



Original Article

Paperless Classroom Paradigm: Shift toward Environmental Sustainability in the Implementation of an Emerging LMD System in Eastern DR Congo

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Mass production of paper is one of the significant factors that are contributing to the increase in carbon outrush in the global ecological system. The transition to paperless systems in higher education is gaining momentum as institutions strive to reduce environmental impacts, streamline operations, and embrace digital technologies in the framework of the implementation of the LMD system in eastern DR Congo. This paper explores the implications of paperless consumption, focusing on its potential to mitigate forest destruction. The shift towards a paperless classroom offers significant environmental and financial benefits, particularly in reducing carbon emissions and conserving natural resources. The analysis revealed that a total of 16,226 students for the academic year 2021-2022 have consumed 1,125 A4-sheet annually per student giving approximately 36,508.5 reams of paper, with a total weight of 91,271.25 kilograms, thus leading to the destruction of approximately 1,521.19 trees and incurring a loss of 33,466.96 kg of CO₂ emissions that could have been absorbed. The study found that saving 1,115.54 trees would provide 24,541.88 kg of CO₂ absorption annually. This figure represents the additional CO₂ that would have been absorbed by these trees if they were left standing rather than used in paper production. Though seemingly minor per unit, the cumulative impact over the years is substantial. A total of 73% reduction in paper consumption, calculated from saving approximately 1,115.54 out of 1,521.19 trees, leads to proportional savings across related costs: \$1,533,000 in paper, \$664.30 in printer depreciation, \$659,190 in toner, and \$1,362.91 in electricity. These cumulative savings amount to a total of \$2,194,217.21 annually. Overall, the shift towards a paperless environment not only contributes to significant reductions in GHG emissions but also supports cost-effective environmental stewardship, underscoring the potential benefits of adopting sustainable practices in educational settings.

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INTRODUCTION

Paper has a long history as a medium for transmitting information, and with printers becoming widespread, offices are using increasingly large quantities of paper (Ono et al., 2020) that have proved critical in driving the most sensitive needs of mankind, notably in areas of education and communication (Environmental Paper Network-EPN, 2018). Paperless offices have gained popularity due to the environmental impact of reducing paper waste and carbon emissions. Going paperless has become a determinant factor for the ongoing success of organisations in both the private and public sectors. Many governments all over the world are taking steps to implement the Bologna Process, and the Democratic Republic of Congo (DRC) is no exception. Since the academic year 2021-2022, it launched the three-cycle degree structure well known as the LMD system (Licence, Master, & Doctorate) which is a consequence of this process as an attempt to reposition Higher Education in terms of globalization and competitiveness (Azzi, 2012). Increases in literacy, GNP and population in developing countries result in continued growth of paper and paperboard consumption, at a faster rate than in developed countries. Following this consumption level, the waste paper generation is increasing highly, and so are the economic and environmental impacts. Correspondingly, paper products make up a large proportion of the solid waste generated by universities, due to their

educational and academic endeavours (Modzelewski, 2007). The pulp and paper producing industry is the fourth largest GHG emitter among global manufacturing industries and is responsible for around 9 % of the total overall CO₂ emissions from manufacturing industries (EPN, 2018). The increase in paper consumption is the main driver behind the growth in the sector which results in having a large ecological footprint on the planet (EPN, 2018). The question arises of how to meet the increasing global demand for paper and paperboard (El-Sayed et al., 2020). But one dismaying fact is that millions of trees are felled in a day to make paper. Increased demands for paper production and limited wood resources have directed researchers to look for appropriate additional resources of non-wood material (waste papers) for pulp and paper manufacturing (Kumar et al., 2019). The pulp and paper industry is one of the main players in deforestation. The paperless campus is a new pedagogical approach where most of the pedagogic activities are dependent on electronic gadgets (computer, internet, copier, scanner, and projector).

Higher education institutions are major drivers of change in achieving environmental sustainability both within college campuses and beyond campuses in communities at large. However, achieving campus sustainability is not possible without the involvement of students as one of the

major stakeholders of a university (Abubakar et al., 2016). Nowadays, universities worldwide are changing their mission, vision, and educational practices in order to better cope with growing concerns about social and environmental issues and to respond to the proliferating public demand for a sustainable society in the framework of the LMD system. This is in line with the growing global consensus on the university's role towards promoting sustainability (Baby & Amir Saeed, 2020). As a result of the realization of the importance of higher education institutions (HEIs) in promoting environmental sustainability, numerous universities around the world have within the last two decades been implementing initiatives to become sustainable (Abubakar et al., 2016). Nevertheless, few universities in developing countries, especially in the eastern DRC, are making the necessary adjustments to reduce the negative impact of campus operations on the environment and incorporate sustainability into their systems. Even in the few cases where attempts are being made to implement some sustainability initiatives, the efforts are highly centralized without students' and other stakeholders' involvements, which render the initiatives insufficient to contribute to the transition to a sustainable society (Yuan et al., 2013). Thus, several scholars have called for a more inclusive and "whole-of-university" approach to achieving sustainability and to rethink how higher education can address sustainability issues not only within the curriculum and research but also via community outreach, collaboration, as well as through participation of the various university stakeholders (Beringer & Adomßent, 2008). Given that students are among the key university stakeholders, understanding their perceptions about and their involvement in environmental sustainability may give insight into whether or not and how a university is likely to employ sustainable practices (Emanuel & Adams, 2011).

