

Mechanisms Influencing Digital Literacy among Higher Vocational College Students in the Context of Educational Digitalization: A Perceived Support Perspective

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ABSTRACT:

In the context of educational digitalization, the development of digital literacy has become a critical issue in higher vocational education. From a perceived support perspective, this study examines the mechanisms influencing digital literacy among higher vocational college students. Survey data were collected from students enrolled in higher vocational institutions, and structural equation modeling was employed to analyze the relationships among perceived organizational support, perceived social support, self-efficacy, learning motivation, and digital literacy. The results indicate that both perceived organizational support and perceived social support have significant positive effects on students' digital literacy. Furthermore, self-efficacy and learning motivation play important mediating roles in these relationships, exerting both independent and sequential mediating effects. These findings suggest that perceived support enhances students' psychological and motivational resources, which in turn promotes the development of digital literacy. This study contributes to a deeper understanding of the underlying mechanisms of digital literacy in higher vocational education and provides practical implications for fostering students' digital competencies in the process of educational digitalization.

Keywords: Digital literacy; Perceived support; Higher vocational education

1. Introduction

The rapid advancement of digital technologies has profoundly transformed social structures, modes of production, and educational systems worldwide. In the context of education digitalization, digital literacy has emerged as a foundational competence for individuals to effectively participate in learning, work, and civic life in digital societies (Seeletse et al., 2024). As a key component of educational modernization, digital literacy is increasingly recognized as essential for fostering human capital development, enhancing learning adaptability, and supporting sustainable educational transformation (Mokhtari, 2023).

Within this broader transformation, higher vocational education occupies a distinctive position due to its close alignment with regional economic development and its emphasis on practice oriented talent cultivation. In recent years, higher vocational institutions have actively promoted digital transformation through investments in digital infrastructure, online learning platforms, and technology enhanced instructional practices (Antonopoulou et al., 2023). Despite these efforts, empirical observations indicate that improvements in digital learning environments do not necessarily lead to corresponding gains in students digital literacy (Chen, 2025). A considerable proportion of higher vocational students continue to encounter difficulties in areas such as effective use of digital tools, critical evaluation of information, collaborative digital learning, and problem solving in technology mediated contexts (Shun Xu et al., 2025). These challenges suggest that digital literacy development is not solely determined by technological availability but is closely linked to

students perceptions of support and their internal psychological processes (Yan & Hu, 2025).

Existing research has provided valuable insights into the conceptualization, measurement, and influencing factors of digital literacy. However, several limitations remain evident. First, empirical studies have predominantly focused on students in primary education or general higher education, while higher vocational students have received comparatively limited scholarly attention, despite their distinct learning characteristics, career orientations, and support structures (Lin et al., 2023). Second, many studies emphasize objective factors such as technology access or usage frequency, while insufficient attention has been paid to students perceived organizational support and perceived social support within educational contexts (Xin, 2022). Third, although psychological variables such as self efficacy and learning motivation are frequently acknowledged as important correlates of digital learning outcomes, systematic examinations of how external support is transformed into digital literacy through these internal mechanisms remain scarce, particularly within vocational education settings (Vaszkun & Mihalkov Szakács, 2025).

Social cognitive theory and ecological systems theory provide complementary perspectives for addressing these gaps. Social cognitive theory emphasizes the dynamic interaction between environmental conditions and individual cognitive and motivational processes in shaping learning behaviors (Bandura, 2001), while ecological systems theory highlights the multi layered environmental contexts in which individual development occurs (Darling, 2007). From this integrated perspective, students perceptions of institutional support and peer

support may influence digital literacy both directly and indirectly through self efficacy and learning motivation. Nevertheless, empirical evidence testing such multi level and mechanism oriented models in higher vocational education remains limited.

Based on this, the study takes higher vocational students in the context of education digitalization as the research object. From the perspective of perceived support, and by integrating social cognitive theory and ecological systems theory, the study systematically explores the mechanisms influencing digital literacy among higher vocational students. Specifically, the study seeks to achieve the following research objectives:

RO1: To examine the perceived levels of organizational support and social support among higher vocational students in Chengdu.

RO2: To describe and assess the overall level of digital literacy among higher vocational students in Chengdu and to examine group differences across demographic characteristics, including gender, grade level, field of study, and urban rural background.

RO3: To investigate the direct and indirect effects of perceived organizational support, perceived social support, self efficacy, and learning motivation on digital literacy among higher vocational students.

RO4: To evaluate and compare the model fit and explanatory power of structural models integrated based on social cognitive theory and ecological systems theory, and to analyze the relative explanatory contributions of different pathways to digital literacy.

2. Literature Review

2.1 Theoretical Framework

The development of digital literacy among students is a complex process shaped by the interaction between environmental conditions and individual psychological mechanisms. In the context of education digitalization, higher vocational students are embedded in learning environments characterized by institutional digital infrastructure, instructional practices, and peer interactions, all of which may exert both direct and indirect influences on digital literacy outcomes (Liang et al., 2025). To capture this complexity, the present study adopts an integrated theoretical framework grounded in social cognitive theory and ecological systems theory, with a particular focus on perceived support as a key contextual factor.

Social cognitive theory emphasizes the reciprocal relationship between environmental factors, individual cognitive processes, and behavioral outcomes (Bandura, 2001). Within educational settings, external conditions such as instructional support and peer interaction are not assumed to influence learning outcomes automatically. Instead, their effects are mediated through internal psychological processes, including self efficacy beliefs and learning motivation. Self efficacy reflects individuals judgments about their capability to successfully perform learning tasks, while learning motivation represents the degree to which individuals are willing to invest effort and persist in learning activities (Gan et al., 2023). From this perspective, digital literacy development is understood as a product of both environmental affordances and students cognitive and motivational engagement

with digital learning tasks.

