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Going Paperless in Education: A Circular Economy Approach in Cambodian High Schools

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ABSTRACT

This study examines students' readiness to adopt paperless learning within the Circular Economy framework in senior high schools in Svay Rieng Province, Cambodia. It analyzes the influence of environmental awareness, digital literacy, and habitual behavior on preparedness for transitioning from paper-based to digital learning. A quantitative descriptive approach was applied, using survey data from 148 students. Instrument validity and reliability were confirmed, and multiple regression analysis was conducted to assess the relationships among variables. The results indicate that all three factors significantly influence readiness, with digital literacy as the strongest predictor, followed by habits and environmental awareness. Together, these variables explain 51.3% of the variance in student preparedness. The findings extend existing technology adoption models, including the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), by integrating environmental and behavioral dimensions. Practically, the study emphasizes the need to strengthen digital literacy through training and curriculum integration, supported by programs that foster environmental responsibility and sustainable learning habits. These insights provide a policy framework for schools and policymakers in developing contexts to implement paperless education effectively and inclusively.

Keywords: *Circular Economy; Digital Literacy; Environmental Awareness; Going paperless; Student Preparedness.*

1. Introduction

Paper remains one of the most prominent elements in everyday human activities, ranging from household and industrial use to formal, academic, and administrative needs. The growth in paper consumption follows global population and economic expansion. Since 2013, Indonesia has ranked among the world's top ten pulp and paper producers (Worldpapermill, 2019). However, paper production generates significant environmental costs. Kiprop (2018) reports that approximately 24 trees are cut down to produce one ton of paper, accompanied by high levels of emissions and pollution. These facts highlight the urgent need for more sustainable alternatives.

One promising approach is going paperless, which emphasizes reducing paper consumption through digital technologies. This initiative aligns with the principles of the Circular Economy, particularly design out waste and pollution and dematerialization (Ellen MacArthur Foundation, 2015). Yet, moving toward a paperless system is far from straightforward. Previous studies show that challenges persist in finding appropriate technological solutions, ensuring equitable digital access, and addressing disparities in digital literacy, particularly in resource-limited contexts (Prasetyo et al., 2020; Sofia et al.,

2021). A holistic strategy is therefore required, encompassing sustainable technology design, digital equity policies, responsible e-waste management, and digital competence building. Only through such a framework can the paperless concept truly support circular and sustainable practices.

In education, paper continues to dominate, especially in examinations, administrative processes, and classroom activities. This dependency contributes to deforestation and environmental degradation (Zhan & Zhan, 2023). Moreover, local communities often lose livelihoods when forest resources are commercialized for paper production (Nopilda & Setiawan, 2018). Raising environmental awareness among students has been proposed as a practical way to mitigate this issue, with reduced paper use in schools serving as a catalyst for behavioral change.

Research supports the importance of ecological awareness for shaping sustainable practices. Gudmanian et al. (2018) argue that ecological knowledge enhances psychological commitment to maintaining environmental balance, while Givano & Ismail (2020) note that inadequate information dissemination fosters environmental neglect. At the same time, the rapid development of the technology sector offers opportunities to integrate digital solutions into everyday practices (Wilyani et al., 2018).

Digital literacy plays a central role in reducing paper use in schools. Students equipped with technological and collaborative skills are better prepared to adopt paperless approaches. In fact, digital literacy not only supports sustainable education but also prepares learners with competencies required in the 21st century, such as *e-business* and technology-based careers (Baby & Saeed, 2020). However, digital literacy alone does not guarantee successful transitions; consistent student habits are equally vital.

Habits influence how individuals consistently adopt environmentally friendly and technology-oriented practices. Zaenuri et al. (2017) emphasized that environmental education programs can instill sustainable habits among students, providing an early foundation for ecological responsibility. More recent evidence supports this link, as Princy et al. (2023) showed that consistent study habits are strongly associated with better student performance. Nonetheless, research highlights diverse student preferences: some prefer digital tools for learning, while others remain attached to traditional paper methods. Meishar-Tal and Shonfeld (2019) observed that preferences vary according to task context, content length, typography, and motivation factors such as comprehension or exam preparation.

Previous studies have often examined environmental awareness, digital literacy, or habits separately. Yet, there is limited evidence of how these three factors interact to shape students' readiness for paperless learning. This lack of integrative analysis is particularly pressing in developing countries, where disparities in access and skills make the transition to paperless systems even more complex. Understanding these interrelationships is essential for both educational policymakers and institutions seeking effective, sustainable strategies.

