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Predictors of Student Academic Performance in Blended Learning: The Mediating Role of Digital Literacy

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Abstract: Blended learning requires students to regulate their learning and use digital technologies effectively; however, academic performance remains shaped by psychological and social factors. Previous studies have tended to examine self-efficacy, perceived social support, self-regulated learning, and digital literacy separately, leaving the mechanisms connecting these factors insufficiently integrated. This study tested a model of student academic performance in blended learning, with digital literacy as a mediator. A cross-sectional quantitative design involved 449 students from three private universities in Jakarta selected through purposive sampling. Data were collected using measures of academic self-efficacy, perceived social support, self-regulated learning, digital literacy, and cumulative grade point average, and were analyzed using path analysis and mediation tests. The model demonstrated excellent fit. Academic self-efficacy, perceived social support, and digital literacy had positive and significant direct effects on academic performance, whereas self-regulated learning had no significant direct effect. Digital literacy mediated the effects of academic self-efficacy and self-regulated learning on academic performance. The study's novelty lies in positioning digital literacy as a mechanism that translates students' psychological learning resources into academic achievement, while perceived social support retains a direct role in post-pandemic blended learning.

Keyword: Academic Performance, Self-Efficacy, Blended Learning, Digital Literacy, Self-Regulated Learning

INTRODUCTION

Blended learning integrates face-to-face activities with structured online learning. This approach has become increasingly important in Indonesian higher education because it provides spatial and temporal flexibility while preserving direct interaction in the learning process (Junaidi, 2020). Nevertheless, the post-pandemic transition from fully online instruction to blended learning has not consistently been accompanied by improved academic performance. Students continue to experience difficulties in understanding digital materials, managing their time, sustaining active participation, obtaining learning support, and using

technology effectively. These conditions indicate that the success of blended learning is determined not only by instructional design but also by students' psychological readiness, social support, and digital competence.

Academic performance refers to the outcomes attained by students throughout the educational process and is represented in this study by cumulative grade point average. From a constructivist perspective, students actively construct knowledge through cognitive activity and social interaction (Jonassen et al., 1995). Accordingly, academic performance in blended learning can be understood as the outcome of interactions between internal and external resources. Internal resources include self-efficacy and self-regulated learning, whereas external resources are reflected in perceived social support. In a technology-mediated learning environment, these resources must also be supported by digital literacy.

Academic self-efficacy refers to students' beliefs in their ability to organize and execute the actions required to complete academic tasks. Social cognitive theory explains that such beliefs influence behavioral choices, effort, persistence, and responses to difficulty (Bandura, 1999). Previous studies have shown that self-efficacy is positively associated with academic performance in both face-to-face and online learning (Yokoyama, 2019; Hayat et al., 2020; Tomás et al., 2020). In blended learning, self-efficacy is also expected to encourage students to explore, master, and use the digital devices and information resources required for their studies.

Self-regulated learning is a proactive process through which students set goals, structure their learning environment, manage time, select task strategies, seek assistance, and evaluate their learning progress (Barnard et al., 2009). This capacity is particularly important because blended learning places greater responsibility on students to manage both online and face-to-face activities. A systematic review found that self-regulated learning strategies are associated with academic achievement in online higher education environments (Broadbent & Poon, 2015). However, the strength of this association may vary according to context and the specific strategies employed (Broadbent, 2017). This variation suggests that self-regulated learning may not always affect academic performance directly but may operate through other competencies that enable learning strategies to be implemented effectively.

Perceived social support refers to students' perceptions that parents, lecturers, and classmates provide emotional, informational, and practical assistance. Such support can enhance security, engagement, persistence, and students' capacity to cope with academic pressure (Malecki et al., 2000, 2006). Previous research has also demonstrated an association between social support and university students' academic success (Mackinnon, 2012; Tinajero et al., 2019). Perceived social support remains relevant in blended learning because students require lecturer feedback, peer collaboration, and family support while engaging in learning activities across different physical and digital settings.

