

# Towards Consolidating Environmental Education in Public Primary Schools of Mali: A Critical Analysis

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## ABSTRACT

The current study addressed the depth of environmental education (EE) implemented in the syllabus of Malian primary education from the perspectives of pupils and teachers. This study aimed to (1) assess the teaching materials and methods provided in environmental education; (2) evaluate the knowledge of environmental education and behaviour towards environmental protection of primary school pupils and their teachers, and (3) examine the links established by pupils and their teachers between health and the environment. The study was conducted in two primary schools selected by the Pedagogical Animation Centre of Sogoniko, Bamako. The participants comprised four teachers and fifty-two pupils. A descriptive research design was employed with a qualitative and quantitative approach. The syllabi of grade 4 and grade six were analysed to explore EE topics. Interviews were conducted with teachers and pupils to investigate their knowledge of EE. Additionally, a questionnaire was administered to pupils to examine their knowledge of EE. Moreover, participant observation was undertaken of the school environment and classroom, aiming to evaluate teachers' and pupils' behaviour towards the environment and the links established between health and the environment. The findings indicated that the course content relating to the environment remained unclear. The schools suffer from the teaching materials and techniques on environmental issues. Moreover, the pupils and teachers are not properly engaged with the school environment, and their activities regarding healthcare are not safe.

**Keywords:** environmental education, primary school, sustainable development.

## INTRODUCTION

Humanity has been experiencing drastic climate change (CC), with genuine concerns for sustainability.

Therefore, human life is based on education. The line that distinguishes humans from other animals and makes them the most powerful and intelligent beings on the planet is education (Patel, 2023).

Indeed, the whole world notes with bitterness the effects of climate change, mainly caused by the emission of greenhouse gases through human development activities (IPCC, 2021; Koutsoyiannis, 2021). Consequently, these issues subsequently led to the idea of sustainable development (SD), which aims to improve the quality of a state through organising actions, behaviours, and, most importantly, a form of governance that prioritises the well-being of communities (Johan et al., 2022; Mustajoki et al., 2022).

Environmental education (EE) enables people to form long-term attitudes about the environment. This encourages active participation in environmental conservation (Altin et al., 2014). Education on climate change and environmental degradation is an important instrument for mitigating the current global warming crisis (Busch et al., 2018; Ledley et al., 2017; Molthan-Hill et al., 2025) and encouraging strategic climate action (UNESCO, 2026). Education is an enabler for communities and individuals when it comes to deciding how to reduce climate change and build the capacity to adapt to the impending severe climatic impacts (Molthan-Hill et al., 2025; UNESCO, 2026). Moreover, education is crucial for promoting SD and increasing people's capacity to handle environmental and development challenges, along with the dynamics of both physical-biological and socioeconomic environments (Anderson, 2010, 2012; Roemhild & Gaudelli, 2021).

The pedagogical practices and teaching strategies have a significant influence on student learning. The main orientations of Mali's government education policy prescribe the competency-based curriculum approach, a global and systemic approach to learning. The Mali competency-based approach curriculum emphasises learner-centred methods, differentiated pedagogy, group pedagogy, and project-based pedagogy, which is recognised internationally (Anderson, 2012; Morton et al., 2010; Spence & Pidgeon, 2010) for framing the climate change message. New trends include systems thinking, eco-citizenship, and the emergence of broad ideas promoted from 1970 to 2000, which continue to interact in educational discourses (Colucci-Gray et al., 2006). As a result, the educational practises promoted by Education for Sustainable Development (ESD) help both teachers and pupils find or relearn specific concepts that are critical to understanding an increasingly complex reality. However, some scholars (Anderson, 2010, 2012; Chairunnisa et al., 2022; Coyle, 2005; Djane et al., 2009; Koffi et al., 2017) emphasised the significance of preparing students for radical changes that will cause ethical and societal instability. School is essential for educating young people in climate resilience, sustainability and greening strategies to face the many problems caused by climate change, biodiversity loss, and pollution (Anderson, 2012; Colucci-Gray et al., 2006). Social learning and place-based pedagogies are international trends that move beyond climate and environmental awareness to empowerment and action (Centre for Research on Environmental Decisions, 2009; Cirillo & Hoyler, 2015).