Against this backdrop, the present study investigates the readiness of senior high school students in Svay Rieng Province, Cambodia, to adopt the *going paperless* concept. Specifically, it examines the influence of environmental awareness, digital literacy, and student habits on preparedness for paperless learning environments. This study aims not only to contribute theoretically to sustainability research in education but also to provide practical insights for schools and policymakers. The findings are expected to inform targeted interventions that support digital competence, foster environmentally conscious attitudes,

and establish sustainable habits, thereby paving the way toward education systems that are both environmentally responsible and aligned with the demands of the 21st century.

2. Methods

2.1 Data Collection Procedure

To accomplish the objectives of this study, a quantitative descriptive method was employed. Descriptive research was conducted to accurately, methodically, and factually describe phenomena or events without imposing interpretations or comparisons. This approach is specifically designed to ascertain the value of one or more independent variables without establishing connections to other variables (Sugiyono, 2008). The study presents quantitative information gathered from a population about the phenomenon or condition of the subject matter.

Data collection utilized an online survey distributed to senior high schools in Svay Rieng province, Cambodia. The sampling process employed purposive sampling to select participants who were directly relevant to the research variables. A total of 148 senior high school students participated in the study, representing a diverse distribution across educational institutions in Svay Rieng municipality, the provincial capital. The sample included students from both public and private senior high schools, ensuring representation from various socioeconomic backgrounds and academic performance levels.

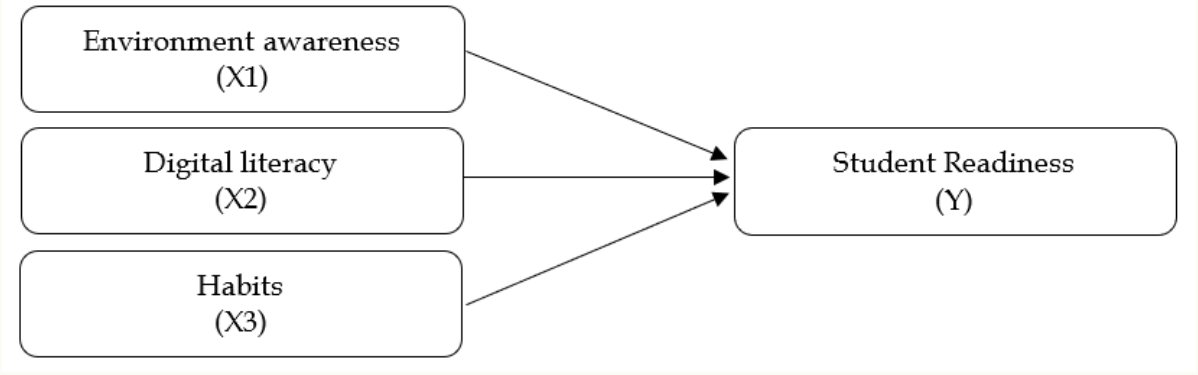

Figure 1. Conceptual Framework of the Study

This framework illustrates the hypothesized relationships:

- H1: Environmental awareness has a significant influence on student readiness.
- H2: Digital literacy has a significant influence on student readiness.
- H3: Habits have a significant influence on student readiness.

2.2 Participants

The respondents were selectively chosen based on their suitability and relevance to the core variables, particularly digital and technology literacy, as they actively use technology as a learning medium and demonstrate awareness of its potential for reducing paper usage. The school distribution encompassed six different senior high schools within Svay Rieng municipality, with participants ranging from grades 10-12 to capture varying levels of digital exposure and environmental awareness. This strategic sampling approach ensured that respondents possessed the necessary technological experience and environmental consciousness to provide meaningful insights into paperless learning readiness, while the geographic concentration in Svay Rieng municipality facilitated focused data collection and

analysis within a consistent educational policy framework. Purposive sampling method is used in this study, and the student backgrounds are various which will categorize as follows:

Table 1. Respondent Profile

Category	Sub-category	Percentage
Grade	10	16%
	11	56%
	12	28%
Age	16	35%
	17	34%
	18	15%

2.3 Instrument

Questionnaires served as the primary research instrument, designed to generate precise data by measuring attitudes, opinions, and perceptions of paperless learning adoption using a Likert scale. The Likert scale ranged from 1 (strongly disagree) to 4 (strongly agree). A research instrument lattice design was compiled following Arikunto (2006) to ensure comprehensive coverage of study variables through systematic alignment of research questions with data sources.