Digital literacy encompasses the technical, cognitive, and social-emotional capabilities required to use digital technologies, locate and evaluate information, create content, and communicate responsibly (Ng, 2012). Digital literacy is associated with academic performance because students who can select credible sources, operate learning applications, and manage digital communication are better positioned to complete academic tasks effectively (Abbas et al., 2019; Santos et al., 2019; Ardhiani et al., 2023). Beyond its role as a predictor, digital literacy may serve as a mechanism through which self-efficacy and self-regulated learning are translated into productive learning behavior. Evidence of an association between self-regulated learning and digital literacy further supports this proposition (Yu et al., 2021; Ilknur Istifci & Nil Goksel, 2022).

Previous models have explained selected relationships among these variables but have not integrated them comprehensively. Hayat, Kohoulat, et al., (2020) examined self-efficacy, academic emotions, metacognitive strategies, and academic performance. Yu et al., (2021)

linked self-regulated learning, teacher credibility, information and communication technology literacy, and performance in blended learning. Munawaroh et al., (2022) positioned digital literacy as a mediator of the relationships among self-confidence, learning motivation, and student achievement. The research gap addressed by the present study is the limited simultaneous examination of self-efficacy, perceived social support, self-regulated learning, and digital literacy within a single model of student academic performance in blended learning. The study advances the state of the art by testing digital literacy as a mediating mechanism for two internal student resources while retaining perceived social support as an external factor with a direct effect in the context of post-pandemic Indonesian higher education.

On the basis of this gap, the study addressed three research questions. First, does a model of student academic performance in blended learning that incorporates self-efficacy, perceived social support, self-regulated learning, and digital literacy fit the empirical data? Second, what are the direct effects of self-efficacy, perceived social support, self-regulated learning, and digital literacy on academic performance? Third, does digital literacy mediate the effects of self-efficacy and self-regulated learning on academic performance? The conceptual model is presented in Figure 1.

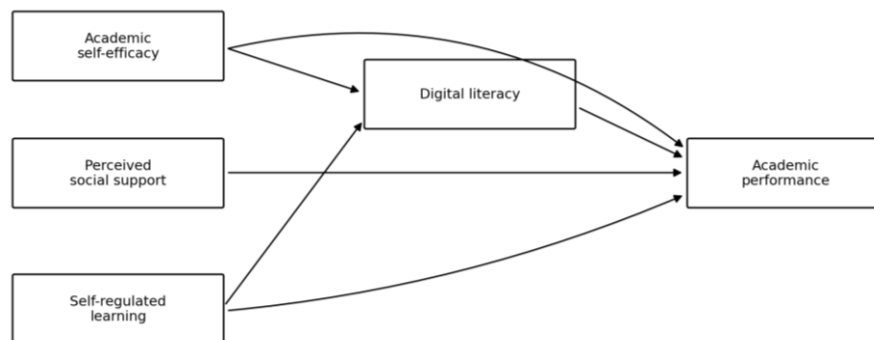


Figure 1. Conceptual model of the study
Source: Processed by the author with SEM – AMOS

METHODS

Study design, research object, period, and setting

This study employed a quantitative approach with a cross-sectional survey design. The research object was a model of student academic performance in blended learning incorporating academic self-efficacy, perceived social support, self-regulated learning, and digital literacy. Data were collected from June 2023 to January 2024 at Universitas Gunadarma, Universitas Pancasila, and Universitas Nasional, all of which are located within the jurisdiction of the Higher Education Service Institution Region III, Jakarta.

Population and sample

The combined population of the five universities considered during the initial stage comprised 131,613 students. The minimum sample size was calculated using the Slovin formula with a 5% margin of error, yielding a requirement of approximately 399 students. Purposive sampling was used to recruit participants who met the following criteria: active enrollment in semesters 3-8, no current academic leave, completion of at least one semester of blended learning, and willingness to participate. A total of 449 questionnaires met the requirements for analysis. Participation was voluntary, and response confidentiality was maintained throughout the study.

