This article presents the results of research conducted between 2021 and 2023 by the Albertine Rift Conservation Society (ARCOS) with 240 partners including teachers, learners and parents in six Rwandan schools. A relational knowledge co-creation methodology was used to gain a shared understanding of education and climate change challenges in the schools and co-create solutions using the Eco-Schools problem-based learning pedagogy. The knowledge co-creation processes revealed a negative relationship at the intersection between climate change and quality education which is interrupting successful implementation of both the Competence-Based Curriculum (CBC), and the School Feeding Programme policies of the Government of Rwanda, affecting national progress towards SDG 4 and SDG 13. However, by integrating climate action projects in the CBC, with practical skills and knowledge from parents and wider community members, education barriers caused by poor school conditions, and poor nutrition, health and comfort of learners are being removed, while the quality and relevance of teaching and learning in schools is being improved. The article therefore proposes the Eco-Schools programme as a potential means of simultaneously addressing the UN’s ‘triple crisis’ of inclusion, quality and relevance. Ultimately, by showing that it is possible to transform education in even the most challenged schools, at a relatively low cost, within a very short space of time (one school year) and without large-scale curriculum reform or infrastructure, the findings of this research promote wider, faster and more optimistic progression toward the UNESCO’s ‘Reimagining Education’ vision and the Greening Education Partnership targets.
Keywords Eco-Schools • Education for Sustainable Development • Rwanda • competence-based-curriculum • SDG 4 • SDG 13

Key messages
• The research reveals a negative relationship at the intersection between climate change and quality education.
• Climate action projects are removing education barriers, while improving learning quality and relevance.
• Climate education can transform education in severely challenged schools, at low cost, within a short timeframe.

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Introduction
Recent international discourse recognises that beyond the challenge of providing universal and equitable access to schooling, education is experiencing compounded crises of quality and relevance in what, how and where children are learning (UN, 2023). This means that while ‘more of the world has greater access to formal educational opportunity than ever before’ (Toukan, 2023: 2), half of the children attending schools are not learning (IUS, 2017) and education is ‘not yet fulfilling its promise to help us shape peaceful, just, and sustainable futures’ (ICFE, 2020: 6). The increasing severity of climate change impacts are compounding this ‘triple crisis’. As recently expressed in a report published by the Foreign, Commonwealth and Development Office ‘for every step we take forward on education, climate and environmental change takes us two steps back’ (FCDO, 2022: 7). This research responds to a call in the same report for ‘more work to understand how priority issues are linked and to find integrated solutions’ (FCDO, 2022).

There is by now widespread acceptance in both academic literature and international discourse that to meet the interlinked challenges of sustainable development, climate change and poverty, education systems worldwide must be transformed (ICFE, 2020; Tikly et al, 2020; FCDO, 2022). Uniting behind a reimagined vision of education as ‘a public endeavour and a common good’ (ICFE, 2020: 6), the UN Secretary-General launched the Greening Education Partnership (GEP) with ambitious targets to use the knowledge and practice accumulated in the field of Education for Sustainable Development (ESD) to achieve the transformation needed (UN, 2023). Previous research has suggested that the international Eco-Schools programme of the Foundation for Environmental Education (FEE) can support education transformation from the bottom up (Copsey, 2019; 2020). As one of the largest global ESD programmes, FEE is a lead partner for the GEP.
However, the targets are ambitious, the challenges are severe (FCDO, 2022) and previous efforts to transform education curricula and teaching have been fraught with obstacles and failures (Schweisfurth, 2011). For example, in Rwanda, where there is strong political support for change and innovation in education (Tikly and Milligan, 2017), multiple issues have interrupted the integration of the Competence-Based Curriculum (CBC) since its launch in 2015. In 2020 the Rwandan Education Board (REB) requested that the Albertine Rift Conservation Society (ARCOS) help understand how Eco-Schools can support integration of the CBC and remove barriers to quality education in Rwanda. Based on this request, a research project entitled ‘Eco-Schools as a tool for integrating sustainable development and climate action within the competence-based curriculum in Rwanda’ was coordinated by ARCOS between 2021 and 2023 with funding from the UKRI (UK Research and Innovation) through the Transforming Education for Sustainable Futures (TESF) network plus. This qualitative research project used a relational knowledge co-creation methodology involving a broad range of partners, and teachers, learners and parents in six Rwandan Eco-Schools.