Environmental knowledge, individuals' attitudes toward the environment, and personal participation have been proposed as variables that influence environmentally conscious actions (Altin et al., 2014; Sali et al., 2015). Environmental education in Malian primary schools is typically offered in Social Sciences or Natural Sciences classes. Especially Natural and observation Science and reading classes cover most of the environmental education. The primary school curriculum was changed in 2016. However, there are a limited number of studies in Mali about environmental knowledge and attitudes towards health and the environment. Previous research was carried out at primary schools (Dolumbia, Filho, et al., 2025) or lower secondary schools (Dolumbia et al., 2026). These studies focused on learners' perceptions, knowledge, and motivation regarding climate change. Therefore, there are gaps in examining teaching materials, and pupils' and their teachers' knowledge about environmental education as well as their attitudes and a healthy school environment.

This study aims to analyse environmental education in public primary schools in Mali. To achieve the specific objectives, it seeks to:

1. assess the teaching materials and methods provided in environmental education;
2. evaluate the knowledge of environmental education and behaviour towards environmental protection of primary school pupils and their teachers, and

3. examine the links established by pupils and their teachers between health and the environment.

## METHODOLOGY

### Study area and participants

This study was conducted in Bamako, the capital city of Mali. The data were collected in two primary schools selected at the Pedagogical Animation Centre (CAP) of Sogoniko. This CAP was chosen because of the diversity of the schools it holds and the immediate affirmative feedback from the director of the CAP to carry out the study in the schools maintained.

The study sample was selected using simple random sampling and purposive sampling. The pupils were selected based on Article 34 of the Malian Educational Orientation Law, which stipulates that children as young as six must attend primary school. As a result, any pupils who began school before or after six years old are excluded. The two schools were coded as School A and School B. The study focused on primary school pupils in Grade 4, the last of the preparatory (level 2) classes, and Grade 6, the last of the consolidation (level 3) classes. The pupils' ages ranged from 9 to 11 years.

School A comprised 59 pupils, including 28 pupils from Grade 4 and 31 pupils from Grade 6. School B consisted of 67 pupils, including 32 in Grade 4 and 35 pupils in Grade 6. The population comprised a total of 126 pupils from two schools. The sample size was determined using the Raosoft (2004) sample size calculator. Therefore, a sample size of 96 was determined among a population of 126 pupils.

We drew the list of pupils and randomly selected the participants. According to the exclusion criteria, this study's sample consisted of eighty-four (84) pupils, forty-five (45) of whom were from school A and thirty-nine (39) of whom were from school B. At school A, twenty-one (21) pupils were from Grade 4, with ten boys and eleven girls and twenty-four (24) from Grade 6, with fourteen boys and ten girls. Accordingly, in School B, twenty (20) pupils were from Grade 4, eight boys and twelve girls, and nineteen (19) were from Grade 6, with ten boys and nine girls. Forty-one pupils were from Grade 4, and Grade 6 pupils consisted of forty-three pupils. Moreover, the study comprised forty-two boys (50%) and forty-two girls (50%). Four (04) teachers from each class were purposively selected. The head teachers of the two primary schools were also selected as resource persons in the study.

### Data collection and analysis

This study used quantitative and qualitative approaches. The quantitative methods comprised a survey and a participant observation grid. The qualitative approach included interviews.

The survey instrument was a questionnaire administered to the pupils. The survey covered the characteristics of the respondents, with four (04) open-ended questions and three free questions. It collected information about the pupils' knowledge of the environment, the modules taught, and their teachers' teaching methods and materials. Pupils were asked about their understanding, and their responses were distributed as "everything around us, an invention and the environment we live in". In the second question, pupils were asked about the elements of the environment. The responses included trees, animals, water, houses, wildlife, buildings and men. The third question asked about pupils' understanding of environmental destruction and the consequences of ecological destruction. Therefore, the respective responses were as follows: bushfires, cutting down trees, abusive wildlife killing, water wasting, pollution and household waste, getting sick, forest disappearing, short rainfall during the rainy season, and abundance of rains during the dry season. In addition, four open questions were asked about the environmental topics in the syllabus and their teachers' teaching materials and resources.