The paper industry has been an important part of the global economy for centuries, providing essential products such as books, newspapers, packaging, and writing materials, among others.

The industry has played a significant role in shaping human culture and facilitating communication and learning (Shenoy & Aithal, 2016). However, the paper production process has become increasingly complex, and the industry faces significant challenges in meeting the demand for sustainable and eco-friendly products (Sharma et al., 2020). These challenges include environmental concerns such as deforestation, water pollution, and habitat destruction, which are a direct result of the paper production process. The increase in global carbon emissions due to human activities such as deforestation and the burning of fossil fuels has become an issue of worldwide concern. Paper is widely used in academia (EPN, 2018). As a result, many organisations and institutions, including universities, are striving to increase their environmental performance and responsibility. This includes efforts to reduce their carbon emissions, promote sustainability and combat climate change (IFL, 2016; PBL, 2016). The idea of a paperless office has gained popularity since the 1980s when dependence on computers led people to believe that the use of paper would become obsolete. Annually, approximately 300 million tons of paper are consumed globally, most of which is made from virgin pulp rather than recycled materials (Obiora et al., 2017). Therefore, the global increase in recovered paper use demonstrates the potential of recycling to mitigate environmental degradation (Čabalová et al., 2011) and a "paperless society" concept (That et al., 2024).

There are very few numbers of existing peer-reviewed studies focused on the necessary conditions of a paperless campus and the negative impacts of paper usage on the environment in the world. There is a wide range of universities attempting to "go paperless." Prior studies on paperless campuses revealed that the real paperless environment must begin at the cultural level. However, even though universities are now leveraging computing technologies to reduce costs and the environmental impact associated with paper-based classrooms, their contribution to creating a paperless environment has been marginal (Mphidi & Snyman, 2004). In the eastern

DRC, educational institutions are gradually embracing this shift. The implementation of the LMD system, as outlined in Decree No. 22/39 of 06 December 2022, provides a framework for integrating digital technologies into educational practices, supporting the transition to paperless classrooms.

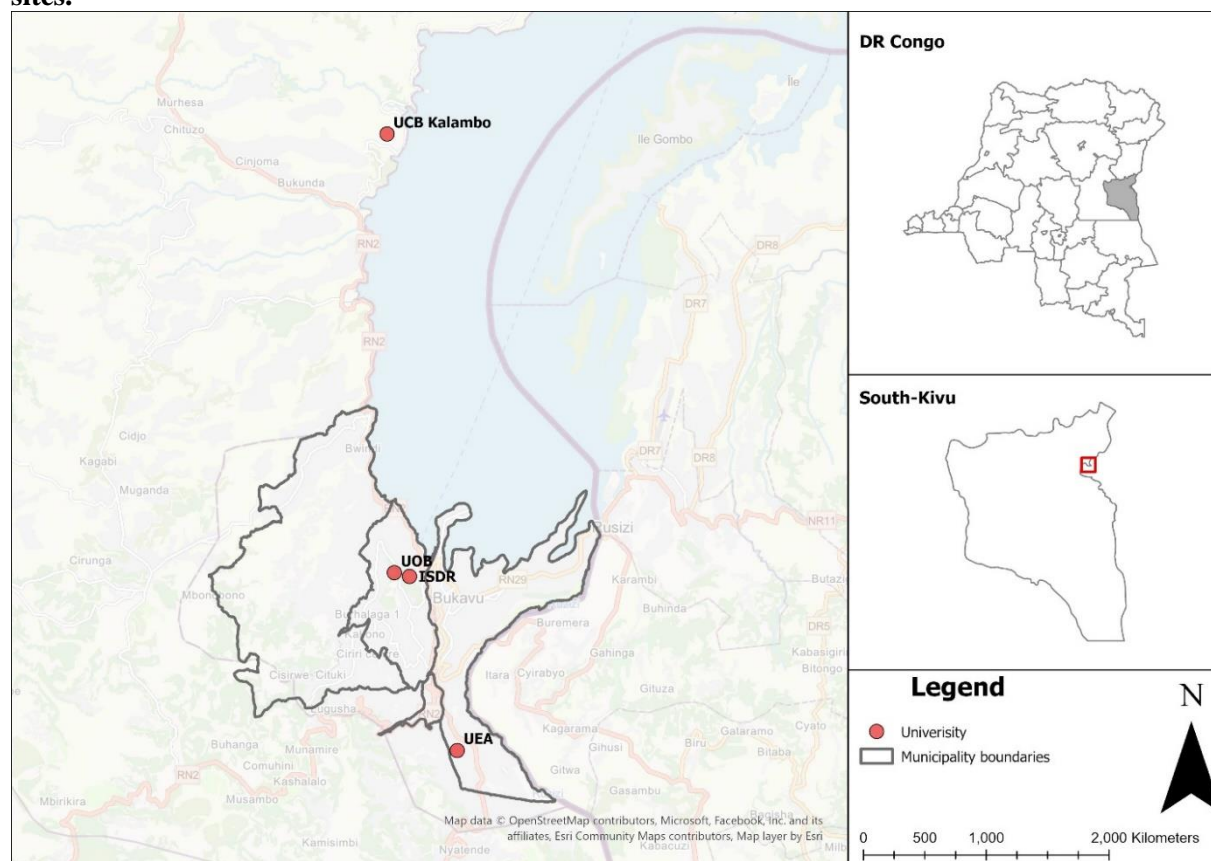
The umbrella purpose of this paper is to explore the potential factors responsible for the consumption of paper in organisations and estimate its impact on environmental degradation and economic cost. Moreover, to answer the questions of how efficiently paper is used for printing purposes in organisations, what are the students' attitudes to paper consumption levels in relation to carbon emissions? What are the impacts of the consumption of paper on the environment and economic cost? Is paperless through recycling, in the higher education system able to reduce CO₂ emissions and conserve forests by its rates of paper recycling? Overall, the study x-rayed the current body of existing knowledge by identifying and analyzing potential factors to gather a first glimpse of available, up-to-date evidence on positive and negative environmental effects of the digital transformation in a holistic way while attempting to seek the possibility of a paperless Higher Education system in South Kivu region.