Ecological systems theory further extends this understanding by situating individual development within multiple layers of environmental influence (Darling, 2007). In the context of higher vocational education, organizational support provided by institutions represents an important component of the mesosystem, encompassing access to digital resources, instructional guidance, and institutional encouragement for digital learning (Xu et al., 2025). At the same time, social support derived from peer interactions constitutes a salient element of students' immediate social environment, shaping norms, expectations, and opportunities for collaborative digital engagement (Maksum et al., 2025). These environmental layers interact dynamically with individual characteristics, highlighting the importance of examining perceived rather than merely objective support conditions.

By integrating social cognitive theory and ecological systems theory, the present study conceptualizes perceived organizational support and perceived social support as key environmental antecedents of digital literacy. These forms of perceived support are expected to influence digital literacy both directly and indirectly through self-efficacy and learning motivation. Perceived support may enhance students' confidence in engaging with digital technologies, strengthen their motivation to participate in digital learning activities, and thereby facilitate the acquisition and application of digital competencies. At the same time, the relative strength of different pathways may vary, underscoring the need for a structural examination of both direct and indirect effects.

Based on this integrated framework, the study proposes a mechanism-oriented model in which environmental support, psychological factors, and digital literacy are systematically linked. This framework provides a theoretical foundation for examining how perceived support is transformed into digital literacy outcomes among higher vocational students and offers a structured basis for subsequent empirical analysis of the relationships among perceived organizational support, perceived social support, self-efficacy, learning motivation, and digital literacy.

2.2 Hypothesis Development

Ecological systems theory posits that higher-level institutional environments shape interpersonal processes within educational microsystems by organizing norms, expectations, and interaction opportunities (Tong & An, 2023). Perceived organizational support reflects students' evaluations of whether institutions provide stable structures, clear rules, and supportive climates that legitimize collaboration (Kao et al., 2023). When organizational support is perceived as strong, peer interaction is more likely to occur within predictable and psychologically safe contexts, making assistance from peers appear accessible and trustworthy. Research in higher education shows that institutional climates emphasizing fairness and inclusiveness strengthen students' perceptions of peer support, whereas fragmented or competitive environments weaken such perceptions (Moges et al., 2025). In vocational education contexts, where peer collaboration is often embedded in practice-based learning, organizational support may play an even more pronounced role in shaping peer relations (Jin et al., 2022). These findings suggest that

organizational support functions as an upstream condition for social support perception. Accordingly, this study hypothesizes:

H1: Perceived organizational support is positively associated with perceived social support.

Social cognitive theory conceptualizes self efficacy as a belief system formed through environmental feedback, social persuasion, and interpretations of contextual support (Bandura, 2001). Perceived organizational support provides evaluative cues regarding resource availability and the legitimacy of effort, which may reinforce confidence in handling learning demands. When institutions communicate care, guidance, and recognition, learners are more likely to interpret challenges as manageable rather than threatening. Empirical studies across higher education, vocational education, and workplace learning consistently indicate that supportive organizational environments are associated with higher self efficacy, with stronger effects observed in more structured systems (Yan, 2025). These patterns indicate that organizational support operates as a cognitive affirmation mechanism. Therefore, this study proposes:

H2: Perceived organizational support is positively associated with self efficacy.

According to social cognitive theory, self efficacy develops partly through vicarious experiences and verbal encouragement embedded in social interaction. Perceived social support offers learners opportunities to observe peers successfully managing similar tasks, providing informational cues about personal capability (Wang et al., 2025). Peer encouragement and shared problem solving further reinforce

confidence by normalizing difficulties and validating effort (Mikolajczak-Degrauwe et al., 2023). Research across secondary, higher, and vocational education consistently reports positive associations between peer support and academic self efficacy, particularly in collaborative and practice oriented learning environments (Zhu et al., 2025). These findings suggest that social support plays a direct role in efficacy belief formation. On this basis, this study hypothesizes:

H3: Perceived social support is positively associated with self efficacy.

Motivational theories emphasize that learning motivation is shaped by environmental affordances influencing perceived value and expectancy of success (Bandhu et al., 2024). Perceived organizational support may enhance motivation by reducing barriers to engagement and reinforcing the usefulness of learning activities (Mori et al., 2024). From an ecological systems perspective, institutional arrangements organize access to learning opportunities and shape motivational orientations (El Zaatari & Maalouf, 2022). Empirical evidence from higher and vocational education suggests that organizational support is associated with stronger learning motivation, although effects vary with institutional coherence and implementation quality (Chen et al., 2025). Overall, organizational support functions as a motivational catalyst. In light of these arguments, this study proposes:

H4: Perceived organizational support is positively associated with learning motivation.

Self determination theory identifies relatedness as a fundamental psychological need underlying sustained learning motivation (Neufeld, 2025). Perceived social support from peers may

satisfy this need by fostering belonging and emotional engagement in learning activities (Villar et al., 2025). In social learning environments, peer affirmation and cooperation enhance willingness to invest effort and persist (Järvenoja et al., 2025). Empirical research across diverse educational contexts indicates that peer support is positively associated with intrinsic motivation and learning persistence, with particularly strong effects in vocational education settings (Zhu et al., 2025). These findings highlight the motivational function of social support. Accordingly, this study advances the following hypothesis:

H5: Perceived social support is positively associated with learning motivation.

Social cognitive theory positions self efficacy as a proximal determinant of motivational regulation by shaping expectations of success. Individuals who believe they can successfully perform tasks are more likely to set challenging goals and sustain effort (de la Fuente et al., 2022). Self efficacy influences motivation by affecting judgments about the relationship between effort and outcomes (Schunk, 1995). Empirical studies across face to face, blended, and online learning contexts consistently demonstrate this relationship, especially in digitally mediated environments requiring self regulation (ElSayad, 2024). These findings support a direct efficacy motivation link. Therefore, this study proposes:

H6: Self efficacy is positively associated with learning motivation.

Digital literacy development requires sustained engagement with complex and evolving technological tasks (Shatila et al., 2025). From a social cognitive perspective, self efficacy determines whether learners initiate, persist in,

and adapt to such tasks. Individuals with higher confidence in managing digital tools are more likely to explore, practice, and refine digital skills (Ren et al., 2025). Empirical evidence from higher education and vocational training consistently shows that self efficacy predicts digital competence, particularly in contexts requiring autonomous technology use (Hu et al., 2025). These findings suggest that self efficacy directly supports digital literacy acquisition. Thus, this study hypothesizes:

H7: Self efficacy is positively associated with digital literacy.