This article presents the results of the ARCOS study aiming to build on previous understanding of how the Eco-Schools programme can help remove education barriers and achieve the vision of quality education as lead partner of the GEP. In particular this research focusses on the intersection between climate and environmental change (SDG 13) and quality education (SDG 4) asking: how can Eco-Schools pedagogies and climate action projects address the triple education crises in the real-life context of Rwandan schools facing severe education and climate change challenges?

**Literature review**

The 2023 report on the UN Transforming Education Summit held in September 2022, describes ‘a dramatic triple crisis’ confronting education today.

> A crisis of equity and inclusion, as millions are out of school; a crisis of quality, as many of those who are in school are not even learning the basics; and a crisis of relevance, as many educational systems are not equipping the new generations with the values, knowledge, and skills they need to thrive in today’s complex world. (Garnier, 2023: 1)

The persisting gap between education access and education quality becomes more apparent even as global progress is made towards targets for universal education. As Toukan warns ‘The world has greater access to formal educational opportunity than ever before, yet many of the individual and collective benefits education promises are falling further and further out of reach’ (Toukan, 2023: 2). There is widespread acceptance in both academic literature and international discourse that to address the triple crisis of ‘equity, quality, and relevance’ in education (UN, 2023: 3) and meet combined modern challenges of sustainable development, climate change and poverty (ICFE, 2020; Tikly et al, 2020; FCDO, 2022) education systems worldwide must be transformed. At the Transforming Education Summit, 133 Member States submitted statements of ‘National Commitment to Transform Education’ (UN, 2023).

However, efforts to transform education systems and curricula have been fraught with obstacles and failures (Schweisfurth, 2011), including those which are structural
(Stanistreet, 2022), environmental (Sims, 2021) and ideological (van de Kuilen et al., 2019). For example, evidence from implementation of Learner Centred Pedagogy (LCP) across both northern and southern education systems is ‘riddled with stories of failure grand and small’ (Schweisfurth, 2011: 425). A case in point is Rwanda where there is strong political support for change and innovation in education (Tikly and Milligan, 2017), and good progress has been made towards enrolment (98 per cent in primary education) (UNICEF, 2024) with boys and girls showing gender parity in both pre-primary and primary education (REB, 2015).

Following other member states of the East African Community (EAC: Tanzania, Uganda, Kenya, Burundi and South Sudan) (van de Kuilen et al., 2019) and in line with the 2013 harmonised curriculum framework for the EAC (REB, 2015), Rwanda’s CBC was launched in 2015, demanding major changes in teaching methodology and assessment. A statistical analysis carried out by Ndihokubwayo and Habiyaremye in 2018 found that a significant number of teachers prefer the CBC to the previous Knowledge-Based Curriculum in terms of practicability to teachers’ needs and interests, organisation and timing, appropriateness of activities and market orientation.

However, despite its tagline ‘Curriculum for Sustainable Development, Dignity and National Identity’ (REB, 2015), themes of sustainable development are not well integrated in the CBC (Tusiime and Imaniriho, 2020) and several implementation problems persist (Ngendahayo and Askell-Williams, 2016; Tusiime and Imaniriho, 2020; Bizimana et al., 2021). Literature suggests that the approach is not being easily understood, accepted and implemented at classroom level (Ndihokubwayo and Habiyaremye, 2018; van de Kuilen et al., 2019). A recent study with teacher-training college tutors in Rwanda found that teachers still rely too heavily on traditional, teacher-centred instruction, and no evidence that the CBC is appropriate or produces the expected results in the Rwandan context (Bizimana et al., 2021). Despite high enrolment, school completion and learning quality remains low with learning adjusted years of schooling equating to only 3.9 years (World Bank, 2020) and there remain ‘enormous challenges that will have to be addressed for education to be a real catalyst to social economic and environmental transformation’ (Tusiime and Imaniriho, 2020) in Rwanda.

