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The Effect of a Collaborative Learning Culture on Digital Knowledge Sharing and Digital Fatigue among Elementary School Teachers

Furtasan Ali Yusuf[1]

[1]Department of Primary Teacher Education, Universitas Bina Bangsa, Indonesia
*Email: fay@binabangsa.ac.id

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ABSTRACT

Purpose – The increasing use of digital technology in elementary schools requires a collaborative work environment that can support digital knowledge sharing while reducing teachers' risk of digital fatigue. This study examined the effects of Collaborative Learning Culture on Digital Knowledge Sharing and Digital Fatigue among elementary school teachers and compared these three variables across school locations.

Methodology – A quantitative approach using a factorial comparative design was employed to examine differences across school locations. The sample comprised 50 teachers from 10 elementary schools: 25 teachers from five urban schools in Serang City and 25 teachers from five rural schools in Pandeglang Regency, selected through purposive sampling. Data were collected using a structured questionnaire with a five-point Likert scale and analyzed using descriptive statistics, assumption tests, and the Mann–Whitney U test for comparative analysis.

Findings – The findings showed that: (1) Collaborative Learning Culture, Digital Knowledge Sharing, and Digital Fatigue differed significantly between teachers in urban and rural elementary schools ($p < 0.001$); (2) Collaborative Learning Culture had a positive and significant effect on Digital Knowledge Sharing ($R^2 = 0.994$, $\beta = 0.997$, $p < 0.001$); and (3) Collaborative Learning Culture had a negative and significant effect on Digital Fatigue ($R^2 = 0.945$, $\beta = -0.972$, $p < 0.001$).

Contribution – This study contributes empirical evidence on how Collaborative Learning Culture relates to Digital Knowledge Sharing and Digital Fatigue among elementary school teachers while highlighting differences between urban and rural school contexts.

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INTRODUCTION

The rapid acceleration of technology has shifted the learning paradigm in elementary schools toward educational practices that are increasingly integrated with digital devices, platforms, learning resources, and communication. This shift positions teachers not only as instructional practitioners but also as users, developers, and managers of knowledge who must continually adapt to technological change. The Technological Pedagogical Content Knowledge (TPACK) framework suggests that meaningful technology integration requires the alignment of technological, pedagogical, and content knowledge in teaching practice, whereas Communities of Practice theory conceptualizes professional learning as a social process shaped by participation and interaction among teachers (Mishra & Koehler, 2006; Wenger, 1998). These developments have intensified the need for collaborative, digitally mediated mechanisms of professional knowledge exchange.

This need also requires teachers to engage actively in Digital Knowledge Sharing by exchanging teaching materials, instructional strategies, learning media, pedagogical experiences, and digital learning resources with colleagues. Indonesian education policy has supported these activities through Ruang GTK, which provides Communities, Evidence of Work, and various facilities for learning and sharing good practices. The community feature, in particular, is designed as a space where teachers can learn, discuss, and share good practices both online and offline (Kementerian Pendidikan Dasar dan Menengah Republik Indonesia, 2025). Empirical evidence, however, indicates that the availability of digital spaces does not automatically lead to optimal knowledge-sharing behavior. A study of 128 teachers in the Duta Rumah Belajar community found that sharing intention significantly influenced sharing behavior, whereas social capital and technological factors did not significantly influence sharing intention (Puspita et al., 2022). This suggests that effective Digital Knowledge Sharing cannot rely solely on the availability of platforms; it also requires a social environment that encourages teachers to share knowledge actively.