Learning motivation determines the intensity and persistence of engagement with learning activities. In digital learning environments, motivated learners are more likely to experiment with technologies, seek information, and apply digital skills across contexts (Haleem et al., 2022). Motivational theories suggest that internal drive translates into competence development through sustained effort (Bandhu et al., 2024). Empirical studies indicate that learning motivation predicts both digital engagement and digital literacy, although effects may be moderated by instructional design and institutional support (Lan et al., 2025). Overall, motivation remains a central driver of digital literacy. Accordingly, we proposes:

H8: Learning motivation is positively associated with digital literacy.

Ecological systems theory suggests that institutional environments directly shape developmental outcomes by organizing resources, expectations, and norms (El Zaatari & Maalouf, 2022). Perceived organizational support may influence digital literacy by increasing access to digital tools and legitimizing their use in learning

activities (Passlack et al., 2025). When institutions visibly support digital learning, students may be more willing to invest effort in developing digital competencies. Empirical research supports a positive association between organizational support and digital literacy, although some studies report stronger indirect than direct effects (Passlack et al., 2025). These mixed findings highlight the importance of examining both pathways. On this theoretical basis, we hypothesize:

H9: Perceived organizational support is positively associated with digital literacy.

From an integrated perspective of ecological systems theory and social cognitive theory, perceived social support functions as a critical microsystem factor influencing learning outcomes in digitalized educational environments. Peer interaction represents a proximal context in which daily learning activities and skill acquisition occur, making social support particularly salient for competence development (Justice et al., 2025). Across higher and vocational education, peer supported learning facilitates digital literacy through collaborative practice and shared problem solving, although effect sizes vary by task structure and institutional regulation (Haleem et al., 2022). Social cognitive theory further explains that social support shapes internal cognitive and motivational processes through vicarious experience and social persuasion (Wang et al., 2022). Observing peers successfully engaging with digital tasks enhances self efficacy, which in turn strengthens learning motivation and sustains engagement (Lee & Hancock, 2023). Empirical studies across classroom based, blended, and online environments support both direct effects of peer support on digital competence and

indirect effects mediated by efficacy beliefs and motivation, with indirect pathways more pronounced in structured contexts (He & Wen, 2025). Organizational support may further reinforce or constrain these mechanisms by shaping the stability of peer interaction (Mitic et al., 2021). Hence, this study proposes the following hypotheses:

H10: Perceived social support is positively associated with digital literacy.

H11: Self efficacy mediates the relationship between perceived organizational support and digital literacy.

H12: Learning motivation mediates the relationship between perceived organizational support and digital literacy.

H13: Self efficacy and learning motivation sequentially mediate the relationship between perceived organizational support and digital literacy.

H14: Self efficacy mediates the relationship between perceived social support and digital literacy.

H15: Learning motivation mediates the relationship between perceived social support and digital literacy.

H16: Self efficacy and learning motivation sequentially mediate the relationship between perceived social support and digital literacy.

3. Method

3.1 Data Collection and Sample

The target population of the study comprised students enrolled in higher vocational institutions in Chengdu, China. During the 2024 academic year, higher vocational colleges in

Chengdu collectively enrolled approximately 280,000 students. Given the scale of the population and practical constraints related to time and resources, a sample based survey design was adopted to obtain representative data for empirical analysis.

To ensure institutional diversity and reasonable generalizability, five comprehensive higher vocational colleges in Chengdu were selected as sampling sites. The selection was guided by criteria including institutional registration within Chengdu, representation of both public and private governance models, moderate to large student enrollment size, and comprehensive disciplinary coverage across major vocational fields such as engineering, business, information technology, and transportation. Based on these criteria, three public and two private higher vocational colleges were included in the study, reflecting the proportional distribution of institutional types in the region.

A stratified random sampling strategy was employed to enhance sample representativeness. Stratification was conducted according to key demographic characteristics, including institutional type and year of study. Within each

stratum, students were randomly selected to participate in the survey, which helped reduce sampling bias and ensured that major subgroups within the target population were adequately represented.

Table 1 illustrates the distribution of the sample across the five participating higher vocational institutions. Based on the planned sample size of 400 questionnaires, data were collected through an anonymous online questionnaire administered during a regular academic term. A total of 445 questionnaires were returned. After excluding 35 questionnaires due to missing information, logical inconsistencies, or invalid response patterns, 410 valid responses were retained for analysis, yielding an effective response rate of 92.13%. The final sample slightly exceeded the planned size, and the sample distribution was proportionally aligned with institutional enrollment size, ensuring balanced representation across colleges. This sample size met commonly accepted thresholds for quantitative research and provided an adequate empirical basis for examining digital literacy and its influencing mechanisms among higher vocational students.

Table 1. Sampling distribution

College Name	Number of Respondents	Sampling Proportion
Urban Vocational College of Sichuan	104	26%
Chengdu Vocational and Technical College	80	20%
Sichuan Vocational and Technical College of Communications	80	20%
Sichuan Changjiang Vocational College	64	16%
Chengdu Industrial Vocational and Technical College	72	18%
Total	400	100%

3.2 Measurement

The primary quantitative instrument used in the study was a structured questionnaire, a widely adopted method for collecting large scale data in educational research. To test the proposed theoretical model and hypotheses, all core constructs were operationalized based on established theories and empirical literature. The questionnaire was developed through literature review and preliminary qualitative exploration to ensure conceptual clarity and contextual relevance.

The questionnaire consisted of two sections. The first section collected demographic information, including gender, age, year of study, field of study, institutional type, urban or rural background, ownership of digital devices, frequency of internet use, and prior experience with online learning platforms. The second section measured five key constructs, namely perceived organizational support, perceived social support, self efficacy, learning motivation, and digital literacy. All items were measured using a five point Likert scale ranging from strong disagreement to strong agreement. Internal consistency reliability was assessed using Cronbach alpha coefficients.