MATERIALS AND METHODOLOGY

Study Area

Bukavu city (Fig. 1), the capital of the South Kivu province located at -2° 29' 26.77" S 28° 50' 34.12" E in the eastern Democratic Republic of the Congo (DRC) is an academic hub complemented by booming academic, administrative and commercial activities leading to lots of paper consumption. (Fig. 1). The Ibanda municipality alone is densely populated as evidenced by the large number of houses that have been built. In the last two decades alone, it has 69 elementary schools, 124 secondary schools, and 22 kindergartens (Bayumbasire et al., 2021). This study investigates paper consumption practices

within the environmental sectors of public and private higher education institutions in Bukavu, the most populous academic hub in South Kivu Province. The research was conducted across four institutions: the Institut Supérieur de Développement Rural (ISDR-Bukavu), Université Officielle de Bukavu (UOB), Université Catholique de Bukavu (UCB), and Université Évangélique en Afrique (UEA) over the years 2021 and 2023 (Fig 1). The rationale for selecting environmental studies students as the study population was twofold. Firstly, the sample met the research criteria for a case study of paper consumption in relation to carbon emissions because the lecturers taking the two courses were committed to delivering the course content electronically. Secondly, the staff researchers involved in the present study were lecturing one of the courses. As an 'insider', the staff researchers were thus able to undertake in-depth exploration of the issues via interviews or observations.

Fig. 1. Map showing the Bukavu city and its municipalities with the selected sampling academic sites.

Source: Map produced by the Banswe Gedeon, 2024.

The study utilized a primary data collection approach, incorporating both surveys and personal history interviews. Simple random sampling was employed to identify participants for focus group discussions and personal histories, following the methodology described by Sallu et al. (2010). The focus groups consisted of up to five individuals, while the personal history interviews involved individual participants, all of whom were at least 18 years old as required by Congolese law.

A total of 388 students were chosen and 35 personal history interviews were conducted. The sampling design of selecting 388 students in a paperless survey can be explained using several key statistical principles that help ensure the validity, reliability, and generalizability of the study's results. Sampling 388 students from a population ensures that the results are representative, given that the Central Limit Theorem (CLT) supports the use of sufficiently large sample sizes (typically over 30) to approximate a normal distribution, even if the

population is non-normally distributed (Tamhane & Dunlop, 2000). This stratified random sampling approach is emphasized by Lohr (2010) for increasing precision in estimates and making the sample more representative of the population. The decision to sample 388 students in a paperless survey is based on a combination of statistical theory and practical considerations. It provides a balance between ensuring representativeness and managing resources efficiently, while still adhering to principles of reliable survey design.

The questionnaires aimed to assess the frequency and average daily use of paper on campus, providing insights into the rate and quantity of paper consumption. This method was designed to focus specifically on student usage. The study also employed triangulation, a method that leverages the strengths and compatibility of different data collection techniques to enhance the reliability of the findings (O'Donoghue & Punch, 2003). Triangulation addresses concerns related to construct validity by offering multiple measures of

the same phenomenon through diverse sources of evidence (Altrichter et al., 2008).

Methods of Data Analysis

The research instrument used in this study is a questionnaire designed to produce accurate data using a Likert scale, which measures attitudes, opinions, and perceptions about a social phenomenon. To ensure satisfactory research results, the design of the research instrument lattice was compiled. The grid aims to demonstrate the relationship between the variables studied and the data sources or theories used (Arikunto, 2005).

Validity refers to the extent to which a measuring instrument accurately measures what it is intended to measure. Reliability is assessed through Cronbach's alpha analysis, with results showing values of 0.53 for environmental awareness, 0.75 for digital literacy, 0.55 for habit, and 0.85 for student readiness. A Cronbach's Alpha value equal to or greater than 0.5 indicates that the instrument is considered appropriate for research purposes (Cronbach, 1951).