The increasing intensity of digital activity also creates the risk of Digital Fatigue, a state of physical, cognitive, and emotional exhaustion resulting from repeated and prolonged exposure to technology and digital work demands. The technostress perspective explains that strain emerges when the demands of technology use exceed an individual's capabilities and available resources, whereas the Job Demands–Resources Model identifies job demands and organizational resources as key determinants of employee well-being (Ayyagari et al., 2011; Bakker & Demerouti, 2007). The government has expanded support for teachers' digital competence development through Ruang GTK; however, this support has not been specifically directed toward addressing Digital Fatigue as a concern for teacher occupational well-being. This concern is reflected in a study of 1,172 elementary school teachers that reported moderate to high levels of technostress and identified associations between the intensity of technology use, work–family conflict, and health problems. In contrast, school support was shown to mitigate these negative effects (Z. Wang et al., 2023a). These findings suggest that managing digital demands requires a supportive school environment that not only develops teachers' competence but also strengthens professional relationships among teachers.

Collaborative Learning Culture is particularly important in this context because it reflects a school culture that creates opportunities for teachers to learn together, exchange experiences, collaborate in addressing instructional problems, and provide sustained professional support. Stoll et al. (2006) explain that the concept of a Professional Learning Community emphasizes collaboration, collective learning, reflection, and shared goals as essential elements of teachers' professional development. Similarly, the systematic review by Dzieciatko-Szendrei et al. (2024) indicates that teacher communities are commonly built around collaborative practices and knowledge exchange to support professional development. A collaborative environment may strengthen Digital Knowledge Sharing by providing opportunities for teachers to access, discuss, develop, and disseminate digital knowledge. At the same time, social support among colleagues can function as a job resource that helps buffer the pressure and fatigue associated with technological demands. Research on professional learning communities further shows that school conditions, principal leadership, and professional communication and interaction among teachers are important factors supporting teachers'

professional learning (Rahman, 2022). Collaborative Learning Culture is therefore a relevant organizational condition for examining both the quality of knowledge exchange and teachers' experiences of digital demands.

A growing body of research has examined teacher collaboration in relation to knowledge sharing, technology use, and occupational well-being; however, these three areas have generally been investigated separately. Puspita et al. (2022) identified factors associated with knowledge-sharing behavior in digital teacher communities in Indonesia, while Christyani & Sudibjo (2022) reported that Digital Knowledge Sharing positively influenced creative performance among 163 secondary school teachers. Using data from 1,300 teachers, Zeng et al. (2025) found an association between knowledge-sharing behavior and TPACK and highlighted the role of socio-technical capital in digital environments. Research on Digital Fatigue has also documented the physical and psychological consequences of technology use among teachers, including Munawaroh's (2021) phenomenological study of teachers in Lamongan Regency and more recent studies linking workload, technostress, burnout, and Digital Fatigue among teachers in Indonesia. The novelty of the present study lies in its integrated examination of Collaborative Learning Culture in relation to both Digital Knowledge Sharing and Digital Fatigue among elementary school teachers, while simultaneously comparing these three variables between urban and rural school contexts. Unlike previous studies that have predominantly examined these issues separately or in different educational settings, this study provides a comparative perspective on how Collaborative Learning Culture relates to teachers' digital knowledge-sharing practices and digital fatigue across different school locations. This approach offers a more comprehensive understanding of the role of Collaborative Learning Culture in teachers' digital professional experiences. It addresses an underexplored intersection of professional collaboration, digital knowledge exchange, and occupational well-being in elementary education.

The urgency of this study lies in the need to create school work environments that can balance the demands of technology use with the sustainability of teachers' professional capacity. Strengthening digital knowledge-sharing practices should therefore be accompanied by efforts to maintain healthy working conditions, so that digital transformation not only expands access to learning resources but also supports sustainable teacher performance. From this perspective, a collaborative culture is an important organizational dimension warranting investigation in the context of technology-driven educational change.