Measures

Academic performance was operationalized as the cumulative grade point average, measured on a scale from 0 to 4, obtained after participation in blended learning. Academic self-efficacy was assessed using an adaptation of the Academic Self-Efficacy Scale developed by (Sagone & Caroli, 2014). Following confirmatory factor analysis, 11 items were retained, with a reliability coefficient of 0.882.

Perceived social support was measured using an adaptation of the Child and Adolescent Social Support Scale, which assesses support from parents, lecturers, and classmates (Malecki & Demary, 2002). The final model retained five parent-support items, five lecturer-support items, and six classmate-support items, with an overall reliability coefficient of 0.943. Self-regulated learning was assessed using an adaptation of the Online Self-Regulated Learning Questionnaire, which covers goal setting, environmental structuring, task strategies, time management, help seeking, and self-evaluation (Barnard et al., 2009). Fourteen items were retained, with a reliability coefficient of 0.923.

Digital literacy was measured using an adaptation of the Digital Literacy Scale, which encompasses technical, cognitive, and social-emotional dimensions (Ng, 2012). Ten items were retained in the final model, with a reliability coefficient of 0.816. All instruments underwent translation, back-translation, readability testing, expert review, content-validity assessment, item-discrimination analysis, reliability testing, and confirmatory factor analysis.

Data collection and analysis

Questionnaires were administered both in person and online after data-collection permission had been obtained from the participating universities. Data were analyzed using descriptive statistics, Pearson correlations, and path analysis in AMOS version 22 with maximum-likelihood estimation. Model fit was evaluated using the chi-square statistic, the chi-square-to-degrees-of-freedom ratio, absolute and incremental fit indices, and the root mean square error of approximation. Standardized direct, indirect, and total effects were derived from the recalculated model after the conscientiousness personality variable had been excluded. The significance of the mediating effects of digital literacy was evaluated using the Sobel test based on the available unstandardized regression coefficients and standard errors.

RESULTS AND DISCUSSION

The study included 449 university students. Of these, 313 (69.7%) were women and 136 (30.3%) were men. Most participants were aged 20-21 years, and more than half were enrolled at Universitas Gunadarma. The participants' mean cumulative grade point average was 3.53 (SD = 0.24). Detailed participant characteristics are presented in Table 1.

Table 1. Participant characteristics (N = 449).

Characteristic	Category	n (%)
Sex	Female	313 (69.7)
	Male	136 (30.3)
Age	20 years	199 (44.3)
	21 years	181 (40.3)
	22 years	44 (9.8)
	23 years	25 (5.6)
University	Universitas Gunadarma	248 (55.2)
	Universitas Pancasila	102 (22.7)
	Universitas Nasional	99 (22.0)
Semester	3	184 (41.0)
	5	196 (43.7)
	7	69 (15.4)
Questionnaire administration mode	In person	222 (49.4)

Characteristic	Category	n (%)
Academic performance	Online	227 (50.6)
	Cumulative grade point average, mean (SD)	3.53 (0.24)
	Cumulative grade point average range	2.29-3.93

Source: Processed by the author with IBM SPSS Statistics

The measurement instruments demonstrated good to excellent internal consistency, with reliability coefficients ranging from 0.816 to 0.943. Confirmatory factor analysis further indicated that the measurement model for each construct had acceptable fit indices. A summary of the instrument evaluation is provided in Table 2.

Table 2. Reliability and confirmatory factor analysis of the study instruments.

Construct	Retained items	α^*	Factor-loading range	p	RMSEA	GFI	AGFI
Academic self-efficacy	11	0.882	0.47-0.74	0.069	0.028	0.980	0.964
Self-regulated learning	14	0.923	0.39-0.88	0.055	0.026	0.976	0.959
Digital literacy	10	0.816	0.26-0.79	0.129	0.025	0.982	0.970
Social support: parents	5	0.943†	0.60-0.91	0.482	0.000	0.996	0.988
Social support: lecturers	5	0.943†	0.68-0.77	0.217	0.030	0.994	0.981
Social support: classmates	6	0.943†	0.66-0.88	0.073	0.041	0.988	0.973

Source: Processed by the author with SEM – AMOS

Note: The alpha coefficient reported for perceived social support represents the reliability of the overall scale.