The questionnaire titled “Computing Technologies and Paperless Classroom Questionnaire” (CTPCQ) was employed to gather data. The data were analyzed using mean scores and standard deviations for research questions, and Pearson Product Moment Correlation (PPMC) to test hypotheses. The interpretation of results used the following scale: 3.50-4.00 = Strongly Agree (SA), 2.50-3.49 = Agree (A), 1.50-2.49 = Disagree (D), and 1.00-1.49 = Strongly Disagree (SD) (Likert, 1932). Hypothesis testing was based on the probability value ($P < 0.05$), rejecting the null hypothesis if the p-value was less than 0.05, and accepting it if $P > 0.05$ (Field, 2013).

RESULTS AND DISCUSSION

Paper Consumption within Higher Educational Institutions

New technology is constantly making its way into the classroom in an attempt to improve the learning experience (Melhuish & Falloon, 2010) and many universities and schools are using

computers and mobile devices in the classroom to enhance students' academic performance. This use of technology can create a paperless classroom. Colleges, universities and schools have different approaches when putting in place the paperless classroom (Lunsford, 2014). Paper consumption in higher education institutions has significant environmental and cost impacts. Each new student admitted into a Bachelor's program submits a file folder containing numerous documents, including admission request letters, copies of diplomas, grade reports, identity documents, and certificates of various kinds. This study assumes that a ream of paper containing 500 A4 sheets weighs approximately 2.5 kg (Mukete et al., 2016).

University admissions and examinations

During the 2021/2022 academic year, four universities—ISDR-Bukavu, Université Officielle de Bukavu (UOB), Catholic University of Bukavu (UCB), and Evangelical University of Africa (UEA) - registered over 7,692 admission files. Each file comprised 12 documents for the registration process and 16 documents for the enrollment process, totalling 28 papers per student. The selected students studying in higher education are passing through about five mid-term & end-term theory examinations and four mid-term & end-term practical examinations in a semester. Students also submit about five assignments to his/her teacher in a semester. This resulted in a consumption of approximately 215,376 papers, equivalent to 431 reams or 1,076.88 kg of paper for that year alone (Mukete et al., 2014).

Table 1. Student populations in four sampled higher education institutions in Bukavu

Ref	Institution	2018- 2019	2019- 2020	2020- 2021	2021- 2022	2022- 2023	Source
1	ISDR-Bukavu	2821	2837	2500	2395	2050	Annual report 2023
2	UCB	2850	3150	3509	3800	4100	Annual report 2023
3	UEA	3173	3053	3149	3058	2914	Annual report 2023
4	UOB	5605	6162	6045	6973	7301	Kahindo, pers. Comm.
TOTAL		11,628	15,202	15,203	16,226	16,365	

Socio-economic and environmental Impacts of paper recycling and related challenges

For the academic year 2021/2022 in South Kivu province, each student consumed an average of 1,125 papers, totalling about 18,254,250 sheets (36,508.5 reams or 91,271.25 kg) for 16,226 students (Table 1). The World Watch Institute's report provides an analysis of environmental resource use, including statistics on paper production, noting that between 17-24 trees are required to produce one ton of office paper, depending on tree type and size (EPN, 2018). Its production, consumption and disposal are known to have significant impacts on the environment – deforestation, high water consumption (in plantations), water pollution (during production), and carbon emissions, among others (Senarathna, 2023). Each of these resources offers valuable context on the environmental footprint of paper production, including wood use and broader sustainability impacts. EPN (2018) estimates that a mature tree absorbs approximately 22 kg of carbon dioxide annually, therefore, approximately 33,466.96 kg of CO₂ would have been absorbed per year by 1,521.19 mature trees generated by a total of 36,508.5 reams (91,271.25 kg) consumed by 16,226 students in 2021-2022.

According to Conservatree, 2015), optimized minimal use of paper to reduce paper consumption is set at around 500 sheets per student per year. Therefore, the amount of paper saved if each student only consumed an average of 500 sheets instead of 1,125.54 sheets could translate into 8,924.3 kg of CO₂ that could have been absorbed per year by 405.65 mature trees generated by a

total of 9,735.6 reams (24,339 kg) consumed in 2021-2022. Building upon the individual consumption average of paper set at 0.6 trees per year per student (Iqbala et al., 2015), the study showed an average of 0.09 trees per year per student, though respectively 14.76%; 23.42%; 18.85% and 42.97% of total trees were destroyed by ISDR-Bukavu, UCB; UEA and UOB.

As the ingesting of paper is been growing, it is becoming problematic to obtain raw materials due to which the primary means are being exploited. The recycling of waste papers is imperative as the requirement for papers will rise and more natural resources will deteriorate. Recycling paper using the 4R ("Reduce, Reuse, Recycle and Recover") approach is one of the ways to fulfil this goal (Senarathna et al., 2023).

Paper can be virgin paper, which is produced from virgin pulp, or recycled paper, produced from recycled wastepaper or reprocessed pulp (Deshwal et al., 2019). Knowing that each ton of virgin paper emits around 530 kg CO₂-eq while a ton of recycled paper emits only around 210 kg CO₂-eq, reducing CO₂ emission by 320 kg CO₂-eq per ton of paper (Seigné-Itoiz et al., 2015), saving 1,115.54 trees provides 24,541.88 kg of CO₂ absorption loss annually. If recycling 40 kg of waste paper saves one tree (Kučerová & Halajová, 2009); thus, recycling 91,271.25 kg of waste paper could save approximately 2,281.78 trees. Knowing that 1,521.19 trees produce 33,466.96 kg of CO₂, the total of 2,281.78 trees could produce approximately 50,199.16 kg of CO₂. This figure represents the additional CO₂ that would have

been absorbed by these trees if they were left standing rather than used in paper production. Paper recycling also plays a major role in decreasing greenhouse gas (GHG) emissions since fewer trees are cut down, leading to more CO₂ captured through photosynthesis; paper manufacturing costs are also reduced because fewer processes are required (Gemechu et al., 2013).