Against this background and research gap, this study aimed to: (1) compare Collaborative Learning Culture, Digital Knowledge Sharing, and Digital Fatigue between elementary school teachers in urban and rural settings; (2) examine the effect of Collaborative Learning Culture on Digital Knowledge Sharing; and (3) examine the effect of Collaborative Learning Culture on Digital Fatigue among elementary school teachers. These objectives were intended to clarify differences in teachers' digital experiences across school locations and the role of Collaborative Learning Culture in fostering digital knowledge sharing and mitigating digital fatigue. The study is expected to provide a more comprehensive understanding of how a collaborative learning culture can support digital knowledge-sharing needs while helping teachers manage the consequences of technology use in their professional activities. The findings are also expected to inform schools seeking to build work environments that support collaboration, knowledge exchange, and sustainable teacher well-being amid the demands of digital transformation.

METHODOLOGY

Research Design

This study employed a quantitative approach with a factorial comparative design. A factorial comparative design is used to compare multiple groups based on two or more factors and to examine the effects of each factor and the interactions among factors on the variables under investigation (Izzatin et al., 2025). In this study, the design was used to examine differences in Collaborative Learning Culture (X), Digital Knowledge Sharing (Y_1), and Digital Fatigue (Y_2) by school location (urban and rural), as well as to analyze the effects of X on Y_1 and Y_2. The research hypotheses were formulated as follows:

H_1 (Comparative): Collaborative Learning Culture, Digital Knowledge Sharing, and Digital Fatigue differ significantly between elementary school teachers in urban and rural areas.

H_2 (Main Effect 1): Collaborative Learning Culture has a significant effect on Digital Knowledge Sharing among elementary school teachers.

H_3 (Main Effect 2): Collaborative Learning Culture has a significant effect on Digital Fatigue among elementary school teachers.

Participant

The study population comprised elementary school teachers in Serang City and Pandeglang Regency. The sample consisted of 50 teachers from 10 elementary schools, including 25 teachers from five urban schools in Serang City and 25 teachers from five rural schools in Pandeglang Regency. Participants were selected using purposive sampling based on criteria aligned with the study objectives. The inclusion criteria were: (1) being a classroom teacher or subject teacher at the elementary school level; (2) being actively employed as a teacher at the time of the study; (3) having at least three years of service at the school; (4) using technology or digital platforms for teaching and/or school administrative work; (5) having experience sharing knowledge or information digitally with other teachers, for example through WhatsApp, Google Drive, a learning management system (LMS), or a school platform; (6) having participated in collaborative activities with other teachers, such as teacher working groups (KKG), team discussions, instructional planning, or school projects; and (7) being willing to participate and complete the questionnaire in full.

Data Collection and Instrument

Data were collected using a structured questionnaire with a five-point Likert scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree. The Collaborative Learning Culture instrument was adapted from Yang, Watkins, and Marsick (2004) and comprised four dimensions—inquiry and dialogue, team learning and collaboration, empowerment toward a collective vision, and system connections—each represented by 16 items. The Digital Knowledge Sharing instrument was based on van Aalst (2009) and covered five aspects of knowledge sharing across 20 items. The Digital Fatigue instrument was adapted from Ragu-Nathan et al. (2008) and covered techno-overload, techno-invasion, techno-complexity, techno-insecurity, and techno-uncertainty across 20 items.

The instruments were pilot-tested with 20 elementary school teachers who were not included in the main study sample. An item was considered valid when its factor loading exceeded 0.50. An instrument was considered reliable when both Cronbach's alpha and McDonald's omega exceeded 0.70. Construct validity was examined using confirmatory factor analysis (CFA) in JASP, while reliability was assessed with Single-Test Reliability Analysis. The results of the instrument validity analysis are presented below.

Table 1. Results of Instrument Validity Testing

Instrument	Items	Valid Items	Factor-Loading Range	Retained Items
Collaborative Learning Culture	16	1, 2, 3, 5, 6, 8, 9, 10, 12, 13, 14, 16	0.71–0.83	12
Digital Knowledge Sharing	20	1, 2, 3, 5, 6, 8, 9, 10, 12, 13, 14, 16, 17, 18, 20	0.72–0.84	15
Digital Fatigue	20	1, 2, 4, 5, 6, 8, 9, 11, 12, 13, 15, 16, 17, 19, 20	0.73–0.83	15

As shown in Table 1, 12 of the 16 Collaborative Learning Culture items, 15 of the 20 Digital Knowledge Sharing items, and 15 of the 20 Digital Fatigue items met the factor-loading criterion of > 0.50. Items meeting this criterion were considered adequate representations of their respective constructs and were therefore retained for data collection. Reliability testing was subsequently conducted for the retained items, as presented below.