The interviews were conducted with teachers to explore the topics of environmental education used in their teaching-learning process, the methods and materials used in environmental education, and the professional development in which they participated. The training modules, methodologies, teaching materials, and recommendations were covered during the interviews. They were also asked about pupils' behaviour toward the environment. The school principals were asked about the environmental education project implemented in

their schools and pupils' and teachers' behaviour toward the environment. The interviews were conducted with pupils to assess the teaching methods and materials in their classes. It also focused on their understanding of the environment and its degradation and protection. The interviews ended at saturation.

The observation grid made it possible to observe the classrooms, playgrounds, pupils' and teachers' behaviours, and the immediate surroundings of the schools.

The survey data were processed using the Statistical Package for Social Sciences (SPSS) version 29. The interviews and the observation data were processed manually. The teachers' interviews were coded from (Teacher 1) to (Teacher 4), and the pupils' open questions were coded from Pupil 1 to Pupil 84.

## RESULTS

### Materials and teaching methods of Environmental Education

The environment is not taught as a separate discipline in the different primary schools of study. The information collected from teachers reflects the observed reality: *"We have some modules including Geography, Family economics, Morals education, Observational sciences and reading that we teach pupils, therefore during these modules teaching we explain the environment... however from two years ago, at the beginning of the school, the government provides a model lesson about the environment to be taught in the classes as the first lesson"* (Teacher 1).

The methods used were more or less the same in both primary schools. Therefore, teachers used the blackboard, pictures in books, and concrete objects - if there were any - to illustrate their lessons. Moreover, the pupils mentioned a variety of teaching materials that their different teachers use, including the Observational Sciences book. *"The teacher presents the environment in the Science and Geography book, according to (Pupil 1). "There are days when the teacher teaches crop rotation and illustrates crop development on the board"*, says another (Pupil 17).



**Photo 1:** An Observational Science Book in Grades 5 and 6



**Photo 2:** Books for teachers and pupils on climatic risks and flooding in Mali, which teachers focused on for their model lesson at the beginning of school but do not currently use in the classes.

### Knowledge and behaviour of pupils and their teachers

Throughout the school observation process, the researchers examined the interaction of the pupils and their teachers within their working environment, particularly the classrooms, playgrounds, and toilets. While the classrooms appeared the most maintained, the playground was maintained less, and the toilets were the least maintained overall.

The teachers, in turn, organised classroom sweeping sessions for the girls in their respective classrooms. The teachers prepared and managed a general cleaning operation or maintenance of the school's compound every Friday.

*"...We aim to inculcate an attitude of cleanliness in pupils,"* according to a school director. However, *"Pupils are often primarily responsible for the state of the toilets as well as the schoolyard. We plan cleaning sessions, but some of them always take the opportunity to go home"* (Teacher 4). Another (Teacher 2)

mentioned that “...pupils prefer to sit in the unclean classroom, or when the teacher enters, they start sweeping the class”.



**Photo 3:** A School Compound Well Maintained by a Tree Plantation



**Photo 4:** Runoff water and piles of garbage in the school compound close to classrooms

### Pupils' knowledge about the environment

To address this concern, the researchers asked the pupils four questions: What is the environment? What are its elements? What can destroy the environment? What are the consequences of environmental destruction? Tables 1, 2, 3 and 4 present the responses.

Table 1 presents the data on pupils' knowledge about the environment, distributed by Grade. It reveals a significant prevalence of response 1. The pupils emphasised the widely recognised definition. Accordingly, the environment is “everything around us” (61.9%). On the other hand, many also indicated that “it is the environment we live in” (29.8%). In terms of education level, in the same table, the percentage of the pupils in Grade 4 and Grade 6 was almost the same, 28.6 % and 33.3%, respectively, in their citation of “Everything around us”.