Perceived organizational support referred to vocational students subjective perceptions of institutional care, fairness, teacher support, incentives, and digital learning resources. The scale was adapted from the Survey of Perceived Organizational Support developed by Eisenberger et al. (1997), with contextual adjustments informed by the facilitating conditions construct in the Unified Theory of Acceptance and Use of Technology. The construct was measured as a single dimension using ten items.

Perceived social support focused on perceived peer support in digital learning contexts, capturing emotional, informational, and academic assistance received from classmates. Measurement items were adapted from the peer support dimension of the Multidimensional Scale of Perceived Social Support developed by Zimet et al. (1988). Four items were retained and revised to reflect digital learning situations.

Self efficacy referred to students confidence in their ability to complete digital learning tasks, master new technologies, solve problems, and regulate learning behaviors in technology enhanced environments. The scale was adapted from the Computer Self Efficacy Scale developed by Compeau and Higgins (1995) and measured as a single dimensional construct with ten items.

Learning motivation represented vocational students internal and external drivers of engagement in digital learning activities. Based on self determination theory, the construct was measured using an adapted version of the Short Academic Motivation Scale developed by Kotera et al. (2023). The scale comprised fourteen items covering seven types of motivation, including amotivation, external regulation, introjected regulation, identified regulation, and three forms of intrinsic motivation.

Digital literacy referred to students ability to access, evaluate, produce, and communicate digital information, solve problems using digital tools, and participate responsibly in digital learning environments. The scale was adapted from the digital literacy instrument developed by Wang et al. (2025), with contextual alignment to national information literacy standards. The construct included approximately eighteen items across five

dimensions: information and data literacy, communication and collaboration, digital content creation, safety, and digital learning. Table 2 summarizes the operational definitions,

measurement instruments, and dimensional structures of all key variables included in the study.

Table 2. Variable operation definition(n = 410)

Variable	Operational Definition	Measurement Tools	Dimensions / Items
Perceived Organizational Support (POS)	Perceived organizational support refers to vocational college students' subjective perception of the extent to which their institutions provide care, fairness, teacher support, institutional incentives, and digital learning resources. It emphasizes students' sense of organizational commitment and resource provision in digital learning environments.	Adapted from the Survey of Perceived Organizational Support (SPOS) developed by Eisenberger et al. (1986), with contextual adjustments based on the "facilitating conditions" construct in the UTAUT model (Venkatesh et al., 2003) to fit digital learning scenarios.	Single dimension; 10 items
Perceived Social Support—Peer Support (PSS)	Perceived social support in this study refers specifically to students' perceived emotional, informational, and academic support from peers during digital learning. It captures the extent to which learners feel assisted, encouraged, and supported by peers in technology-enhanced learning contexts.	Adapted from the Multidimensional Scale of Perceived Social Support (MSPSS; Zimet et al., 1988), using the original four peer-support items (items 5, 9, 10, 14), revised to reflect digital learning situations.	Single dimension; 4 items
Self-Efficacy (SE)	Self-efficacy refers to students' confidence in their ability to complete digital learning tasks, master new technologies, solve digital problems, sustain learning efforts, and regulate their learning behaviors in technology-enhanced environments.	Adapted from the Computer Self-Efficacy Scale (CSE) by Compeau and Higgins (1995), revised to align with vocational students' digital learning tasks and contexts.	Single dimension; 10 items
Learning Motivation (LM)	Learning motivation refers to vocational students' internal and external psychological drivers that motivate their engagement in digital learning activities. It includes interest, value	Based on Self-Determination Theory (Deci & Ryan, 1985; Ryan & Deci, 2000). Adapted from the Short Academic	Seven dimensions: Amotivation, External Regulation, Introjected Regulation, Identified Regulation, Intrinsic Motivation to Know,

Variable	Operational Definition	Measurement Tools	Dimensions / Items
	identification, and externally regulated motives in technology-enhanced learning.	Motivation Scale (SAMS) developed by Kotera, Conway, & Green (2020), covering seven types of motivation.	Intrinsic Motivation to Accomplish, Intrinsic Motivation to Experience Stimulation; 14 items
Digital Literacy (DL)	Digital literacy refers to vocational students' ability to effectively access, evaluate, produce, and communicate digital information; solve problems using digital tools; and participate safely and responsibly in digital learning environments.	Adapted from the digital literacy scale developed by Xing & Liu (2023), with contextual alignment to the Chinese Ministry of Education's Information Literacy Standards.	Five dimensions: (1) Information & Data Literacy, (2) Communication & Collaboration, (3) Digital Content Creation, (4) Safety, (5) Digital Learning; approx. 18 items

3.3 Data analysis

Data analysis was conducted to examine the relationships among perceived organizational support, perceived social support, self efficacy, learning motivation, and digital literacy among higher vocational students. First, descriptive statistical analyses were performed to summarize the basic characteristics of the sample and to provide an overall overview of the distributions of the main study variables. Subsequently, reliability analysis was carried out to assess the internal consistency of the measurement instruments, with Cronbach alpha coefficients calculated for each scale to evaluate scale reliability. After establishing acceptable reliability, quantitative analytical methods were employed to examine both direct and indirect relationships among the study variables in order to address the research objectives and test the proposed hypotheses. Guided by the theoretical framework integrating ecological systems theory and social cognitive theory, particular attention was given to examining the mediating roles of self efficacy and learning motivation in the relationships between

perceived support variables and digital literacy. Through this analytical process, the proposed influence pathways were systematically assessed, providing an empirical basis for evaluating the explanatory structure of the research model. Accordingly, the results derived from these analyses are presented in the following section.