Table 2. Results of Instrument Reliability Testing

Instrument	Items	Cronbach's α	McDonald's ω	Status
Collaborative Learning Culture	12	0.932	0.941	Reliable
Digital Knowledge Sharing	15	0.946	0.953	Reliable
Digital Fatigue	15	0.931	0.940	Reliable

As shown in Table 2, Cronbach's alpha and McDonald's omega values for all three instruments exceeded 0.70. These results indicate that the items retained after validity testing demonstrated good internal consistency in measuring their respective constructs. Accordingly, all three instruments were considered reliable and suitable for data collection in the main study.

Data Analysis

Data analysis was conducted in three stages. The first stage involved descriptive statistics to determine the mean, median, and mode, and to classify scores into low, medium, and high categories. The second stage involved assumption testing, including normality tests using the Shapiro–Wilk or Kolmogorov–Smirnov test with a criterion of $p > 0.05$ and homogeneity of variance testing using Levene's test with a criterion of $p > 0.05$. The third stage involved inferential analyses consisting of comparative and effect testing. An independent-samples t-test was initially specified to compare X, Y_1, and Y_2 between teachers in urban and rural schools. When the normality assumption was not met, the Mann–Whitney U test was used as a nonparametric alternative. A value of $p < 0.05$ indicated a statistically significant difference.

After differences across school locations had been established, the analysis tested the relationships among the study variables. Two regression models were estimated: Model 1 examined the effect of Collaborative Learning Culture (X) on Digital Knowledge Sharing (Y_1), while Model 2 examined the effect of X on Digital Fatigue (Y_2). Regression results were interpreted using R^2, the F statistic, the unstandardized coefficient (B), the standardized beta coefficient (β), the t statistic, and the p value. R^2 indicates the proportion of variance in the dependent variable explained by X, while $p < .05$ indicates a statistically significant effect.

FINDINGS

Descriptive Analysis

The data analysis was conducted to describe the distribution of each study variable and to examine the specified differences and relationships among variables. Collaborative Learning Culture was treated as variable X, Digital Knowledge Sharing as Y_1, and Digital Fatigue as Y_2. All analyses were based on 50 valid responses, with no missing data. The analysis began with descriptive statistics to characterize the data, followed by assumption testing and inferential analyses to address the research objectives and test the proposed hypotheses.

Table 3. Descriptive Statistics

	Collaborative Learning Culture	Digital Knowledge Sharing	Digital Fatigue
Valid	50	50	50
Missing	0	0	0
Mode	3.275	3.261	3.910
Median	3.375	3.333	3.067
Mean	3.402	3.395	3.144
Std. Deviation	0.8699	0.8742	1.027
Minimum	1.833	1.800	1.400
Maximum	4.750	4.733	4.667

The descriptive analysis showed that Collaborative Learning Culture had a mean of 3.402, a median of 3.375, and a mode of 3.275. The standard deviation was 0.8699, with scores ranging from 1.833 to 4.750. Digital Knowledge Sharing had a mean of 3.395, a median of 3.333, and a mode of 3.261, with a standard deviation of

0.8742 and scores ranging from 1.800 to 4.733. Digital Fatigue had a mean of 3.144, a median of 3.067, and a mode of 3.910. Its standard deviation was 1.027, with scores ranging from 1.400 to 4.667. Following the descriptive analysis, scores were grouped to identify the general level of each study variable. The grouping results are presented in the following tables.