**Table 1:** Cross-tabulation of Pupils' knowledge about the environment, distributed by grade

| Responses                  | Grade 4   |             | Grade 6   |             | Total     |             |
|----------------------------|-----------|-------------|-----------|-------------|-----------|-------------|
|                            | <i>f</i>  | %           | <i>f</i>  | %           | <i>f</i>  | %           |
| Everything around us       | 24        | 28.6        | 28        | 33.3        | 52        | <b>61.9</b> |
| An invention               | 4         | 4.8         | 0         | 0.0         | 4         | <b>4.8</b>  |
| The environment we live in | 13        | 15.5        | 12        | 14.3        | 25        | <b>29.8</b> |
| Don't know                 | 0         | 0           | 3         | 3.6         | 3         | <b>3.6</b>  |
| <b>Total</b>               | <b>41</b> | <b>48.8</b> | <b>43</b> | <b>51.2</b> | <b>84</b> | <b>100</b>  |

**Note\*** Percentages and totals are based on responses.

Table 2 shows the proportion of pupils' responses regarding the elements of the environment. The pupils recognise the relevance of Greenhouse gases (CO<sub>2</sub>) when identifying the environmental components of “Human beings” (71.4%), “Animals” (60.7%), and “Trees” (58.3%).

They also mention “Water and wildlife (53.6%) and “Houses” (40.0%). There are no higher differences between the percentages of Grade 4 and Grade 6 regarding “Human beings (33.3 % and 38.1%). Their

responses are closed for trees 26.2% and 323.1% and “animals (28.6% and 32.1%), respectively. “*The driving cars and food are the elements of the environment*”, as stated by (Pupil36) about other elements.

**Table 2:** Cross-tabulation of Pupils’ understanding of the elements of the environment, distributed by grade.

| Responses    | Grade 4   |             | Grade 6   |             | Total     |             |
|--------------|-----------|-------------|-----------|-------------|-----------|-------------|
|              | <i>f</i>  | %           | <i>f</i>  | %           | <i>f</i>  | %           |
| Animals      | 24        | 28.6        | 27        | 32.1        | 51        | <b>60.7</b> |
| Trees        | 22        | 26.2        | 27        | 32.1        | 49        | <b>58.3</b> |
| Water        | 15        | 17.9        | 30        | 35.7        | 45        | <b>53.6</b> |
| Wildlife     | 19        | 22.6        | 26        | 31.0        | 45        | <b>53.6</b> |
| Houses       | 16        | 19.0        | 18        | 21.4        | 34        | <b>40.5</b> |
| Buildings    | 5         | 6.0         | 10        | 11.9        | 15        | <b>17.9</b> |
| Human beings | 28        | 33.3        | 32        | 38.1        | 60        | <b>71.4</b> |
| Others       | 1         | 1.2         | 0         | 0           | 1         | <b>1.2</b>  |
| <b>Total</b> | <b>41</b> | <b>48.8</b> | <b>43</b> | <b>51.2</b> | <b>84</b> | <b>100</b>  |

**Note\*** Percentages and totals are based on responses.

Table 3 presents findings about environmental destruction. The answers are as diverse as they are varied. However, the pupils cited “Household waste” (53.6%) thrown in the streets and water (40.5%) as the leading causes of environmental destruction, followed by the abusive “Cutting down trees” (39.3%).

Moreover, as cited by (Pupil75), “*When we plant trees, and we do not water them, they will die*”, as well as (Pupil11), who said that “*...if there is no rainfall to water the forest, all trees will disappear*”. They also indicated that “Pollution” (31.0%), “Bush fires” (28.6%) and “Abusive wildlife killing” (16.7%) can destroy the environment, as shown in Table 3. “*The schoolyard is dirty with dry leaves from trees*”, and “*the war can destroy the environment*”, according to (Pupil20).