Instrument validity was established through both content validity and empirical testing procedures. Content validity was assessed by expert judgment from three educational technology specialists and two environmental education experts who evaluated item relevance and clarity. Empirical validity testing employed Pearson product-moment correlation analysis to examine the relationship between each item and its respective construct scale. Items demonstrating correlation coefficients (r) below 0.30 were eliminated from the final instrument. Additionally, construct validity was confirmed through confirmatory factor analysis (CFA) using SPSS AMOS, which yielded factor loadings above 0.40 for all retained items, supporting the hypothesized factor structure.

Reliability testing utilized Cronbach's alpha analysis to measure internal consistency. The results revealed Cronbach's alpha values of 0.53 for environmental awareness, 0.75 for digital literacy, 0.55 for habit, and 0.85 for student readiness. While the conventional minimum threshold of 0.70 is often cited (Nunnally, 1978), this study adopted a more flexible criterion of 0.50 for exploratory research contexts, particularly given the culturally specific nature of the constructs in the Cambodian educational setting and the relatively small scale of the study. This threshold aligns with recommendations for pilot studies and culturally adapted instruments where achieving higher reliability may be challenging due to contextual factors (Pallant, 2010). The acceptable reliability for the overall student readiness scale (0.85) further supports the instrument's robustness for measuring the composite construct.

Table 2. Confirmatory Factor Analysis (CFA) – Factor Loadings

Construct	Item code	Factor loading	P-value
Environmental Awareness	EA1	0.48	< 0.001
	EA2	0.52	< 0.001
	EA3	0.61	< 0.001
	EA4	0.46	< 0.001
Digital Literacy	DL1	0.71	< 0.001
	DL2	0.68	< 0.001
	DL3	0.75	< 0.001
	DL4	0.79	< 0.001

	DL5	0.63	< 0.001
Habits	H1	0.54	< 0.001
	H2	0.49	< 0.001
	H3	0.57	< 0.001
	H4	0.51	< 0.001
Student Readiness	SR1	0.82	< 0.001
	SR2	0.78	< 0.001
	SR3	0.85	< 0.001
	SR4	0.81	< 0.001
	SR5	0.76	< 0.001

Note: All factor loadings are statistically significant at $p < 0.001$. Minimum acceptable threshold: 0.40.

Table 3. Reliability Analysis – Cronbach's Alpha Coefficients

Construct	Number of items	Cronbach's alpha	Interpretation
Environmental Awareness	4	0.53	Acceptable (exploratory)
Digital Literacy	5	0.75	Good
Habits	4	0.55	Acceptable (exploratory)
Student Readiness	5	0.85	Excellent
Overall Scale	18	0.82	Excellent

Note: Alpha ≥ 0.70 considered good; a ≥ 0.50 deemed acceptable in exploratory or culturally adapted studies (Pallant, 2010; Nunnally, 1978).

Figure 1. Photo of waste collection of high school students

2.4 Data Analytical Procedure

Data analysis commenced with descriptive statistics, including frequency distributions, percentages, means, and standard deviations to characterize the sample and present variable distributions. The arithmetic mean was calculated by dividing the sum of data values by the number of observations to determine central tendencies.

Prior to inferential analysis, assumption testing was conducted to ensure statistical validity. Normality was assessed using the Shapiro-Wilk test and visual inspection of Q-Q plots, with all variables meeting normality assumptions ($p > 0.05$). Multicollinearity was examined through Variance Inflation Factor (VIF) analysis, where all VIF values remained

below 5.0, indicating absence of problematic multicollinearity. Heteroscedasticity was tested using the Breusch-Pagan test, which confirmed homoscedasticity of residuals ($p > 0.05$).

Multiple regression analysis was employed to examine the predictive relationships between independent variables (environmental awareness, digital literacy, and habit) and the dependent variable (student readiness). The model's overall significance was tested using F-test statistics, while individual predictor significance was assessed through t-tests. The coefficient of determination (R^2) was calculated to determine the proportion of variance in student readiness explained by the predictor variables. All statistical analyses were conducted using SPSS version 26 with statistical significance set at $p < 0.05$.

3. Result and Discussion

The regression analysis revealed that all three independent variables significantly influenced students' readiness to adopt paperless learning. Environmental awareness accounted for 19.8% of the variance in readiness, digital literacy contributed 30.5%, and habits exerted the strongest effect at 49.7%. Collectively, these predictors explained 51.3% of the variance ($R^2 = 0.513$), confirming the substantial role they play in shaping preparedness for paperless education.