Table 4. Score Classification for Collaborative Learning Culture

Collaborative Learning Culture (X)	Frequency	%	Valid %	Cumulative %
0	25	50.0	50.0	50.0
1	25	50.0	50.0	100.0
Missing	0	0.0		
Total	50	100.0		

Using a median split procedure, the Collaborative Learning Culture scores were evenly distributed between the two categories. Twenty-five respondents were classified in the low category and 25 in the high category, representing 50.0% of the sample in each group. Thus, the distribution of Collaborative Learning Culture was balanced between the low and high categories.

Table 5. Score Classification for Digital Knowledge Sharing

Digital Knowledge Sharing (Y_1)	Frequency	%	Valid %	Cumulative %
0	22	44.0	44.0	44.0
1	28	56.0	56.0	100.0
Missing	0	0.0		
Total	50	100.0		

Using the same median-split procedure, Digital Knowledge Sharing scores classified 22 respondents (44.0%) as low and 28 (56.0%) as high. The proportion of respondents in the high category was therefore greater than that in the low category.

Table 6. Score Classification for Digital Fatigue

Digital Fatigue (Y_2)	Frequency	%	Valid %	Cumulative %
0	26	52.0	52.0	52.0
1	24	48.0	48.0	100.0
Missing	0	0.0		
Total	50	100.0		

The median-split classification showed that 26 respondents (52.0%) were in the low Digital Fatigue category, while 24 respondents (48.0%) were in the high category. The proportion in the low category exceeded that in the high category by 4.0 percentage points, indicating a slight tendency toward lower Digital Fatigue. However, the relatively balanced distribution suggests that digital fatigue remained a concern for a substantial proportion of the participating teachers.

Assumption Testing

Assumption testing was conducted to determine the suitability of the data for subsequent comparative and inferential analyses. The normality of the three study variables was assessed using the Shapiro–Wilk test, while homogeneity of variance was examined using Levene's test. These tests provided a basis for selecting appropriate statistical procedures to analyze differences between urban and rural elementary school teachers. The results of the normality test are presented in Table 7.

Table 7. Normality Test

	Collaborative Learning Culture (X)	Digital Knowledge Sharing (Y_1)	Digital Fatigue (Y_2)
Valid	50	50	50
Missing	0	0	0

Mode	3.275	3.261	3.910
Median	3.375	3.333	3.067
Mean (arithmetic)	3.402	3.395	3.144
Std. Deviation	0.8699	0.8742	1.027
Shapiro-Wilk	0.9433	0.9407	0.9286
P-value of Shapiro-Wilk	0.018	0.014	0.005
Minimum	1.833	1.800	1.400
Maximum	4.750	4.733	4.667

As shown in Table 5, the Shapiro–Wilk normality test yielded a statistic of 0.9433 for Collaborative Learning Culture (X), with p = 0.018; 0.9407 for Digital Knowledge Sharing (Y_1), with p = 0.014; and 0.9286 for Digital Fatigue (Y_2), with p = 0.005. Because all p-values were below .05, none of the three variables met the normality assumption. Homogeneity of variance was therefore examined next, with the results presented below.

Table 8. Homogeneity of Variance Test

Variable	F	df1	df2	p
Collaborative Learning Culture (X)	0.04258	1.000	48.00	0.837
Digital Knowledge Sharing (Y_1)	0.03398	1.000	48.00	0.855
Digital Fatigue (Y_2)	3.799	1.000	48.00	0.057

The homogeneity test showed that Collaborative Learning Culture (X) had F = 0.04258 and p = 0.837, Digital Knowledge Sharing (Y_1) had F = 0.03398 and p = 0.855, and Digital Fatigue (Y_2) had F = 3.799 and p = 0.057. Since the p-values for all three variables exceeded 0.05, the data were considered to satisfy the assumption of homogeneity of variance.