The situation in Rwanda is reflected across sub-Saharan Africa where children’s access to formal education had increased from 59 to 78 per cent over the past decade (GPE, 2023), yet half of the children attending schools are not learning (UIS, 2017). Meanwhile, increasing impacts of climate change are also posing an accelerating threat to education, particularly for girls, the poorest and the most marginalised children (Sims, 2021; FCDO, 2022). Flooding destroys schools, storms force people to flee their homes; droughts result in children having to go further to collect water or look after animals, leaving less time available for education (Sims, 2021). Research by Nordstrom and Cotton (2020) into the impact of a severe drought on education outcomes in rural Zimbabwe cited substantial evidence showing that economic hardship and hunger caused by droughts lead to children leaving school, either due to the need to work or inability to pay school fees. Even when children stay in school, environmental changes and subsequent economic hardship such as temperature increases, droughts or other extreme weather make learning difficult, as children’s physical well-being, mental health or nutrition deteriorate and their ability to concentrate is compromised (Nordstrom and Cotton, 2020; Sims, 2021).
The literature discussing the interrelationship between education and climate change can be broadly grouped into two themes (Sims, 2021). While research on climate change impacts on education, as detailed earlier, was previously limited it has recently been a subject of significant focus (Shah and Steinberg, 2017; Randall and Gray, 2016; Nordstrom and Cotton, 2020). A much larger body of research exists to explore the role of quality education in increasing the knowledge, skills and attitudes necessary to enable adaptation to current and future changes, and mitigate future climate change (Muttarak and Lutz, 2014; Monroe et al, 2019; Feinstein and Mach, 2020; Rousell and Cutter-Mackenzie-Knowles, 2020; Sims, 2021; FCDO, 2022). The latent instrumental paradigm reflected in this linear ‘climate change education in – climate action out’ model, has been long contested within much emancipatory literature from the field of ESD (see, for example, Huckle and Wals, 2015; Jickling and Wals, 2008; Lotz-Sisitka et al, 2016; Sterling, 2003).

This article aims to highlight a third relationship in the education and climate change intersection that is rarely mentioned: the role of climate change education in improving education quality. Research in this third area is relatively thin. The review found only one article on this topic written by Bangay and Blum in 2010, which highlighted the connections between climate action in schools and education quality and argued that ‘education responses to climate change and quality are two parts of the same agenda’ (Bangay and Blum, 2010: 359). A small amount of literature is also available which identifies contributions of the wider field of ESD to quality education, for example the synthesis of studies carried out in 18 countries by Laurie et al (2016) which showed that ‘teaching and learning transforms in all contexts when the curriculum includes sustainability content and ESD pedagogies’ (Laurie et al, 2016: 226).

Methodology

The ARCOS research team consisted of 21 members from ARCOS, the REB, the Rwandan Environmental Management Authority (REMA), UNESCO National Commission for Rwanda (CRNU), the University of Rwanda, and focal point teachers and head teachers from six schools. Three of the schools were in Bugesera district in the Eastern province and three in Rulindo district in Northern Province. Four of these schools were part of the original pilot group of Eco-Schools chosen in 2020, and had previously been recruited and trained in the Eco-Schools programme pedagogy. One new school in each district was newly recruited to establish causation and attribution of results.

The methodology was co-designed during two workshops in collaboration with all research team members as an essential part of the knowledge co-creation process. This was guided by the TESF methodological guides (Sprague et al, 2021; Mitchell et al, 2020) and literature on social, transdisciplinary, transformative and transgressive research processes that challenge the status quo and enable alternative praxis and change (Lotz-Sisitka et al, 2016; Wals, 2019; Kulundu-Bolus, 2020; Swilling, 2020; Tikly et al, 2020). Research in this view aims to decentre human beings and their anthropocentric tendency towards binary divisions in favour of more relational, ethical, political and ecological modes of understanding and action (Barratt Hacking and Taylor, 2020). This includes the division between ontology, epistemology and ethics, seen instead as an ethico-onto-epistemology (Barad, 2007) which emphasises
the entanglements and responsibilities inherent within ‘intra-actions’ (Haraway, 1991; Barad, 2007) such as those that occur during participatory research. During early meetings of the research team the Rwandan concept of Umuganda, which describes the coming together of people in common purpose, was agreed as a shared philosophy between team members. This research therefore embraced relationality in support of the emancipatory direction of ESD and in celebration of the local and cultural philosophies in the communities where the research takes place.