All study variables were positively and significantly correlated at the 1% level. The strongest correlation was observed between academic self-efficacy and self-regulated learning, while the association between digital literacy and academic performance was also positive and significant. This correlation pattern provided an initial basis for testing the path model. The correlation matrix is presented in Table 3.

Table 3. Pearson correlations among the study variables

Variable	1	2	3	4	5
1. Academic self-efficacy	1				
2. Digital literacy	0.506**	1			
3. Self-regulated learning	0.573**	0.427**	1		
4. Perceived social support	0.492**	0.291**	0.554**	1	
5. Academic performance	0.351**	0.308**	0.288**	0.304**	1

Source: Processed by the author with SEM – AMOS

Note: All coefficients marked with two asterisks are significant at $p < 0.01$

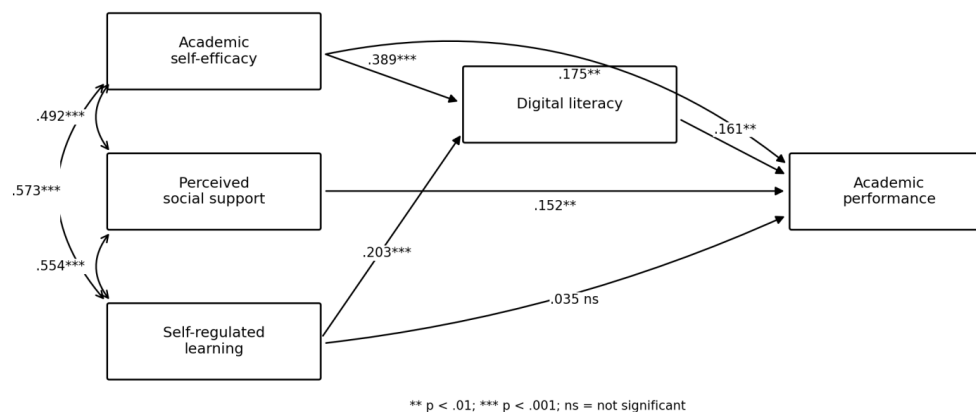
Fit of the student academic performance model in blended learning

The first research question concerned the fit of the proposed model to the empirical data. The analysis yielded a chi-square value of 0.183 with 1 degree of freedom and a probability value of 0.669. The chi-square-to-degrees-of-freedom ratio was 0.183, the goodness-of-fit index was 1.000, the adjusted goodness-of-fit index was 0.998, the comparative fit index was 1.000, and the root mean square error of approximation was 0.000, with an upper 90% confidence limit 0.095. These indicators suggest that the model fitted the data extremely well. Nevertheless, because the model had only 1 degree of freedom, the global fit indices should be interpreted in conjunction with the path coefficients and theoretical rationale rather than treated as the sole evidence of model quality.

Table 4. Model fit indices

Index	Value	Interpretation
χ^2 (df)	0.183 (1)	Nonsignificant
p	0.669	Model not rejected
CMIN/DF	0.183	Excellent fit
RMR	0.115	Scale-dependent residual index
GFI	1.000	Excellent fit
AGFI	0.998	Excellent fit
CFI	1.000	Excellent fit
RMSEA	0.000	Excellent fit
RMSEA 90% CI	0.000-0.095	Upper limit should be interpreted cautiously
PCLOSE	0.805	Close-fit hypothesis retained

Source: Processed by the author with SEM – AMOS


Figure 2. Final standardized path model based on the recalculated analysis

Source: Processed by the author with SEM – AMOS

The model fit indicates that academic performance in blended learning can be explained through a combination of internal resources, external support, and digital competence. This finding is consistent with the constructivist view that learning outcomes emerge through students' active engagement and interactions with the learning environment (Jonassen et al., 1995). The model also extends the academic performance model proposed by Hayat, et al., (2020) by incorporating digital literacy as a competence relevant to technology-mediated learning.