**Table 3:** Cross-tabulation of Pupils’ understanding of the causes of environmental destruction, distributed by grade

| Responses          | Grade 4  |      | Grade 6  |      | Total    |             |
|--------------------|----------|------|----------|------|----------|-------------|
|                    | <i>f</i> | %    | <i>f</i> | %    | <i>f</i> | %           |
| Household waste    | 20       | 23.8 | 25       | 29.8 | 45       | <b>53.6</b> |
| Water wasting      | 16       | 19.0 | 18       | 21.4 | 34       | <b>40.5</b> |
| Cutting down trees | 16       | 19.0 | 17       | 20.2 | 33       | <b>39.3</b> |
| Pollution          | 12       | 14.3 | 14       | 16.7 | 26       | <b>31.0</b> |

|                          |           |             |           |             |           |             |
|--------------------------|-----------|-------------|-----------|-------------|-----------|-------------|
| Bush fires               | 10        | 11.9        | 14        | 16.7        | 24        | <b>28.6</b> |
| Abusive wildlife killing | 6         | 7.1         | 8         | 9.5         | 14        | <b>16.7</b> |
| Others                   | 4         | 4.8         | 7         | 8.3         | 11        | <b>13.1</b> |
| <b>Total</b>             | <b>41</b> | <b>48.8</b> | <b>43</b> | <b>51.2</b> | <b>84</b> | <b>100</b>  |

*Note\* Percentages and totals are based on responses.*

Table 4 demonstrates the responses to the questions on the consequences of environmental destruction. Accordingly, pupils mostly say environmental destruction can result in “getting sick” (52.4%). They mentioned “forest disappearing” as a consequence of environmental degradation at (25.0%). The following consequences of environmental degradation were the “short rainfall during the rainy season” and “the abundance of rainfall during the dry season”, respectively cited by (13.1%) and (10.7%). According to (Pupil39), “...we can get food insecurity”.

**Table 4:** Cross-tabulation of Pupils’ answers about the consequences of environmental destruction, distributed by grade.

| Responses                                   | Grade 4   |             | Grade 6   |             | Total     |             |
|---------------------------------------------|-----------|-------------|-----------|-------------|-----------|-------------|
|                                             | <i>f</i>  | %           | <i>f</i>  | %           | <i>f</i>  | %           |
| Getting sick                                | 21        | 25.0        | 23        | 27.4        | 44        | <b>52.4</b> |
| Forest disappearing                         | 9         | 10.7        | 12        | 14.3        | 21        | <b>25.0</b> |
| Short rainfall during the rainy season      | 4         | 4.8         | 7         | 8.3         | 11        | 13.1        |
| Abundance of rainfall during the dry season | 3         | 3.6         | 6         | 7.1         | 9         | 10.7        |
| Others                                      | 3         | 3.6         | 6         | 7.1         | 9         | <b>10.7</b> |
| <b>Total</b>                                | <b>41</b> | <b>48.8</b> | <b>43</b> | <b>51.2</b> | <b>84</b> | <b>100</b>  |

*Note\* Percentages and totals are based on responses.*

## DISCUSSION

This study has provided evidence of teaching environmental education in public primary schools of Mali. The overall assessment of the outcomes indicates this assertion.

The findings demonstrated that EE is being taught. However, the significant environmental teaching programmes available are summarised in the information provided to pupils while teaching other disciplines, as found in (Nicolas, 2016; Shin & Akula, 2021). The teaching materials were insufficient for primary school pupils to understand the issue of the environment adequately. Therefore, it is not enough to take adequate climate action. This corroborates with Nicolas (2016) who indicated that drawing on the chalkboard or using pictures from a book does not appear to convey enough information. When the teacher teaches the Observation Sciences and Geography course, the environment is handled as a subject. Additional dimensions of the topic are addressed through the modules of Moral Education, Family Economics, and Reading and cleaning activities (Colucci-Gray et al., 2006; Djane et al., 2009). This indicates the limited access to

environmental education in the syllabus. The result mirrored the findings of Doumbia, Filho, et al. (2025), where primary school children remained neutral regarding the existence of climate change-related topics in their syllabi. Our findings are consistent with those of Kafando et al. (2026) on pupils' awareness of flooding in Burkina Faso. Their study among primary school children revealed that pupils do not know of any document that demonstrates the causes and impacts of flooding, and at least some lessons in observational sciences. This study illustrates the findings of Sanogo et al. (2020) who stated that "the environmental teaching activities take place outside the official school curriculum" (p.2); this study confirms that point. Therefore, at this level, pupils are not well prepared to contribute to the better protection of the environment.