Recycling reduces pollution in water bodies by 35% and air pollution by 74%, moreover, it reduces land space usage and conserves natural resources (Misman et al., 2014), therefore, saving 1,115.54 trees would save an estimated 4,462,160 kWh of energy and 33,466,200 litres of water absorption loss annually, thus providing a range of potential environmental impacts when paired with effective recycling practices, as recycling helps mitigate pollution, conserves natural resources, and reduces land use demands. Paper recycling induces numerous environmental benefits, apart from reducing the use of wood as raw material and avoiding landfilling with used paper. Paper manufacturing based on recovered paper also consumes less water and energy per ton of product, thus decisively contributing to the sustainability of the sector. To achieve a higher use of recovered paper as a raw material in the paper and board industry, it is necessary to increase its availability, by examining existing or new sources. For example, paper made from vascular plants such as bananas or pineapples has the potential to replace trees as the main source for making paper (Mahazir & Othman, 2021).

Reducing paper usage by 1,115.54 trees, equating to 24,541.88 kg of CO₂ saved, yields substantial cost savings based on Standard Chartered Bank's (2010) expense breakdown. A total of 73% reduction in paper consumption, calculated from saving approximately 1,115.54 out of 1,521.19 trees, leads to proportional savings across related costs: \$1,533,000 in paper, \$664.30 in printer depreciation, \$659,190 in toner, and \$1,362.91 in electricity. These cumulative savings amount to a total of \$2,194,217.21 annually. This cost-effective reduction highlights the financial

benefits of sustainable practices in minimizing paper-related expenditures.

Environmental Awareness and Student Readiness for a Paperless Concept in Higher Education Institutions

Educational Impact and Student Readiness

Awareness and habits play crucial roles in the adoption of paperless practices. According to the research, environmental awareness has a 28.76% impact on student readiness, digital literacy contributes 19.27%, and habitual practices have a significant 51.97% impact. Environmental education and awareness campaigns via diverse media effectively foster recycling and environmentally responsible behaviour. Studies have shown that the better-informed people are about recycling, the more likely they are to commit to it and feel satisfied with their actions (Levlin et al., 2009).

Moving Towards a Paperless Classroom: Implications for Higher Education in DRC

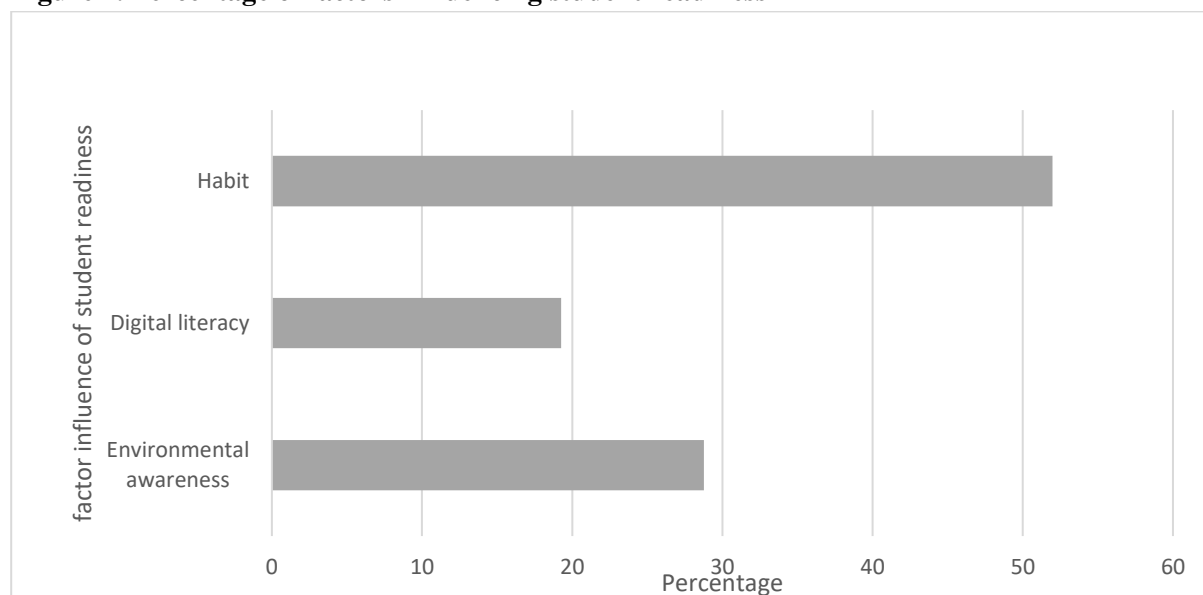
Pulp and paper (P&P) production is one of the largest industrial activity in the world (Bajpai, 2017). Further, the need to replace plastic (produced from nonrenewable sources) with paper in packaging applications is also responsible for the expected growth. The Paperless concept, which was built as a form of concern for the environment, requires students, especially the younger generation, to have an awareness of this concept. Environmental awareness will emerge with an intensification of the contradiction between humans and nature. This action is very important to pay attention to seeing that environmental awareness is the first step in implementing the paperless concept. Apart from family, each day students will spend around 5-6 hours on campus. Based on this, campuses can be a means of implementing this paperless concept.