Direct effects of self-efficacy, perceived social support, self-regulated learning, and digital literacy

The second research question concerned the direct effects among the study variables. Academic self-efficacy had positive effects on digital literacy and academic performance. Self-regulated learning had a positive effect on digital literacy but no significant direct effect on academic performance. Perceived social support and digital literacy had positive direct effects on academic performance. Detailed path coefficients are presented in Table 5.

Table 5. Direct path estimates for the research model

Path	B	SE	β	C.R.	p	Decision
Academic self-efficacy → digital literacy	0.288	0.036	0.389	7.983	<0.001	Significant
Self-regulated learning → digital literacy	0.129	0.031	0.203	4.170	<0.001	Significant
Perceived social support → academic performance	0.004	0.002	0.152	2.833	0.005	Significant

Path	B	SE	β	C.R.	p	Decision
Self-regulated learning → academic performance	0.002	0.003	0.035	0.598	0.550	Nonsignificant
Digital literacy → academic performance	0.011	0.003	0.161	3.155	0.002	Significant
Academic self-efficacy → academic performance	0.009	0.003	0.175	3.023	0.003	Significant

Source: Processed by the author with SEM – AMOS

The direct effect of self-efficacy on academic performance indicates that students who are more confident in their capabilities are more likely to sustain effort, select appropriate strategies, and complete academic tasks effectively. This finding is consistent with social cognitive theory, which identifies self-efficacy as a determinant of choice, persistence, and achievement (Bandura, 1999), and supports previous findings in online learning and higher education contexts (Yokoyama, 2019; Hayat, et al., 2020). Self-efficacy was also the strongest predictor of digital literacy, suggesting that confidence in academic capabilities is associated with students' readiness to master technology-mediated learning activities.

Perceived social support had a positive direct effect on academic performance. Support from parents, lecturers, and classmates can provide the emotional reinforcement, information, feedback, and practical assistance that students require when responding to the demands of blended learning. This result is consistent with studies demonstrating the role of social support in academic adjustment and success (Malecki & Demaray, 2006; Mackinnon, 2012; Tinajero et al., 2019). The finding confirms that the use of technology does not diminish the importance of social relationships in the learning process.

Digital literacy had a positive direct effect on academic performance. Students who can operate digital devices, evaluate information quality, communicate responsibly, and use digital resources effectively are better able to meet the task demands of blended learning. This finding supports Ng's (2012) digital literacy framework and previous studies linking digital competence to educational attainment (Abbas et al., 2019; Santos et al., 2019; Ardhiani et al., 2023). Conversely, the nonsignificant direct path from self-regulated learning suggests that the ability to set goals and organize strategies does not necessarily improve performance when students lack the competence required to implement those strategies in digital environments.

The mediating role of digital literacy

The third research question concerned the mediating role of digital literacy. The standardized indirect effect of self-efficacy on academic performance through digital literacy was 0.063 and was significant according to the Sobel test. Because the direct path from self-efficacy to academic performance was also significant, this pattern indicates partial mediation. The standardized indirect effect of self-regulated learning through digital literacy was 0.033 and was significant, whereas its direct path was nonsignificant. This pattern indicates indirect-only mediation. The mediation results are presented in Table 6.

Table 6. Indirect effects and tests of digital literacy mediation

Indirect pathway	a (SE)	b (SE)	Sobel z	p	Standardized indirect effect	Conclusion
Academic self-efficacy → digital literacy → academic performance	0.288 (0.036)	0.011 (0.003)	3.333	0.001	0.063	Partial mediation

Indirect pathway	a (SE)	b (SE)	Sobel z	p	Standardized indirect effect	Conclusion
Self-regulated learning → digital literacy → academic performance	0.129 (0.031)	0.011 (0.003)	2.751	0.006	0.033	Indirect-only mediation

Source: Processed by the author with SEM – AMOS

The partial mediation of the effect of self-efficacy indicates that students' confidence influences performance through two pathways. Self-efficacy may directly increase effort and persistence while also promoting the development of digital literacy required to access course materials, evaluate information, and complete academic tasks. This finding clarifies that self-efficacy functions not only as a psychological belief but also as a resource that helps students develop competencies relevant to blended learning. The pattern is consistent with research positioning digital literacy as a link between personal resources and academic achievement (Munawaroh et al., 2022).