The field surveys conducted at both schools indicate that the pupils consider the environment as "everything around us" (61.9%), followed by saying an environment we live in (29.8%). In addition, the majority of pupils stated the elements of the environment such as animals, trees, water, wildlife and houses. These findings are consistent with those of Kafando et al. (2026) on pupils' definitions of flooding in Burkina. Their study reported that 94.5 % of primary school pupils mentioned flooding as water entering houses, collapsing buildings, and flooded streets. The results of this study align with the post-test findings of Doumbia, Coulibaly, et al. (2025), who compared pupils' definitions to the concepts of the definitions put forward by the Intergovernmental Panel on Climate Change (IPCC). The IPCC defines climate change as "any change in climate over time, whether due to natural variability or as a result of human activity" (Folland et al., 2001; p.22). The definitions were analysed focusing on causes, impacts and alternative conceptions. The study revealed that 43.0% of pupils mentioned causes of climate change, focusing on cutting down trees, firewood, waste and river sand mining. The study further indicated that 33.3% of pupils included climate change impacts in their definitions of climate change, including rising temperatures, flooding, droughts, air pollution, and water pollution. According to the findings of this study, pupils' views about the definition of the environment are higher compared to those of Doumbia, Filho, et al. (2025) among fifth and sixth-grade pupils' perceptions and motivations of climate change. In their study, about 86.0% of pupils reported alternative conceptions in defining climate change. Another study (Doumbia et al., 2026) found that 80.8% of lower secondary school students mentioned misconceptions in their definitions of climate change. These study participants mainly focused on alternative conceptions as a shift from the rainy season to the dry season and from the cold season to the hot season.

The findings of this study showed that about half of the participants indicated household waste and water could destroy the environment. The study participants also mentioned cutting down trees as causes of environmental degradation. Despite the provision of teaching, the pupils and even the school compound demonstrate unhealthy practices, as highlighted in the studies of Djane et al. (2009); Koffi et al. (2017); Nicolas (2016). The area between two blocks of the school (from grade 1 to grade 3 and grade 4 to grade 6) serves as a dumping point for classroom rubbish. Water pipes also leak as they run around the school. The toilets were in poor condition, and there was no functioning hand-washing facility; therefore, pupils' practices regarding health care were not satisfactory (Kouakou et al., 2021; Sarkar, 2013). Moreover, none of them mentioned rising sea levels due to ice melting as one of the most significant factors in the environmental crisis, probably because Mali is a Sahelian country. The findings align with Doumbia, Filho, et al. (2025), who found that the majority of pupils do not know the causes of climate change, such as industrial waste and household waste. The findings of this study illustrate that pupils and their teachers have unhealthy behaviour between the environment and health in terms of water and waste management in the school yard. This result corroborates with Doumbia, Filho, et al. (2025) who found that more than 90% of pupils reported being neutral regarding the statements that waste could contribute to environmental degradation. Similar findings were underscored by Doumbia et al. (2026) among lower secondary school students in Mali.

The pupils are aware of the impacts of environmental destruction on "getting sick" (52.6%), registered as one of the highest percentages observed during the surveys. Teachers were determined to keep children healthy, "*...corporeal cleanliness is insufficient on its own, therefore we add environmental cleanliness*", says (Ti04). There is still more to be accomplished because an unhealthy atmosphere can lead to sickness (Djane et al., 2009; Nicolas, 2016), a consequence relevant to the studied schools. Regarding the impacts of environmental degradation, this study mirrored the findings of Kafando et al. (2026) where primary school pupils indicated that flooding can cause risk of death, destruction of houses, uproot trees and remove roofs from houses. This

study is also in line with the post-test assessment of Doumbia, Coulibaly, et al. (2025), who demonstrated that the majority of primary school children agreed with statements of climate change impacts, including floods, droughts, loss of food production, air and water pollution, and damage to forests and wildlife.