3.4 Pre-test

To examine the proposed theoretical model and hypothesized pathways, data analysis was conducted in stages using SPSS 26.0 and AMOS 24.0. Prior to formal analysis, the data were screened for quality and reliability. Questionnaires with more than 15 percent missing values on key variables were excluded, while remaining missing data were handled using mean substitution or multiple imputation as appropriate. Potential outliers were identified through boxplot inspection and standardized Z scores, and extreme cases were removed cautiously. Distributional properties were assessed using skewness and kurtosis statistics, with data transformations applied when necessary to improve normality. Multicollinearity was examined

using variance inflation factor values. Following data cleaning, descriptive statistics were calculated to summarize sample characteristics and variable distributions, and Pearson correlation analysis was conducted to examine associations among the main study variables.

Reliability and validity of the measurement instruments were then assessed prior to hypothesis testing. Internal consistency reliability was evaluated using Cronbach alpha coefficients, and confirmatory factor analysis was conducted to examine measurement validity (Raykov et al., 2024). Structural equation modeling was subsequently employed to test the hypothesized relationships and to evaluate overall model fit using commonly accepted fit indices. Path coefficients were examined to assess direct effects among variables, and theoretically justified model modifications were applied when necessary. Mediation analysis was conducted using bias corrected bootstrap procedures with 5,000 resamples and a 95 percent confidence interval to examine the mediating roles of self efficacy and learning motivation. This analytical procedure provided an empirical basis for evaluating the proposed model within the integrated framework of social cognitive theory and ecological systems theory.

4. Results

4.1 Descriptive Statistics and Demographic Analysis

An anonymous online questionnaire survey was conducted to examine digital literacy among higher vocational students. A total of 445 questionnaires were collected through an online survey platform, and 410 valid responses were retained after excluding invalid cases due to missing data, logical inconsistencies, or inattentive responding, yielding an effective response rate of 92.13 percent.

Table 3 presents the demographic characteristics of the valid sample. Respondents were drawn from five higher vocational institutions with a relatively balanced distribution, indicating adequate institutional representation. Students from all years of study were included, with second year students forming the largest group. Gender distribution was relatively even, with a slightly higher proportion of female students. In terms of academic background, STEM related majors accounted for the largest share, followed by arts and humanities, business and economics, and medicine and health sciences. Public vocational institutions were more represented than private ones, and students from rural backgrounds constituted a larger proportion than those from urban areas. Patterns of digital device use indicated frequent engagement with digital technologies, with most students reporting daily usage exceeding four hours. Self assessed digital literacy was predominantly reported at basic to intermediate levels, while advanced and expert levels were relatively rare.

Table 3. Demographic Characteristics of the Valid Sample(n = 410)

Category	Option	Frequency	Percentage (%)
Institution	Urban Vocational College of Sichuan	106	25.85

Category	Option	Frequency	Percentage (%)
	Chengdu Vocational and Technical College	83	20.24
	Sichuan Vocational and Technical College of Communications	81	19.76
	Sichuan Changjiang Vocational College	67	16.34
	Chengdu Industrial Vocational and Technical College	73	17.81
Year of Study	First year	121	29.51
	Second year	155	37.81
	Third year	134	32.68
Gender	Male	193	47.07
	Female	217	52.93
	Other / Prefer not to answer	0	0
Field of Study	STEM (Science, Technology, Engineering, and Mathematics)	174	42.44
	Business and Economics	73	17.81
	Arts, Humanities, and Social Sciences	95	23.17
	Medicine and Health Sciences	68	16.59
	Other	0	0
Institution Type	Public vocational college	244	59.51
	Private vocational college	166	40.49
	Other	0	0
Place of Household Registration	Urban	149	36.34
	Rural	261	63.66
Daily Digital Device Use	Less than 2 hours	12	2.93
	2–4 hours	62	15.12
	4–6 hours	145	35.37

Category	Option	Frequency	Percentage (%)
Self-assessed Digital Literacy	More than 6 hours	191	46.59
	Beginner	80	19.51
	Basic	143	34.88
	Intermediate	173	42.2
	Advanced	10	2.44
	Expert	4	0.98

Descriptive statistics for the core study variables were calculated using SPSS 26.0 and are reported in Table 4. Mean values for perceived organizational support, perceived social support, self efficacy, learning motivation, and digital literacy ranged from 3.310 to 3.419, indicating moderately positive levels across all constructs. Perceived organizational support exhibited the highest mean value and relatively low dispersion, suggesting consistent perceptions of institutional support among students. Digital literacy showed

the lowest mean value and slightly greater variability, indicating more heterogeneous levels of digital competence. Standard deviations across variables were moderate, suggesting no extreme polarization in responses. Distributional diagnostics revealed slight negative skewness and relatively flat kurtosis across all variables, indicating that most scores were clustered above the mean and that the data met the assumptions required for subsequent statistical analyses.

Table 4. Descriptive Statistics of the Study Variables (n = 410)

Variable	Minimum	Maximum	Mean	Standard Deviation	Skewness	Kurtosis
Perceived Organizational Support	1.7	4.8	3.419	0.827	-0.259	-0.919
Perceived Social Support	1	4.75	3.385	0.924	-0.507	-0.673
Self-Efficacy	1.4	5	3.386	0.847	-0.269	-0.95
Learning Motivation	1.5	4.786	3.352	0.843	-0.247	-0.996
Digital Literacy	1.556	4.778	3.31	0.868	-0.165	-1.099

4.2 Measurement Model: Reliability and Validity Assessment

Internal consistency reliability reflects the extent to which items within a scale consistently measure the same construct. Cronbach's alpha

coefficient is widely used to evaluate internal consistency, with values exceeding 0.70 indicating acceptable reliability. Higher alpha values suggest stronger coherence among scale items and greater stability of measurement results.

The reliability results of this study show that the Cronbach's alpha coefficients for all dimensions range from 0.849 to 0.964, and the overall scale demonstrates a Cronbach's alpha coefficient of 0.965. All values exceed the recommended threshold, indicating that the items within each dimension exhibit strong internal consistency and that the measurement instrument provides reliable and stable assessments of the constructs examined in the study. Table 5 presents the number of items and Cronbach's alpha coefficients for each variable.