The indirect-only mediation of self-regulated learning indicates that learning strategies acquire academic value when implemented through digital competence. Students may establish learning goals and schedules, but such strategies become effective only when they can use learning platforms, identify appropriate resources, evaluate information credibility, and communicate in digital environments. This finding is consistent with the relationships among self-regulated learning, technology literacy, and performance in blended learning reported by Yu et al., (2021), as well as the association between self-regulated learning and digital literacy identified by Istifci & Goksel, (2022)

The novelty of this study lies in a model that positions digital literacy not only as a predictor of academic performance but also as a mechanism that translates self-efficacy and self-regulated learning into academic achievement. At the same time, perceived social support retains a direct pathway to academic performance. The model therefore distinguishes two complementary mechanisms: an internal mechanism grounded in digital competence and an external mechanism grounded in social support. This pattern extends previous models that have largely treated metacognitive strategies or technology literacy as separate variables (Hayat, et al., 2020; Yu et al., 2021), particularly in the context of post-pandemic blended learning in Indonesian higher education.

Practical Implications

Universities should integrate digital literacy development into courses and learning activities rather than confining it to stand-alone technical training. Developmental content should encompass device operation, information searching and evaluation, communication ethics, digital identity management, and the production of academic content. Lecturers can also design assignments that require students to practice self-regulated learning through goal setting, progress monitoring, reflection, and the use of verified digital resources.

Programs designed to strengthen self-efficacy may include constructive feedback, progressively challenging mastery experiences, peer modeling of effective strategies, and support when students encounter technological difficulties. The direct contribution of perceived social support highlights the need to maintain lecturer-student communication, collaborative learning, and family involvement, particularly for students who experience barriers in either online or face-to-face learning.

CONCLUSION AND FUTURE RESEARCH

Conclusion

This study addressed three principal research questions. First, the model of student academic performance in blended learning incorporating self-efficacy, perceived social support, self-regulated learning, and digital literacy demonstrated excellent fit to the empirical data, although the fit indices should be interpreted cautiously because the model had only 1 degree of freedom. Second, self-efficacy, perceived social support, and digital literacy had positive direct effects on academic performance, whereas self-regulated learning did not have a significant direct effect. Third, digital literacy partially mediated the effect of self-efficacy and provided an indirect-only mediation pathway between self-regulated learning and academic performance.

These findings indicate that efforts to improve academic performance in blended learning should integrate the strengthening of students' efficacy beliefs, social support, and digital literacy. Digital literacy represents a critical mechanism through which students' psychological resources can be applied effectively in technology-mediated academic activities.

Study Limitations and Future Research

The cross-sectional design limits causal inference because all variables were measured during a single period. The sample was selected purposively from three private universities in Jakarta; consequently, generalization to public universities or other geographical regions should be undertaken cautiously. Some data were collected through online questionnaires that could not be directly monitored and may therefore have been susceptible to response bias. The final path model had only 1 degree of freedom; therefore, its exceptionally favorable global fit indices should be interpreted alongside the path coefficients. In addition, mediation significance was calculated using the Sobel test based on rounded coefficients.

Future research should employ longitudinal designs, more diverse samples, academic performance data obtained directly from institutions, and bootstrap confidence intervals to evaluate indirect effects.

Author Contributions

This study was jointly prepared by the research team. The first author was responsible for developing the research concept, conducting data collection and statistical analysis, and preparing the initial draft of the manuscript. The second author contributed to the methodological design, data validation, and substantive revision of the manuscript. The third author provided overall research supervision, assisted in interpreting and evaluating the findings, and reviewed the final manuscript. All authors critically reviewed and approved the final version submitted for publication.

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