Table 4. Summary of Regression Results

Predictor Variable	β Coefficient	p-value	Interpretation
Environmental Awareness (X1)	0.28	< 0.01	Significant positive effect
Digital Literacy (X2)	0.42	< 0.001	Strongest predictor, highly significant
Habits (X3)	0.31	< 0.05	Significant positive effect
R^2	**0.513**	–	Model explains 51.3% of variance

The findings presented in Table 2 indicate that digital literacy emerged as the strongest predictor of readiness, followed by habits and environmental awareness. This result aligns with previous studies that highlight the importance of technological skills in modern education (Eshet-Alkalai, 2004; Baby & Saeed, 2020). However, the relatively lower contribution of environmental awareness differs from research by Zaenuri et al. (2017), where ecological consciousness was emphasized as a primary driver of sustainable behavior. This discrepancy suggests that in low-resource contexts, technological competence may play a more decisive role than ecological values. Theoretically, these results extend adoption frameworks such as TAM and UTAUT by incorporating environmental and behavioral factors, thereby offering a more holistic perspective on sustainable education.

Figure 1 illustrates the percentage contributions of environmental awareness, digital literacy, and habits to student readiness for adopting paperless learning practices.

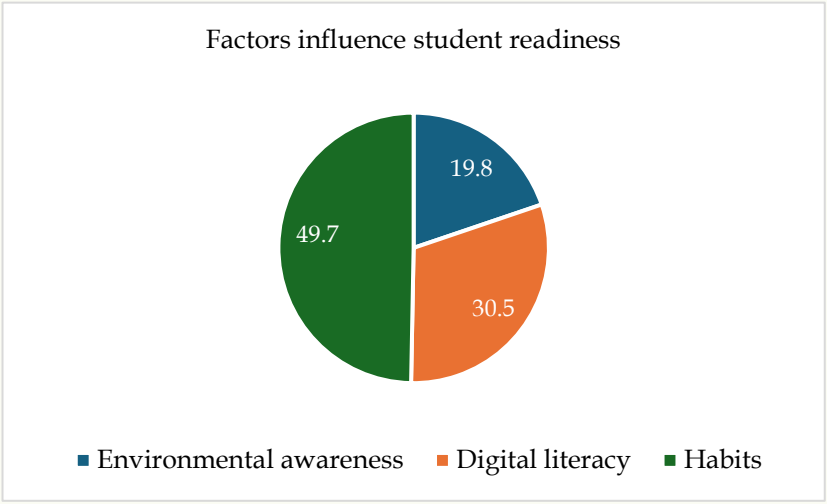

Figure 2. Percentage of factors influence student readiness

3.1 Effect of Environmental Awareness (X1) on Student Readiness

Environmental awareness had the smallest effect (19.8%, $p < 0.05$), yet it remained a significant predictor of student readiness. Many students in this study recognized that paper consumption harms the environment, suggesting that ecological awareness provides an important motivational foundation for sustainable practices. In the Indonesian context, Ludiya (2024) emphasized that environmental awareness can be nurtured through civic education to build students' ecological character. This resonates with Bazaliy's (2021) argument that cultivating ecocentric-ecological consciousness is essential for guiding students toward sustainable practices. Similarly, Lapuz and Manlapaz (2024) found that teachers' ecological attitudes strongly influence students' pro-environmental behavior, highlighting the decisive role of schools in shaping sustainable habits.

Recent international reports expand this perspective by stressing that ecological values must accompany digitalization to ensure genuine sustainability. The European Environment Agency (2022) warned that digital innovation alone cannot reduce environmental pressures unless guided by strong ecological awareness. Similarly, UNEP (2023) underscored the need to align digital transformation with environmental responsibility to advance circular economy practices. Taken together, these insights suggest that while awareness is necessary, it is not sufficient on its own. Schools must therefore complement ecological education with digital literacy initiatives and the cultivation of consistent routines to ensure that paperless practices become both effective and sustainable.

3.2 Effect of Digital Literacy (X2) on Student Readiness

Digital literacy explained 30.5% of the variance in readiness and was statistically significant ($p = 0.02$). Students proficient in using digital platforms were better prepared for paperless practices such as online assignments and virtual discussions. Earlier research by Kress and Pachler (2007) emphasized the role of mobile technologies in situated learning, and more recent studies in Southeast Asia confirm this pattern: Nguyen et al. (2022) found that the readiness of high schools in Vietnam strongly depends on their digital capabilities, while Ly and Nguyen (2024) demonstrated that organizational culture and digital capacity play a decisive role in schools' transformation efforts.