Table 5. Reliability analysis results of the study variables (n = 410)

Variable	Number of items	Cronbach's alpha
Perceived organizational support	10	0.925
Perceived social support	4	0.849

Variable	Number of items	Cronbach's alpha
Self-efficacy	10	0.928
Learning motivation	14	0.95
Digital literacy	18	0.964
Overall scale	56	0.965

4.3 Structural Model and Hypothesis Testing

Structural equation modeling was conducted using AMOS 23.0 to examine the hypothesized relationships among the latent variables. The structural model specifies the directional paths linking perceived organizational support, perceived social support, self efficacy, learning motivation, and digital literacy. The estimated structural model is presented in Figure 1, which illustrates the standardized path coefficients among the constructs included in the study.

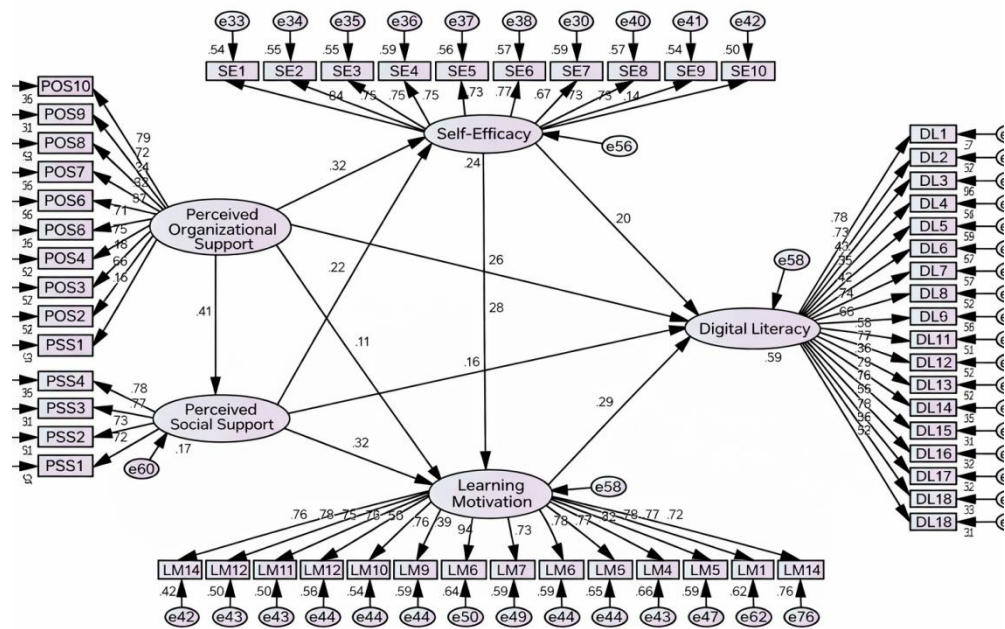


Figure 1 Structural Equation Model Diagram

Prior to hypothesis testing, the overall goodness of fit of the structural model was

evaluated to determine whether the model adequately represented the observed data. The model fit indices are reported in Table 6. The chi square value of the model is 1648.583 with 1474 degrees of freedom, yielding a chi square to degrees of freedom ratio of 1.118, which falls well below the commonly accepted threshold. The root mean square error of approximation is 0.017 and the root mean square residual is 0.038, indicating a low level of residual error. Incremental fit indices including the comparative

fit index, incremental fit index, and Tucker Lewis index all exceed 0.95, reflecting an excellent model fit. The goodness of fit index and adjusted goodness of fit index both exceed the acceptable criterion for complex structural models. Taken together, these indices demonstrate that the structural model exhibits an adequate and acceptable fit to the sample data, providing a sound basis for subsequent path analysis and hypothesis testing.

Table 6. Model fit indices

Common indicators	χ^2	df	χ^2/df	RMS EA	RM R	CFI	NFI	IFI	TLI	GFI	AGFI
Criterion for judgement	-	-	<3	<0.08	<0.05	>0.9	>0.8	>0.9	>0.8	>0.8	>0.8
Value	1648.583	1474	1.118	0.017	0.038	0.988	0.899	0.988	0.988	0.881	0.872

Following confirmation of overall model fit, the hypothesized structural paths were examined through estimation of path coefficients and their corresponding significance levels. The results of the structural path analysis are presented in Table 7, including unstandardized estimates, standard errors, critical ratios, significance levels, and standardized path coefficients. The critical ratio serves as the ratio of the estimated parameter to its standard error, with values exceeding the conventional threshold indicating statistical significance. The path analysis results indicate that all hypothesized relationships are statistically

significant at the 0.05 level or above. Perceived organizational support exerts a significant positive effect on perceived social support, with a standardized path coefficient of 0.415. In addition, perceived organizational support demonstrates a significant positive influence on self efficacy, while perceived social support also shows a positive and significant effect on self efficacy. These results suggest that both organizational and social contextual factors are closely associated with individual efficacy beliefs within the structural framework of the study.

Table 7. Structural Model Path Analysis Results

Hypothesis	Path	Unstandardized Estimate	S.E.	C.R.	p-value	Standardized Estimate	Result
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Hypothesis	Path	Unstandardized Estimate	S.E.	C.R.	p-value	Standardized Estimate	Result
H1	Perceived Social Support ← Perceived Organizational Support	0.405	0.057	7.149	< 0.001 ***	0.415	Supported
H2	Self-Efficacy ← Perceived Organizational Support	0.346	0.055	6.263	< 0.001 ***	0.363	Supported
H3	Self-Efficacy ← Perceived Social Support	0.212	0.056	3.796	< 0.001 ***	0.217	Supported
H4	Learning Motivation ← Perceived Organizational Support	0.103	0.05	2.057	0.040 *	0.113	Supported
H5	Learning Motivation ← Perceived Social Support	0.301	0.055	5.493	< 0.001 ***	0.319	Supported
H6	Learning Motivation ← Self-Efficacy	0.268	0.054	4.979	< 0.001 ***	0.278	Supported
H7	Digital Literacy ← Perceived Organizational Support	0.176	0.056	3.141	0.002 **	0.164	Supported
H8	Digital Literacy ← Perceived Social Support	0.169	0.061	2.784	0.005 **	0.154	Supported
H9	Digital Literacy ← Self-Efficacy	0.224	0.06	3.737	< 0.001 ***	0.199	Supported
H10	Digital Literacy ← Learning Motivation	0.335	0.064	5.235	< 0.001 ***	0.287	Supported

Note: $p < 0.05$; $p < 0.01$; $p < 0.001$.