Reducing the use of paper in the teaching and learning process does not mean eliminating the use of paper 100%, this can be overcome by the collaboration of using paper and technology in the teaching and learning process, especially in the framework of the emerging LMD system. The use

of electronic devices is also very common at this time; it is not uncommon for every individual to have more than one electronic device, such as cell phones, tablets or laptops. From the study findings, environmental awareness had a positive

impact where it influenced student readiness for the amount of 28.76% while digital literacy positively influenced student readiness by 19.27%. Habit has supported a rate of 51.97% increase in student readiness.

Figure 2. Percentage of factors influencing student readiness



Environmental Awareness Towards Student Readiness

Reducing the use of paper daily will minimize the dependency on paper in academic activities. Like higher education institutions that have implemented the Paperless concept, they have begun not to use paper in recording lessons, collecting assignments, and others. This concept should apply to all public and private higher education institutions in eastern DRC. Seventy-nine percent agree that Teaching and Learning activities can reduce the use of paper to protect the environment. From the data presentation, the environmental awareness of higher education institution students as the nation's youth in eastern DRC is a good starting point for the country regarding the sustainability of its natural resources as 90.6% of them agree that excessive use of paper will cause environmental damage. This ecological damage puts the South Kivu province at a real risk

and threat condition if the people are still indifferent to protecting the environment. The study results indicate that the environmental awareness variable influences students' readiness to implement the paperless concept in higher education institutions. This variable gets a probability with a significance level set at 0.46, which is lower than the 0.05 threshold, indicating a strong influence on student readiness. This means that the environmental awareness variable significantly influences students' readiness to implement the paperless concept in public and private academic institutions. Based on previous research, shows that building a culture of environmental care can be done by applying the activity of paperless usage. Something similar is also found by Zaenuri et al. (2017), to apply the concept of reducing the use of paper, knowledge education about the environment is necessary to build students' awareness of the environment.

Table 2. Mean and standard deviation scores on the rationales for a paperless classroom for the attainment of a sustainable paperless approach in public and private Universities

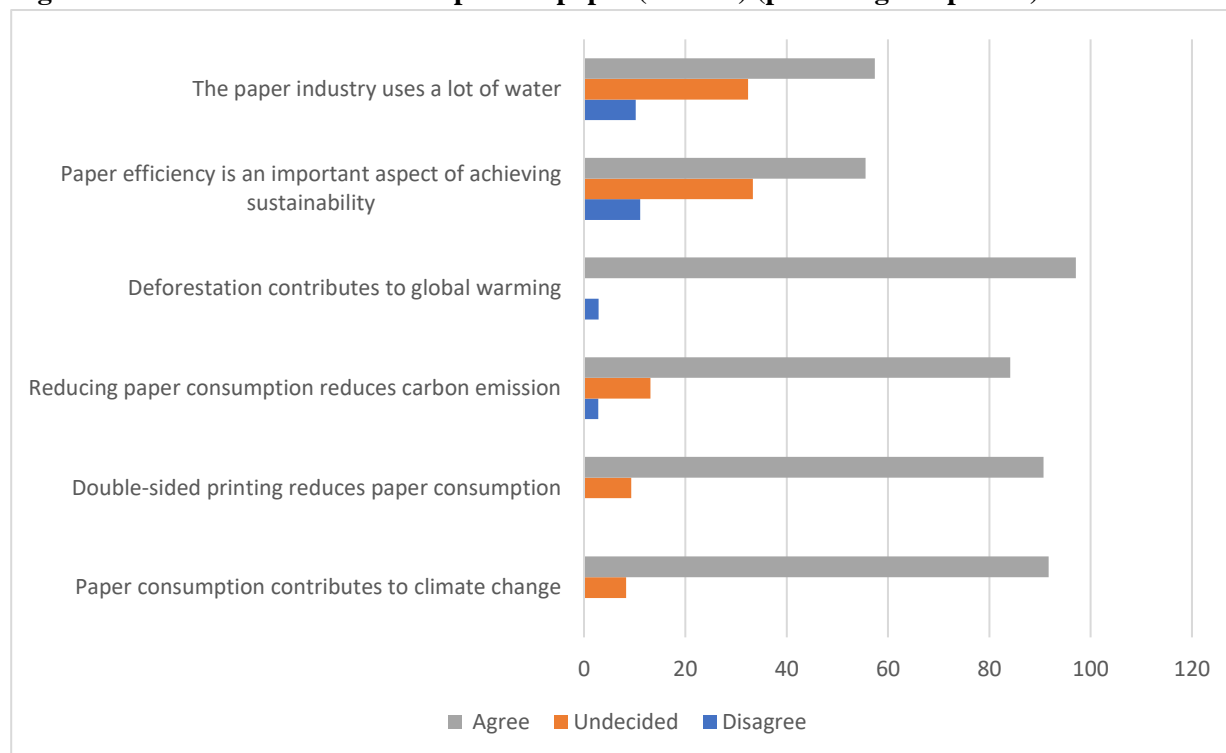
S/No	Items	Students n=388			Teachers n=15			Mean Set	
		Mean	\bar{X}_1	SD	Mean	\bar{X}_2	SD	\bar{X}	Decision
1.	Educational resources are optimally utilized	2.98		0.78	2.84		0.91	2.91	Agreed
2	Students are able to develop relevant empowerment skills	2.92		0.81	2.91		0.86	2.92	Agreed
3	Paperless classrooms make teaching and learning more efficient and effective	2.90		0.85	2.82		0.89	2.86	Agreed
4	Students are able to develop good social character	2.64		0.98	2.74		0.94	2.69	Agreed
5	It prepares students for future responsibilities	2.97		0.79	2.76		0.93	2.87	Agreed
Grand Mean and Standard Deviation		2.88		0.84	2.81		0.91	2.85	Agreed