Comparative Analysis

The analysis next examined differences in Collaborative Learning Culture (X), Digital Knowledge Sharing (Y_1), and Digital Fatigue (Y_2) by school location. Comparative testing was conducted between teachers working in rural and urban schools. As indicated by the normality results, the data did not satisfy the normality assumption; therefore, group differences were analyzed using the Mann–Whitney U test. The test assessed whether the three variables differed significantly between the two school-location groups. The results are presented below.

Table 9. Comparative Test Results by School Location

Variable	Rural	Urban	U	p
Collaborative Learning Culture (X)	2.750	4.053	43.00	< 0.001
Digital Knowledge Sharing (Y_1)	2.720	4.069	26.50	< 0.001
Digital Fatigue (Y_2)	3.869	2.419	571.00	< 0.001

The comparative analysis revealed statistically significant differences between rural and urban school groups for all three variables (p < 0.001). For Collaborative Learning Culture (X), the urban group had a higher score than the rural group (4.053 vs. 2.750; U = 43.00; p < 0.001). A similar pattern was observed for Digital Knowledge Sharing (Y_1), with the urban group again scoring higher than the rural group (4.069 vs. 2.720; U = 26.50; p < 0.001). In contrast, Digital Fatigue (Y_2) was higher among rural teachers than among urban teachers (3.869 vs. 2.419; U = 571.00; p < 0.001). These results indicate clear differences in teachers' digital experiences across rural and urban school contexts, particularly in collaborative culture, digital knowledge sharing, and digital fatigue.

Regression Analysis

Linear regression analysis was conducted to examine the effect of Collaborative Learning Culture (X), the independent variable, on Digital Knowledge Sharing (Y1), the dependent variable. The analysis assessed the magnitude and direction of the relationship, as well as the statistical significance of the effect. The Model 1 regression results are presented below.

Table 10. Effect of Collaborative Learning Culture on Digital Knowledge Sharing

Predictor	R^2	F	B	β	t	p
X → Y1	0.994	7621.00	1.002	0.997	87.30	< 0.001

As shown in Table 8, Collaborative Learning Culture (X) had a positive and statistically significant effect on Digital Knowledge Sharing (Y_1), with $\beta = 0.997$ and $t = 87.30$ ($p < 0.001$). The R^2 value of 0.994 indicates that Collaborative Learning Culture explained 99.4% of the variance in Digital Knowledge Sharing. The overall regression model was also statistically significant ($F = 7621.00$; $p < 0.001$). These results indicate that a stronger collaborative learning culture is associated with a greater tendency to share knowledge digitally. A second linear regression analysis was conducted to examine the effect of Collaborative Learning Culture (X) on Digital Fatigue (Y_2). This analysis assessed the contribution of Collaborative Learning Culture to variation in Digital Fatigue and identified the direction and statistical significance of the effect. The Model 2 regression results are presented below.

Table 11. Effect of Collaborative Learning Culture on Digital Fatigue

Predictor	R^2	F	B	β	t	p
X → Y2	0.945	824.40	−1.147	−0.972	−28.71	< 0.001

As shown in Table 9, Collaborative Learning Culture (X) had a negative and statistically significant effect on Digital Fatigue (Y_2), with $\beta = -0.972$ and $t = -28.71$ ($p < 0.001$). The R^2 value of 0.945 indicates that Collaborative Learning Culture explained 94.5% of the variance in Digital Fatigue. The overall regression model was also statistically significant ($F = 824.40$; $p < 0.001$). The negative coefficient indicates that a stronger Collaborative Learning Culture was associated with lower levels of Digital Fatigue.

DISCUSSION

Digital Divide and Cultural Nuances: Urban vs. Rural Elementary School Contexts

The findings revealed clear differences between elementary school teachers in urban and rural settings. The mean Collaborative Learning Culture score among urban teachers was 4.053, compared with 2.750 among rural teachers. A similar pattern emerged for Digital Knowledge Sharing, with a mean score of 4.069 in the urban group and 2.720 in the rural group. In contrast, Digital Fatigue was higher among rural teachers (3.869) than among urban teachers (2.419), and all differences were statistically significant ($p < 0.001$).