## CONCLUSION

At the end of the analysis, the authors found that the environmental teaching provided in Malian schools is limited by certain shortcomings, as presented in the results. The lesson contents in EE are not sufficiently explicit. The teaching method suffers from the lack of adequate teaching materials. Regarding the pupils' opinions and actions as well as the teachings provided, the researchers noted a mismatch in attitudes and behaviours of the pupils towards the environment. Accordingly, the link between health and the environment made by teachers and pupils revealed weaknesses. However, it is essential to understand the state of the risks faced and the social representations of the environment in the school. Definitely, EE would enhance sustainable development when it is appropriately provided and accompanied by adequate material and pedagogical tools in the daily modules of primary school pupils.

## LIMITATIONS

The sample size from two schools in one Pedagogical Animation Centre (CAP) of Bamako, Mali, limits the generalisability of the results to other nations. The sample size should include more schools from different regions to provide a fuller understanding of EE nationwide. Additionally, the study did not include the socio-economic characteristics of pupils. The reliance on self-reported data could have introduced bias or inaccuracies. One of the limitations of this study is an extensive review of the curriculum to examine the EE topics throughout the competency domains of the curriculum. Additionally, the study did not account for external factors, such as family background, media exposure, or community engagement, which could have influenced the pupils' environmental awareness. To address these limitations, future research could expand the sample size and include schools from various regions of Mali to obtain a more comprehensive understanding of knowledge about environmental protection. Longitudinal studies with educational intervention on environmental education could foster eco-citizens among young learners. Investigating the influence of family, community, and media would provide a more holistic view. The analysis of the five competency domains of the Malian curriculum, including Languages and Communication (LC), Personal Development (DP), Science, Mathematics and Technology (SMT), Human Sciences (SH) and Arts, could state the integration level of EE in the curriculum.

## IMPLICATIONS AND RECOMMENDATIONS

The researchers recognised that the consolidation of EE in primary schools required enormous efforts. The practical point of this study provided pupils' and teachers' views of teaching materials and resources in EE at public primary schools. The study also demonstrated pupils and teachers' knowledge of the environment. Therefore, we recommend that governments enhance teachers' continuing training by providing materials on EE and integrate EE topics into formal curricula by advancing the three interlinked learning dimensions of cognitive, socio-emotional and behavioural. Moreover, training modules should be developed in collaboration with the National Directorate of Education and the National Directorate of Normal Education, with the assistance of financial and technical partners. This further necessitates the provision of contextualised teaching materials and school manuals for schools. The capacity building of teachers and the school management committees on EE and its monitoring are prerequisites for achieving EE. More interestingly, beyond French, initiating sessions in the local languages with bilingual practices and materials (pupils' mother tongue) in Grades 4, 5, and 6, despite the significant ethnic group diversity in Mali, could contribute to a more robust implementation of the reviewed curriculum of 2016, leading to the understanding of environmental issues. To successfully implement the competency-based approach, necessitate, the creation of a garden or green areas enhanced by students, which can introduce a new socio-environmental dynamic to their EE; for example, the school can welcome volunteer students to maintain the garden on its property over the summer (Pipon, 2014, p.54; Pruneau et al., 2008). Furthermore, the government should consider the implementation of green walls as teaching materials in a competency-based approach towards pupils' education in environmental

sustainability (Doumbia, Coulibaly, et al., 2025). The above recommendations may empower learners to develop the knowledge, skills, values, and attitudes they need for a holistic learning experience that puts learners on a pathway of empowerment and transformation for a just, peaceful, and sustainable world that addresses the gaps highlighted by Sanogo et al. (2020). The computer would be a tremendous tool to help provide engaging activities in EE for pupils. Documentary film screenings would greatly enhance what textbooks, programmes, pedagogical approaches, and instructional materials attempt to achieve to be more effective in engaging in environmental preservation.

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## Authors' contributions

**ABD:** Conceptualisation, investigation, methodology, visualisation, data curation, formal analysis, writing – original draft preparation. **CAK, AC, VNO & WLF:** Supervision, Review & editing. All authors read and approved the final manuscript.

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