Table 2 shows the mean responses of the students to items 1, 2, 3, 4 and 5 to be 2.98, 2.92, 2.90, 2.64 and 2.97. These items were all above the criterion mean score of 2.50 used for decision-making and as such implied that the items were agreed upon. On the part of the lecturers, their responses to the same set of items produced mean scores of 2.84, 2.91, 2.82, 2.74 and 2.76. These items were also above the criterion mean score of 2.50 used for decision-making and as such signified that the items were agreed upon. The grand mean scores of 2.88 and 2.81 from the male and female lecturers showed that they both agreed on the rationales for a paperless classroom for the attainment of a sustainable paperless approach in public and private Universities in eastern DRC. The grand mean set of 2.85 showed that both students and the lecturers agreed on the rationale for a paperless classroom for the attainment of a sustainable paperless approach in public and private Universities.

Awareness of the Carbon footprint of paper

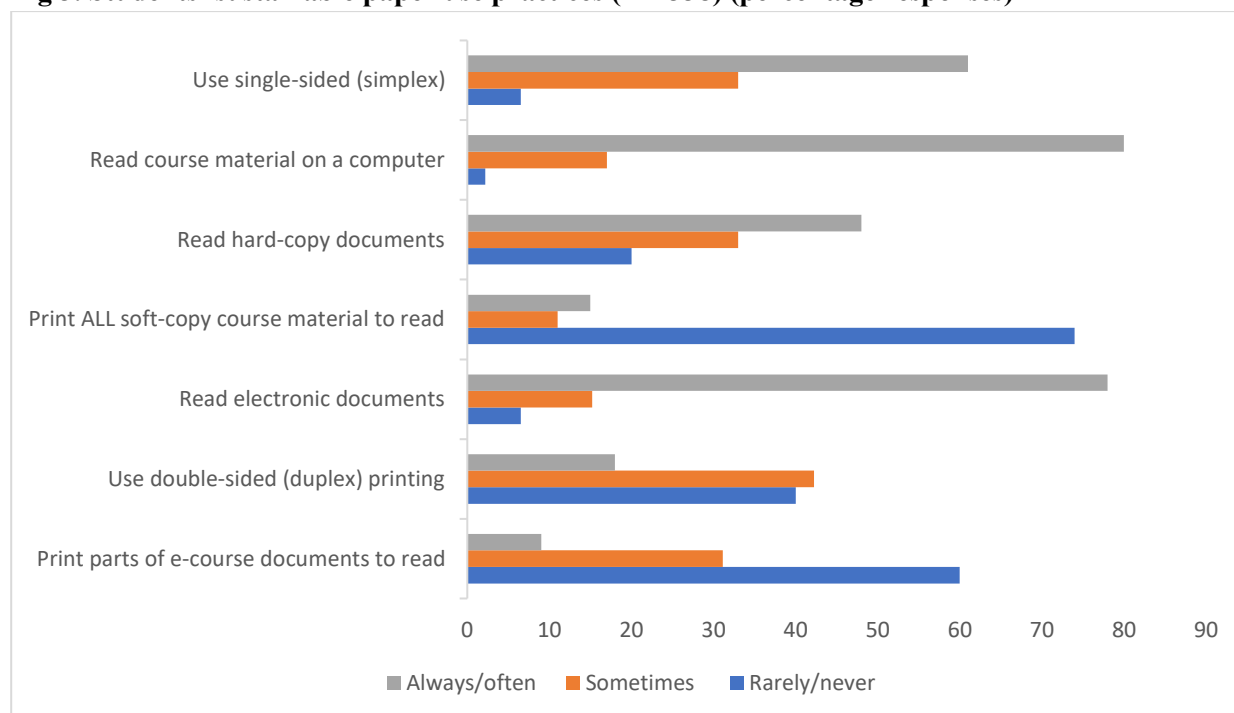
The majority of students surveyed were aware of the carbon footprint of paper, with 55% having significant knowledge of its impact. Students understood that efficient paper use, tree planting, and recycling could help offset carbon emissions.

Despite this, interview data suggested an insufficient understanding of the paper manufacturing industry's carbon impact. Overall, 91.7% of students were aware of the fact that paper consumption contributed to climate change while 97% recognized that deforestation highly contributed to global warming (Fig 2).