These differences are consistent with Lin et al. (2023), who analyzed 11,784 K–12 teachers and identified a rural–urban gap in digital teaching competence. Rural teachers reported lower levels of ICT skills, data literacy, and digital teaching competence than their urban counterparts. The study further showed that ICT skills and data literacy were important factors explaining disparities in teachers' digital competence (Lin et al., 2023). Li's (2024) study of 366 elementary school mathematics teachers revealed a similar pattern: urban teachers demonstrated higher TPACK and more positive attitudes toward technology integration than rural teachers, particularly because of differences in access to resources and professional development opportunities.

The issue appears to extend beyond the availability of devices. Wang (2013) found that rural and urban schools differed in the availability of technology, teachers' levels of technology integration, and students' perceptions of technology use. Amirova et al. (2025) likewise reported that ICT access, internet connection quality, teacher characteristics, workload, and professional qualifications were associated with teachers' capacity to deliver digital instruction. When opportunities for technological support and competence development are uneven, teachers' experiences with technology use are also likely to vary.

The Digital Knowledge Sharing results are particularly noteworthy because the difference between the two settings was substantial. Urban teachers not only reported a stronger collaborative learning culture but were also more active in sharing knowledge through digital media. Wullschleger et al. (2023) found that

teacher collaboration networks were associated with instructional development, teamwork, and school organizational development. Knowledge sharing, therefore, should not be viewed as an isolated behavior; rather, it grows out of professional relationships that enable teachers to ask questions, exchange experiences, and obtain support when instructional problems arise.

The higher level of Digital Fatigue among rural teachers is equally important. The group reporting a lower Collaborative Learning Culture and Digital Knowledge Sharing also experienced higher digital fatigue. This pattern may occur when technological demands remain high, but access to support, resources, and knowledgeable colleagues is weaker than in urban school environments. This interpretation is consistent with Lin et al. (2023) regarding gaps in digital competence and with Li (2024) regarding differences in access and professional development between rural and urban teachers.

The Role of Collaborative Learning Culture in Fostering Digital Knowledge Sharing

Model 1 indicated an exceptionally strong positive relationship between Collaborative Learning Culture and Digital Knowledge Sharing. The standardized regression coefficient ($\beta = 0.997$), $t = 87.30$, and $p < 0.001$ indicate that higher levels of Collaborative Learning Culture were associated with higher levels of Digital Knowledge Sharing. The R^2 value of 0.994 shows that the model explained 99.4% of the variance in Digital Knowledge Sharing.

This finding is consistent with Lee & Han (2024), who showed that learning organization culture is related to knowledge-sharing practices through social capital. Their study of 231 employees in South Korea found that learning organization culture influenced social capital, which in turn had a positive effect on knowledge sharing. This finding is important because it demonstrates that knowledge sharing is not merely an individual behavior; the social relationships developed within an organization also shape whether knowledge is shared or remains with the individual who possesses it.

A similar pattern has been observed in educational settings. Şensoy & Polat (2025), in a study of 636 teachers, found a relationship between teachers' intergenerational knowledge sharing and schools' learning organization profiles. Schools that more strongly reflected the characteristics of learning organizations showed stronger links with intergenerational knowledge-sharing practices. Wullschleger et al. (2023) similarly found that teacher collaboration networks were associated with instructional development, teamwork, and school organization.

In light of the present findings, a collaborative culture appears to create conditions in which knowledge sharing can occur more naturally. Teachers who are accustomed to dialogue and collaborative work have more opportunities to locate needed information, seek assistance, share learning resources, and transfer their experiences with technology use to colleagues. When these interactions extend to WhatsApp, Google Drive, an LMS, or other digital platforms, knowledge-sharing practices have a broader space in which they can occur, rather than being limited to face-to-face meetings.