It was decided that the ARCOS methodology should mirror and reinforce the Eco-Schools problem-based learning (PBL) approach, which had already been established for one year in four of the six schools (two in each district). In Eco-Schools PBL learners establish an Eco-Schools committee including teachers, parents and other community members with whom they evaluate, research and co-create solutions to priority challenges. Our knowledge co-creation methodology was developed to advance the Eco-Schools PBL according to Hirsch Hadorn et al’s (2008) critical transdisciplinary research challenge. ‘To grasp the complexity of the problems, to take into account the diversity of scientific and societal views of the problems, to link abstract and case specific knowledge, and to constitute knowledge with a focus on problem-solving for what is perceived to be the common good’ (cited in Lotz-Sisitka et al, 2016: 52).

Three original research questions were co-developed:

1. What are the main challenges being identified to quality education and climate change adaptation in Rwanda and how are these articulated by learners, teachers and parents in six Rwandan Eco-Schools?
2. How can these challenges be addressed using the Eco-Schools methodology?
3. What is the potential impact of these Eco-Schools solutions on the integration of the CBC and the quality of education in Rwanda?

The project received ethical clearance from the University of Rwanda (received 15 September 2022) and the knowledge co-creation process was launched in six schools in September 2022. In total, 240 people participated in research in the six schools during interviews and focus group sessions. They included 6 head teachers, 72 teachers, 18 parents and 144 students, as well as 27 representatives from different District Education Partners in Bugesera and 24 from Rulindo including Civil Society Organisations, District Directors of Education (DDE) and Sector Education Inspectors (SEI).

The knowledge co-creation process was carried out in four phases (Table 1).

**Challenges at the intersection between climate change (SDG 13) and quality education (SDG 4)**

This section presents an analysis and findings from the interviews and focus group sessions which were held in October 2022 during Phase One of the ARCOS research project. The questions centred around research question one: ‘What are the main challenges being identified to quality education and climate change adaptation in Rwanda and how are these articulated by learners, teachers and parents in six Rwandan Eco-Schools?’ The analysis was carried out individually by the lead author using open coding (Kennedy-Lewis, 2014), and verified during in-depth discussion with members of the research team.
A total of 240 teachers, learners, parents and district officials participated in these knowledge co-creation sessions in the six schools to explore current challenges being faced within the two areas of quality education and climate change. Recent literature is discussed alongside the findings from this phase of the research to gain a deeper understanding of key challenges within the broader Rwandan context. Analysis from the survey responses during focus group discussion exploring the challenges in schools reveal an interrelationship between climate change and quality education that consists of direct and indirect causal effects and interactions.

The challenges posed by climate change to learners, schools and families, particularly in the areas of water, food and poverty, are directly affecting the ability of schools to provide a quality education due to poor conditions, hunger and ill health. Ultimately, the negative relationship happening at the intersection between climate change and quality education is affecting progress toward SDG 4 and SDG 13. The intersection remains the same when seen through the policy lens when the challenges facing families and schools interrupt the delivery of the school feeding programme and therefore continue to stall the successful integration of the CBC.

**Challenges with Competence-Based Curriculum integration**

Being designed as a ‘Curriculum for Sustainable Development, Dignity and National Identity’ (REB, 2015: 1), the Rwandan CBC framework is potentially congruent with both the emancipatory education view and the problem-based Eco-Schools approach. The CBC asks teachers to shift from traditional methods of instruction and adopt participatory and interactive learning methods using a learner-centred approach (LCP), with learning content becoming more relevant and adaptive to the changing needs of pupils, teachers and society (Ngendahayo and Askell-Williams, 2016; van de Kuilen et al, 2019). However, discussions with education stakeholders, including teachers, and growing evidence in Rwandan education literature suggest that the approach is not being easily understood, accepted and implemented at classroom level and teachers still rely too heavily on traditional, teacher-centred instruction (Ndihokubwayo and Habiyaremye, 2018; van de Kuilen et al, 2019; Bizimana et al, 2021). During the knowledge co-creation sessions in the schools, concerns over lack of training on the ‘modern methods’ of LCP and CBC were raised in four out of the six schools. Teachers also raised the lack of teaching materials, and high density of learners per classroom linked to poor learning and behaviour. The knowledge co-creation processes revealed concerns in all six schools over a lack of interest, involvement and monitoring being shown by parents for their children’s education. As one teacher stated, ‘Parents themselves discourage students and don’t support them in learning’ and ‘insufficient parent involvement’ was given as a frequent cause of drop-out. Our findings supported Nizeyimana et al (2020), that many key education stakeholders question the value and relevance of education in preparing children for the future, and suggest that the CBC’s purpose in making learning content more relevant was not being met in the six schools.