Fig 2. Awareness of the carbon footprint of paper (n = 388) (percentage responses)**Students' sustainable paper use practices**

Interview and observation data revealed that most students practised sustainable paper use, except for duplex printing, despite knowing it cuts paper use by half (Fig 3). Manual duplex printing is

time-consuming, and the cost remains the same for both printing methods (Nkuba & Bongo, 2020). This suggests that convenience and cost often outweigh environmental awareness in influencing students' paper consumption behaviour.

Fig 3. Students' sustainable paper use practices (n = 338) (percentage responses)

For a successful shift to a paperless classroom, both students and lecturers need to possess the right attitude and perception. As highlighted by the study, 80% of students read course material on a computer and 78% read electronic documents (Fig 3), thus paving the way for sustainable paper-use practices. Previous studies, such as those by Hults (2015), have shown that paperless classrooms can enhance student engagement and attitudes when lecturers support the transition. Furthermore, research by Runnels and Rutson-Griffiths (2013) indicates that while lecturers preferred using regular-sized tablets for classroom materials, students showed a preference for smaller devices for everyday tasks. These findings underscore the need for appropriate resources that cater to both lecturers' and students' preferences.

Challenges of Implementing Paperless Classrooms in Congolese Higher Institutions

The higher education system heavily relies on paper for administrative and academic processes. As the system evolves, there is a growing need to minimize paper use through technological adoption. Emerging technologies can significantly reduce paper usage and streamline educational processes. Implementing a paperless classroom in higher education institutions in the DRC faces several challenges, including:

- **High Costs:** Technology tools are expensive, and institutions may struggle with budget constraints;
- **Cultural Resistance:** Changing organisational culture to embrace new technologies can be difficult;
- **Power Supply Issues:** Reliable power supply is a significant concern, requiring additional investment in alternative energy sources;
- **Manpower and Resources:** There is a reliance on consultants and limited availability of qualified personnel;
- **Infrastructural Limitations:** Poor network infrastructure and data storage challenges further complicate the transition.

Reducing Paper Use in Higher Education Institutions: A Path to Sustainability and Future Prospects

Studies of institutions like ISDR-Bukavu, UEA, UOB, and UCB highlight the potential for a paperless higher education system in the DRC. The vision for these institutions includes enhancing research, teaching, and community service through technological advancements (Shonfeld & Meishar-Tal, 2016). Harvard's president notes that technology, changing knowledge structures, and educational value assessments are driving forces in higher education ((Shonfeld & Meishar-Tal, 2016). Embracing these changes can help DRC institutions overcome the limitations of traditional paper-based systems and improve information management (Nkuba & Bongo, 2020).

Paper can be recycled up to seven times, after which the cellulose fibres are deemed unsuitable for paper production and are rejected (Ozola et al., 2019). Therefore, there is a strong need for routes other than recycling for the utilization of paper waste, including adopting a paperless culture involves several strategies to minimize paper use through (i) digital Editing and approval: use electronic circulation for document editing and approvals; (ii) efficient printing: employ duplex printing (printing on both sides) and print multiple pages per sheet; (iii) document retrieval: ensure that printed materials are collected to monitor usage; (iv) digital meetings: bring digital devices to meetings instead of printing documents, and share information through projections or electronic distribution of handouts.

Although the finding is successful in explaining the behaviour, limitations should be highlighted. First, since the respondents were dominated by students who are in the second year of study and above, the result of this study may differ if new students dominate the sample as new students have just experienced a change of contextual factors, which in turn may have different determinants of paper consumption behaviour. Second, some Cronbach alpha values are below the usual cut-off of 0.7 (Cronbach, 1951) even though the measures were adopted from literature,

which are both the most reliable and widely used measures. The low value of Cronbach's alpha could be due to the use of limited items for measuring consumption behavioural variables. Thus, more related items should have been added to increase the alpha. Future potential research could further test the suggested potential interventions to reduce paper consumption. Due to the under-representation of First-year students in this study, potential research could examine whether or not new students may differ from senior students when it comes to paper consumption. Other future research could also explore how individual habits spread and, thus, affect the routines of the organisation.

CONCLUSION AND MANAGEMENT IMPLICATIONS

The increasing trend of paper production and consumption leads to more serious future negative environmental impacts in the academic arena. The pulp and paper industry is one of the main players in deforestation. The shift to a paperless classroom in higher education institutions in the DRC is both necessary and feasible.

Based on the estimated findings, this paper suggests that there is a high environmental burden from power consumption in the production and usage of papers. Recycling is considered to be the most effective method to preserve South Kivu's environmental security. By simply reusing the materials instead of discarding them, we can reduce the number of waste materials and also conserve future natural resources.

Overall, it is concluded that to protect green forests, the use of the new papers which are made by wood pulps should be decreased. It can also protect our environment. As we can recycle paper seven times, thus we should recycle the waste papers and make handmade papers or products which are eco-friendly and no harmful chemicals are used to make handmade paper (US EPA, n.d). In a nutshell, the findings suggest that while the paperless classroom paradigm offers significant benefits, it also presents challenges that require further research into making technology more environmentally- friendly and adaptation to

optimize teaching and the development of new conversion technologies in order to improve the environmental sustainability of the pulp and paper industry.

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