Overall, the structural model results indicate that learning motivation and digital literacy are jointly shaped by contextual support and individual psychological factors. Learning motivation is significantly predicted by perceived organizational support, perceived social support, and self efficacy, reflecting the combined influence of institutional environments, peer related support, and learners' confidence in their

capabilities. Digital literacy is directly influenced by perceived organizational support, perceived social support, self efficacy, and learning motivation, with learning motivation demonstrating the strongest direct association among the predictors, followed by self efficacy, while contextual support variables also contribute significantly. Taken together, these findings suggest that digital literacy development within

the proposed model reflects an integrated process in which environmental support, cognitive beliefs, and motivational mechanisms operate simultaneously.

4.4 Mediation effects Analysis

Mediation effects were examined using the bootstrapping procedure implemented in AMOS 23.0. Bias-corrected bootstrap analyses with 5,000

resamples were conducted, and mediation effects were considered statistically significant when the 95 percent bias-corrected confidence intervals did not include zero. Table 8 presents the total, direct, and indirect effects for all hypothesized mediation pathways.

Table 8. Intermediary test

Path label	Effect type	Effect size	Bias-corrected 95% CI (Lower)	Bias-corrected 95% CI (Upper)
Perceived organizational support → self-efficacy → digital literacy	Total effect	0.425	0.335	0.505
	Indirect effect	0.072	0.035	0.119
	Direct effect	0.164	0.059	0.267
Perceived organizational support → learning motivation → digital literacy	Total effect	0.425	0.335	0.505
	Indirect effect	0.032	0.001	0.072
	Direct effect	0.164	0.059	0.267
Perceived organizational support → self-efficacy → learning motivation → digital literacy	Total effect	0.425	0.335	0.505
	Indirect effect	0.029	0.015	0.051
	Direct effect	0.164	0.059	0.267
Perceived social support → self-efficacy → digital literacy	Total effect	0.306	0.197	0.407
	Indirect effect	0.043	0.017	0.081

Path label	Effect type	Effect size	Bias-corrected 95% CI (Lower)	Bias-corrected 95% CI (Upper)
Perceived social support → learning motivation → digital literacy	Direct effect	0.154	0.033	0.27
	Total effect	0.306	0.197	0.407
	Indirect effect	0.092	0.05	0.149
Perceived social support → self-efficacy → learning motivation → digital literacy	Direct effect	0.154	0.033	0.27
	Total effect	0.306	0.197	0.407
	Indirect effect	0.017	0.007	0.034
	Direct effect	0.154	0.033	0.27

As reported in Table 8, all six indirect pathways yield statistically significant mediation effects, as none of the corresponding confidence intervals include zero. With respect to perceived organizational support, self efficacy and learning motivation each function as significant mediators in the relationship with digital literacy. In addition, a significant sequential mediation pathway through self efficacy and learning motivation is observed. The direct effect of perceived organizational support on digital literacy remains statistically significant after accounting for the mediators, indicating the presence of partial mediation. A similar pattern is observed for perceived social support. Both self efficacy and learning motivation significantly mediate the relationship between perceived social support and digital literacy, and a significant sequential mediation effect through self efficacy and learning motivation is also identified. The direct

effect of perceived social support on digital literacy remains significant when the mediators are included in the model, further supporting partial mediation. Comparatively, the indirect effect via learning motivation is larger than that via self efficacy, suggesting that motivational processes play a particularly salient role in translating social support into digital literacy outcomes.

Taken together, the mediation results indicate that self efficacy and learning motivation serve as key intervening mechanisms linking perceived organizational support and perceived social support to digital literacy. Beyond their independent mediating roles, the significant sequential mediation pathways suggest that perceived support influences digital literacy through a process in which enhanced self efficacy subsequently promotes learning motivation, thereby contributing to digital literacy development.

5. Discussion

5.1 Research Findings

This study examined the influence mechanisms underlying digital literacy among higher vocational students within the context of educational digitalization, with a particular focus on perceived organizational support, perceived social support, self efficacy, and learning motivation. The findings provide a systematic response to the research objectives and research questions by integrating descriptive evidence, structural relationships, and mediation effects.

First, the descriptive results indicate that higher vocational students report moderately positive levels of perceived organizational support and perceived social support, alongside medium to upper range levels of self efficacy, learning motivation, and digital literacy (Vaszkun & Mihalkov Szakács, 2025). However, digital literacy is comparatively lower than the other core variables, and advanced levels of self assessed digital literacy remain relatively uncommon (Murray et al., 2022). These findings suggest that while higher vocational students are highly engaged with digital technologies, their perceived competence in using digital tools for learning purposes is still developing, thereby addressing the first and second research objectives concerning support perception and overall digital literacy levels.

Second, the structural model results demonstrate that perceived organizational support and perceived social support both exert significant positive effects on self efficacy and learning motivation (Li et al., 2022). These findings confirm that institutional environments and peer related support play important roles in shaping

students' cognitive beliefs and motivational orientations. In addition, self efficacy is found to significantly predict learning motivation, highlighting the central role of efficacy beliefs in sustaining motivational engagement (Wang & Wang, 2025). These results directly address the third research objective by clarifying the direct relationships among perceived support, self efficacy, learning motivation, and digital literacy.

Third, digital literacy is found to be jointly influenced by perceived organizational support, perceived social support, self efficacy, and learning motivation. Among these predictors, learning motivation exhibits the strongest direct association with digital literacy, followed by self efficacy, while contextual support variables also contribute significantly. This pattern indicates that digital literacy development is not driven by environmental support alone but depends on the activation of internal cognitive and motivational mechanisms.