Despite these strengths, only 32% of students in this study demonstrated confidence in evaluating reliable information, revealing gaps in critical digital literacy and exposing them to misinformation. Tandoc et al. (2018) warned about the spread of disinformation in digital spaces, and this concern remains relevant. At the same time, Ding, Chen, and Lü (2023) expanded the definition of digital literacy to include not only technical proficiency but also the ability to critically assess and interpret information, reinforcing the need for higher-order competencies.

The benefits of digital literacy are well documented. Means et al. (2014) showed that blended learning environments lead to improved student outcomes, and similar findings in medical education reveal that digital transformation enhances readiness and engagement when supported by institutional factors (Althubaiti et al., 2022). Exposure to digital environments also fosters collaboration, problem-solving, and self-directed learning, as highlighted by Baby and Saeed (2020). This resonates with Voogt and Roblin (2012), who argued that digital literacy must be understood as part of 21st-century competencies such as critical thinking and teamwork. Building on these foundations, global reports continue to emphasize that equitable digital readiness is essential for sustainable education (OECD, 2021; World Bank, 2023; IREX, 2024).

Considering these perspectives, it becomes clear that digital literacy is not only about operating digital tools but also about cultivating advanced competencies and supportive institutional contexts. Strengthening digital literacy is therefore crucial, not only for paperless adoption but also for broader educational transformation in the digital era.

3.3 Effect of Habits (X3) on Student Readiness

Habits had the strongest effect, accounting for **49.7%** of the variance ($p < 0.001$). Repeated and reinforced behaviors, such as consistently submitting assignments digitally, shaped students' readiness to embrace paperless learning, reflecting the broader principle that habits form through sustained reinforcement (Duhigg, 2012). However, this study also found that many students experienced distractions, particularly from social media use, which reduced focus and academic productivity. Recent research supports this concern: Sánchez-Hernando et al. (2021) showed that lifestyle factors and habits significantly influence middle school students' academic performance, while their later study (2022) confirmed that schools promoting healthier lifestyle habits achieved better academic outcomes compared to those without such initiatives.

Beyond lifestyle, academic study habits themselves are strongly linked to performance and readiness. Princy et al. (2023) found that consistent and disciplined study habits improved the academic performance of nursing students, highlighting the role of daily routines in building preparedness. Similarly, Tagud and Valle (2023) demonstrated that effective study skills and habits directly enhance students' academic achievement, reinforcing the importance of structured behaviors in educational contexts. These findings resonate with the present study, which identifies habits as the most influential factor in students' readiness to adopt paperless learning.

At the systemic level, evidence suggests that positive habit formation requires institutional support in addition to individual practice. Reports from the World Bank (2023) emphasize that structured digital routines in schools are crucial for sustaining student engagement, while IREX (2024) highlights that institutional reinforcement is essential to make digital behaviors sustainable. Thus, habits serve as the bridge between motivation (awareness) and skills (digital literacy), ensuring that readiness for paperless learning is translated into consistent and productive behavior.

The findings reveal that readiness for paperless learning requires a holistic integration of awareness, skills, and habits. While ecological values remain an important foundation, technological competence and consistent digital behaviors emerged as stronger drivers of adoption. This pattern reflects the reality of low-resource educational contexts, where technical ability often outweighs environmental motivation. Theoretically, this study contributes to technology adoption literature by extending TAM and UTAUT with environmental and behavioral dimensions. Practically, it highlights the need for interventions that build advanced digital skills, foster sustainable habits, and embed ecological values into curricula. Such a multidimensional approach ensures that paperless learning is not only technologically feasible but also educationally sustainable.

4. Conclusion

This study demonstrates that environmental awareness, digital literacy, and habits collectively shape students' readiness to adopt paperless learning in senior high schools. Regression analysis confirmed that all three variables significantly influence readiness, with digital literacy emerging as the strongest predictor, followed by habits and environmental awareness. These findings indicate that while ecological values provide the motivational foundation, technological competence and consistent behaviors are more decisive for successful transitions to paperless practices in low-resource educational settings.

From a theoretical perspective, the study extends technology adoption frameworks such as TAM and UTAUT by integrating environmental and behavioral dimensions. Practically, it underscores the importance of equipping students with advanced digital skills, fostering sustainable habits, and embedding ecological values within curricula. By linking digital readiness with environmental responsibility, this research advances the discussion on the Circular Economy in education, offering a new perspective on how schools can reduce paper use while preparing students for sustainable futures.

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