demonstrate a marked inclination toward enhancing their digital communication competencies through online platforms (Lifintsev, Fleseriu, and Wellbrock 2022). This generational preference underscores the imperative for higher education institutions to adopt digital pedagogy as a medium of content dissemination and as a strategic framework for cultivating digital mindsets and communication proficiencies. Integrating tools such as online discussion forums, asynchronous video presentations, and real-time collaborative platforms offers students authentic, practice-rich environments to

develop and refine their digital communication skills. Simultaneously, these platforms foster growth-oriented learning behaviors, reinforcing the pedagogical value of digital environments in promoting adaptive, self-directed, and collaborative learning outcomes.

Our findings resonate with the study by Vanaja Reddy, Nagamalla, and Kaur (2024), who emphasize the importance of English proficiency and digital pedagogy in preparing students for the demands of Industry 4.0. Their work demonstrates that integrating tools such as Moodle, flipped classrooms, and gamified activities enhances both engagement and communication effectiveness in English language education. Our study adds value to this by identifying DGM as a foundational disposition that enables students to derive greater benefits from such digital pedagogies. In this way, DGM can be seen as a metacognitive-enabling factor that fosters motivation, persistence, and openness to new communication forms, essential in navigating today's dynamic digital environments.

In summary, this study contributes to a growing body of research suggesting that digital communication competence is not solely a function of digital tool mastery but is also profoundly influenced by students' psychological orientations toward learning and growth.

Digital Growth Mindset Enhancing Team Collaboration

The present findings underscore the pivotal role of a digital growth mindset in fostering collaborative competencies among university students. In the context of an increasingly digitized and interconnected academic landscape, the capacity for effective collaboration and communication, particularly within digital environments, has become a foundational element of student success. A growth mindset, conceptualized as the belief in one's potential to enhance abilities through sustained effort and learning (Yeager and Dweck 2012), has consistently been associated with heightened perseverance, receptivity to constructive feedback, and adaptive problem-solving (Sarwar et al. 2024; Burnette et al. 2022).

Empirical evidence from this study corroborates these theoretical assertions, indicating that students who internalize a digital growth mindset are more inclined to perceive technological and interpersonal challenges as developmental opportunities. Such orientation promotes a learning climate wherein persistence and collective engagement are emphasized, ultimately enhancing motivation, task efficacy, and mutual accountability in group settings (Tao et al., 2022; Mohamoud, 2024).

Nevertheless, this optimistic narrative warrants critical examination. Several scholars have posited that the efficacy of growth mindset interventions may be contextually bounded. For instance, Lim and Chua (2021) reported that in hypercompetitive academic cultures, such interventions yielded limited impact due to prevailing external performance pressures that disincentivize collaboration and experimentation. These findings imply that the success of a growth mindset framework may be contingent upon institutional ethos and sociocultural norms, particularly in online learning contexts characterized by reduced social cues and heightened individualism, which may attenuate the collaborative impulse.

Furthermore, while De Prada et al. (2022) underscore the value of extracurricular activities such as sports, music, and volunteerism in developing teamwork and leadership capabilities, the present study extends this discourse by demonstrating that similar interpersonal competencies can emerge within informal, digitally mediated collaborative environments. Online group projects, asynchronous forums, and real-time collaborative platforms offer novel affordances that simulate and sometimes surpass the socio-emotional benefits of traditional face-to-face interactions. This suggests an expanded pedagogical potential for digital ecosystems in cultivating teamwork skills.

Theoretically, this research advances the integration of mindset theory with the tenets of social constructivism. From a Vygotskian perspective (Wegerif 2008), learning is inherently social and dialogical. When juxtaposed with a growth-oriented belief system, students do not merely participate in collaborative acts but engage in a co-constructive process marked by intellectual openness, iterative learning, and the incorporation of diverse viewpoints. This dynamic interplay facilitates deeper cognitive engagement and nurtures the metacognitive awareness necessary for complex, technology-mediated collaboration.

Moreover, the findings resonate with and extend the work of Yeager and Dweck (2012), who identify resilience as a core outcome of a growth mindset. While prior studies primarily highlight intrapersonal resilience, our results indicate that such attributes can be collectively enacted within teams. Groups characterized by a

shared growth mindset demonstrated more constructive peer interactions, greater tolerance for ambiguity, and increased adaptability in managing digital tasks, which are indispensable in online collaboration's fluid, often unpredictable nature.

Considering these findings, higher education institutions must reconceptualize the implementation of a growth mindset not solely as an individual intervention but as an embedded pedagogical principle within team-based, digitally enriched learning environments. Curriculum design should incorporate assessment models that privilege collaborative over competitive behaviors, integrate structured reflection on group processes, and foster iterative feedback mechanisms that reinforce growth-oriented engagement.

Studies by Lifintsev et al. (2024) and Vanaja Reddy et al. (2024) provide further support, illustrating how digital pedagogies rooted in self-directed learning facilitate enhanced communication and team collaboration. However, most existing literature neglects to examine the collective dimension of mindset within teams—a conceptual and empirical lacuna that this study addresses.

In conclusion, while the extant literature has predominantly explored the individualistic implications of growth mindset theory, the present study foregrounds its collectivist and cultural manifestations within digital collaborative contexts. By reframing the growth mindset as a shared orientation rather than a purely personal trait, this research contributes to a more nuanced understanding of how psychological constructs operate in group dynamics and influence the development of 21st-century competencies in higher education.