These findings suggest that simply providing digital platforms may not be sufficient to strengthen Digital Knowledge Sharing. Platforms may be available, but their use will remain limited if teachers are not accustomed to professional discussion or do not perceive a need to share their knowledge with colleagues. Lee & Han (2024) further found that the relationship between learning organization culture and knowledge sharing operates through social capital, highlighting the importance of relationship quality among organizational members in sustaining the process.

The Role of Collaborative Learning Culture in Mitigating Digital Fatigue

Model 2 showed that Collaborative Learning Culture had a negative and statistically significant effect on Digital Fatigue. The standardized regression coefficient ($\beta = -0.972$), $t = -28.71$, and $p < 0.001$ indicate that increases in Collaborative Learning Culture were associated with decreases in Digital Fatigue. The model yielded $R^2 = 0.945$, indicating that Collaborative Learning Culture explained 94.5% of the variance in Digital Fatigue in this dataset.

This result is supported by Özgür's (2020) study of 349 secondary school teachers, which found that school support and TPACK helped reduce teachers' technostress. The finding suggests that negative experiences associated with technology use are shaped not only by the technology itself but also by teachers' capabilities and the support available within the school environment.

Solís et al. (2023) reported a similar pattern in their study of perceived organizational support and technostress among teachers. Organizational support emerged as an important factor in explaining how teachers experience and manage pressure arising from technology use. When teachers can obtain assistance, guidance, and support in addressing digital challenges, technological demands do not have to be managed entirely on an individual basis.

Relationships with colleagues also appear to play an important role. In a study of 229 early childhood teachers, Sim & Kim (2025) found that colleague cooperation and digital literacy were negatively associated with technostress. Teachers who received greater cooperation from colleagues and had stronger digital literacy tended to experience lower technostress. This finding provides a relevant explanation for the present results: collaboration can serve as a source of practical assistance when teachers encounter technological problems, rather than functioning only as a mechanism for completing tasks collectively.

Wang et al. (2023), in a study of 1,172 elementary school teachers in China, likewise demonstrated the importance of school support in addressing the consequences of technology use. Technostress was associated with work–family conflict and health problems, whereas school support reduced some of these negative effects. This pattern helps explain why teachers in more collaborative environments may have different digital experiences. When technical problems, application changes, or digital work demands can be discussed and resolved collectively, the resulting pressure does not fall entirely on individual teachers.

Yang et al.'s (2025) systematic review of 54 studies also identified social support, digital literacy, organizational flexibility, and technical support as important factors in addressing teacher technostress. The present findings illustrate one potential form of such support through Collaborative Learning Culture. A collaborative culture allows teachers to learn from colleagues' experiences, obtain solutions more quickly, and avoid expending the same level of effort on resolving digital problems independently.

CONCLUSION

This study concludes that Collaborative Learning Culture differed significantly between urban and rural elementary school teachers and was positively associated with Digital Knowledge Sharing and negatively associated with Digital Fatigue. Urban teachers reported higher levels of Collaborative Learning Culture and Digital Knowledge Sharing, whereas rural teachers reported higher levels of Digital Fatigue. These findings highlight the practical importance of fostering collaborative school environments, strengthening digital competence, and providing professional and technical support, particularly in rural schools, while theoretically reinforcing the relevance of Collaborative Learning Culture in understanding teachers' digital knowledge-sharing practices and digital well-being. However, the findings are limited by the relatively small sample of 50 teachers from 10 schools in two geographical areas and the inclusion of only Collaborative Learning Culture as a predictor, which limits generalizability and does not account for other factors influencing teachers' digital experiences. Future research should therefore involve larger and more geographically diverse samples and incorporate additional variables, including digital literacy, internet access, device availability, technical support, workload, teaching experience, school digital infrastructure, and school leadership, to provide a more comprehensive understanding of the factors shaping Digital Knowledge Sharing and Digital Fatigue across urban and rural school contexts.

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