Finally, the mediation analysis further reveals that self efficacy and learning motivation partially mediate the relationships between perceived organizational support, perceived social support, and digital literacy. Both independent mediation paths and sequential mediation paths are supported, indicating that perceived support enhances digital literacy not only through direct effects but also through a chain process in which self efficacy strengthens learning motivation. These findings address the fourth research objective by empirically validating the integrated structural model based on social cognitive theory and ecological systems theory, and by demonstrating the relative contribution of direct and indirect pathways in explaining digital literacy among higher vocational students.

5.2 Theoretical Contributions

This study advances theory building on digital literacy in vocational education by positioning digital literacy as an outcome of coupled environmental and psychological processes rather than as a function of technology exposure alone. Recent work has often emphasized learners' technology attitudes, usage patterns, or individual readiness as primary antecedents of digital competence, with self efficacy frequently treated as a proximal predictor (Ren et al., 2025). By contrast, the present findings demonstrate that perceived organizational support and perceived social support exert simultaneous direct effects on digital literacy and indirect effects through self efficacy and learning motivation. This integrated account addresses an educational problem repeatedly highlighted in vocational digital transformation debates, namely that access to digital tools does not automatically translate into competence development and equitable learning outcomes. The evidence that learning motivation shows the strongest direct association with digital literacy further refines contemporary explanations by specifying motivation as a central mechanism through which support conditions become educationally productive (Vaszkun & Mihalkov Szakács, 2025).

A second contribution concerns the theoretical integration of ecological systems theory and social cognitive theory in explaining digital literacy formation in vocational contexts. While recent studies in higher and vocational education increasingly apply social cognitive theory to model digital learning related outcomes, they often focus on technology related variables such as digital technology usage, engagement, or satisfaction and give less attention to how

institutional and peer environments jointly shape cognition and motivation (Zhang et al., 2024). The present results empirically operationalize ecological systems theory by distinguishing organizational support as a broader institutional condition and peer support as a proximal microsystem process, and then linking both to social cognitive mechanisms through self efficacy and learning motivation. This linkage provides a clearer theoretical explanation of how educational environments translate into capability development: support structures function as contextual affordances and social signals that strengthen efficacy beliefs, which in turn energize motivational regulation and sustained engagement with digital learning tasks.

A third contribution lies in the specification of multiple mediation pathways that clarify how support contributes to digital literacy, thereby extending recent education research that tends to test single mediator mechanisms or isolated contextual predictors. The bootstrap evidence supports partial mediation through self efficacy and learning motivation and also supports a sequential pathway in which self efficacy strengthens learning motivation, which then predicts digital literacy (He & Wen, 2025). This sequential structure adds new knowledge by identifying an ordered cognitive motivational process that connects support to competence development, which is especially relevant for vocational education where learners often face heterogeneous academic preparation and uneven support access. The findings therefore contribute a theoretically grounded mechanism model that responds to a practical educational challenge in digitalization initiatives: identifying which psychological processes must be activated for

institutional and peer supports to yield measurable improvements in students' digital literacy.

5.3 Practical Implications

The findings of this study offer several practical implications for improving digital literacy development in higher vocational education, particularly in the context of ongoing educational digitalization. These implications are relevant to multiple stakeholders, including educational institutions, teachers, policymakers, and learners, and address systemic challenges in translating digital infrastructure into meaningful learning outcomes.

At the institutional level, the results highlight the importance of strengthening organizational support as a foundational condition for digital literacy development. Higher vocational institutions should move beyond a narrow focus on hardware provision and platform construction and instead cultivate supportive organizational environments that integrate clear digital learning policies, accessible resources, and coherent instructional guidance. Institutional practices that enhance students' perceptions of fairness, teacher support, and learning facilitation can create psychologically safe and predictable learning contexts, which are conducive to building self efficacy and sustaining learning motivation. Such systemic support is particularly important in vocational education, where students often come from diverse academic and socio economic backgrounds and may require structured guidance to engage effectively with digital learning environments.

At the instructional level, the findings underscore the critical role of teachers in translating organizational support into meaningful

learning experiences. Teachers can enhance students' self efficacy and motivation by designing learning activities that emphasize mastery, scaffold digital task difficulty, and provide timely feedback. Collaborative and practice oriented instructional approaches can further leverage peer interaction as a source of social support, enabling students to learn through observation, shared problem solving, and mutual encouragement. By intentionally fostering peer learning communities, teachers can strengthen the social mechanisms that support digital literacy development, especially in technology intensive or project based courses.

From a policy perspective, the results suggest that digital literacy initiatives in vocational education should adopt a holistic framework that integrates environmental, cognitive, and motivational dimensions. Policymakers should consider embedding support for teacher professional development, student guidance systems, and peer learning structures into digital education policies, rather than focusing solely on technological investment. Policies that promote inclusive digital learning cultures and reduce disparities in support access can help ensure that digitalization efforts lead to equitable improvements in student competence, particularly for learners from rural or disadvantaged backgrounds.

At the learner level, the findings point to the importance of fostering self regulated learning capacities and motivational engagement. While institutional and social supports are essential, students' beliefs in their own capabilities and their willingness to invest effort play a decisive role in transforming support into digital competence. Guidance programs that help students reflect on

their learning strategies, set achievable digital learning goals, and recognize progress may strengthen self efficacy and motivation, thereby enhancing the effectiveness of broader support systems.

6. Conclusion

This study examined the mechanisms through which perceived organizational support and perceived social support influence digital literacy among higher vocational students by integrating ecological systems theory and social cognitive theory. The findings demonstrate that digital literacy is shaped not only by direct

contextual support from institutions and peers but also by indirect pathways operating through self efficacy and learning motivation, including a sequential cognitive motivational process. By clarifying how environmental support is translated into individual competence development, the study contributes a theoretically grounded explanation for digital literacy formation in vocational education contexts. Overall, the results underscore that effective digitalization in vocational education requires coordinated support systems that foster learners' confidence and motivation, thereby enabling sustainable and equitable development of digital literacy.

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