Predictive Value of DGM

The results of this study affirm the contributory role of the digital growth mindset (DGM) in enhancing students' digital communication skills (DCS) and team collaboration skills (TCS). Nonetheless, the modest Q^2 values obtained suggest that DGM's predictive power, while statistically significant, remains limited in practical terms. This implies that although DGM represents a salient cognitive disposition, it may not be a robust standalone predictor of digital collaboration competencies. Consistent with the findings of Meng et al. (2024), it is plausible that other factors—such as prior digital literacy, intrinsic motivation, and institutional learning contexts—play a critical role in shaping students' capacity for effective digital engagement.

In contrast to theoretical models that emphasize cognitive traits as the primary drivers of performance, the current findings support a more multifactorial and integrative approach. For instance, emerging research on digital self-efficacy and technological fluency suggests that students' confidence in navigating digital tools mediates the outcomes of mindset-based interventions (Pan and Chen 2021). This aligns with contemporary calls for an ecological framework wherein individual, contextual, and technological variables are considered interactively to explain digital competence development.

Although prior research underscores the value of DGM in promoting resilience and adaptive engagement amid technological challenges (Lee and Hancock 2023), the present findings suggest that such effects are contingent on environmental moderators. This supports a socio-cognitive perspective in which learners' beliefs and dispositions are most effectively actualized in the presence of enabling structural and relational conditions—such as instructional scaffolding, peer collaboration, and institutional support mechanisms.

Moreover, the pedagogical context within which learning occurs appears to exert a substantial moderating influence. Research by Lifintsev et al. (2022) illustrates that blended learning modalities—integrating face-to-face interaction with digital delivery—offer a promising model for developing digital competencies. Their ability to blend the immediacy and relational richness of in-person learning with the flexibility of digital platforms may amplify the effects of mindset-based interventions, suggesting an interaction effect between instructional modality and learner disposition.

Emotional and relational dimensions further complicate the predictive scope of DGM. Cristea et al. (2024) highlight the importance of digital communication skills in mitigating social isolation and enhancing peer engagement, particularly in hybrid and online learning environments. These findings expand the scope of DGM by implicating it in performance-oriented domains and the cultivation of emotional resilience and social presence, critical factors often underexplored in digital pedagogy literature. However, the precise mechanisms linking mindset to these affective and relational outcomes remain insufficiently theorized and merit further empirical investigation.

Moreover, the study by Vanaja Reddy et al. (2024) provides compelling evidence that digital pedagogical innovation, particularly within English Language Teaching (ELT), facilitates enhanced learner autonomy, flexibility, and communicative competence. This finding substantiates the current study's assertion that instructional strategies may serve as mediating variables that link mindset dispositions with collaborative learning outcomes, particularly in preparing students for the demands of an increasingly digitized workforce.

These insights suggest that while DGM holds conceptual and applied promise, its predictive utility is most fully realized when considered within a broader, multidimensional framework. This study contributes to the evolving discourse by positioning DGM not as an isolated cognitive factor but as a component within an integrated system of digital competence development that encompasses cognitive, emotional, contextual, and technological elements. Therefore, future theoretical and empirical models are encouraged to embed DGM within this complex ecosystem, highlighting its interaction with pedagogical design, infrastructure quality, and learner agency.

Implications for Education

The findings of this study highlight the critical role of educators in cultivating a growth-oriented mindset among students, particularly in response to the evolving demands of digitally mediated learning and work environments. By fostering a mindset characterized by continuous learning, adaptability, and problem-solving, educators can enhance students' capacity to collaborate effectively in digital contexts—competencies that are increasingly essential for academic achievement and professional readiness (Krskova and Breyer 2023). These insights underscore the need to embed mindset-based interventions within digital education practices. Doing so not only strengthens academic resilience but also supports the development of key interpersonal skills, such as digital collaboration and communication, which are vital in navigating complex, technology-driven environments.

Accordingly, educational institutions are urged to adopt a dual focus: strengthening digital literacy while simultaneously nurturing students' psychological readiness to engage in dynamic digital ecosystems. This integrative approach aligns with the skill demands of Industry 4.0, ensuring that graduates possess the technical competencies and the mindset required to adapt and thrive in the future of work.

CONCLUSION

This study explored the influence of a digital growth mindset (DGM) on the development of team collaboration skills (TCS) and digital communication skills (DCS) among university students in East and Central Java, Indonesia. The findings offer empirical support for the significant role of DGM in enhancing both TCS and DCS, underscoring its relevance as a psychological construct that facilitates students' preparedness for digitally mediated collaborative environments. These results emphasize the growing importance of incorporating mindset-oriented strategies into higher education, particularly in developing regions where disparities in digital competence remain pronounced.

However, several limitations should be noted. The sample was confined to students from two Indonesian provinces, potentially limiting the generalizability of the findings to other geographical or cultural contexts. Moreover, while the statistical significance of DGM's impact was confirmed, the model's moderate explanatory power suggests that other variables—such as prior digital experience, intrinsic motivation, and instructional design—may also play crucial roles and warrant further exploration.

Despite these constraints, the broader contribution of this research lies in its reinforcement of the importance of digital mindset cultivation within 21st-century education. By demonstrating the positive association between DGM and essential digital soft skills, the study highlights the urgency for curricular innovation and policy reform that embeds mindset-based learning into instructional practice. Higher education institutions and policymakers are encouraged to integrate DGM principles into faculty training, curriculum design, and student support systems. Such integration can foster resilience, adaptability, and collaborative efficacy—core competencies for success in a technology-driven global workforce.

Future research should consider incorporating additional explanatory variables to construct a more robust and comprehensive framework. Furthermore, studies employing longitudinal, experimental, or mixed-method designs across diverse educational settings and learner populations would provide deeper insights into the

mechanisms through which DGM can be effectively cultivated. Such efforts would contribute meaningfully to both theoretical advancement and practical applications in digital education.

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