A link to household poverty and poor quality teaching and learning (Nizeyimana et al, 2020) was also made during our focus group discussions in the inability of some parents to provide adequate school materials and equipment. This was found to be a major concern interrupting CBC implementation in all the schools. Our discussions also confirmed findings by Nzabaliwra and Nkiliye (2012) that the difficult conditions
in which Rwandan teachers work significantly demotivate them and decrease their efforts to achieve better results for their learners. All six schools experience water shortages during the dry season; in the drier eastern province of Bugesera, dry spells are increasing in length, leading to water scarcity and food insecurity (USAID, 2019) and availability of water is a major concern. In this school, learners were each required carry a jerrycan of water to school on their heads. Not only was this tiring but the different water sources being brought to school would often lead to outbreaks of stomach illness and disease.

In most of the schools, lack of specialisation in environment and geography studies was raised as an issue linked to limited awareness and training on how to address

Table 1: The ARCOS knowledge co-creation process

<table>
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<tr>
<th>Phase One: Survey</th>
<th>A questionnaire with a combination of multiple-choice questions and qualitative open questions was crafted together by the research team and translated into Kinyarwanda by the teachers. The survey was carried out in each school with 24 students during four informal focus group discussions of 6 students, staff members, the head teacher and 12 teachers (this is one teacher per class for Primary 1 to Primary 6 and Secondary 1 to secondary 6), and 3 parents in each of the 6 schools. Challenges identified were recorded through stories, diary notes, audio recordings, written work, drawings, photographs and digital artefacts. Analysis was performed by teachers and learners with regular support from the ARCOS team. The purpose of this phase of the research was to identify key challenges in both areas of quality education (SDG 4), and climate change (SDG 13).</th>
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<td>Phase Two: Co-engaged inquiry</td>
<td>A workshop was organised bringing together District Education duty bearers (District Director of Education, District Education Officers, Sector Education inspectors), partners (Civil Society Organisation and other NGOs working in the education sector), with teachers, students and parents facilitated by the ARCOS team. During open and honest discussion, the key challenges identified in Phase One were ranked based on level of severity, their importance and perceived capacity for action. This led to the identification of one priority challenge per school.</td>
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<td>Phase Three: Deliberation and micro-project testing</td>
<td>Workshops were organised at each school with students, staff members, family, friends and neighbours to present and discuss key limiting factors impeding the achievement of quality education (SDG 4) and climate action (SDG 13). Solutions were proposed by participants during deliberative discussion and ranked per priority given the resources available as well as feasibility in terms of time and responsibility of each of the team. Participants were reminded of the guiding research principle of Umuganda, the coming together in common purpose to achieve an outcome. From this, we developed together the action plan for the implementation of identified priority micro-projects at each school.</td>
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<tr>
<td>Phase Four: Co-creative dialogues</td>
<td>Co-creative dialogues were held during follow-up visits to each school between the ARCOS research team, head teachers and teachers, as well as some parents and learners in July 2023 after one year since the start of ARCOS Eco-Schools implementation. The close involvement of the head teachers and other individuals present in the ARCOS-TESF knowledge co-creation project, the relationships developed and their engagement with the aims of the follow-up visits enabled a relational process whereby the data would be co-constructed through dialogue (Roulston et al, 2003) and therefore at the ‘far end of the spectrum’ of informal interviewing (Burgess, 2003: 167). Some degree of simultaneous analysis (Sheridan et al, 2020) was possible during the follow-up co-creative dialogues, with themes arising being reflected back and discussed further. After the meetings were finished, the data was transcribed and analysed individually by the lead author using inductive close reading and open coding to identify themes (Kennedy-Lewis, 2014). An analysis chapter was shared with members of the co-creation team at ARCOS for inputs and further co-creative discussion.</td>
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challenges brought by climate change. The lack of CBC integration meant that no practical climate actions were included in lesson planning.

**Challenges with School Feeding Programme implementation**

The increased severity and regularity of drought in the areas are causing decreases in income and food access and putting pressure on families. As one parent described: ‘Last season in 2022 there was a drastic sun time [drought], they didn’t harvest anything, they couldn’t feed their kids’. In 2019, the Government of Rwanda updated and approved the draft comprehensive School Feeding Policy and Strategic Plan (CNSFP) to pursue four specific outcomes:

Support education through enhanced learning ability: combined with quality education, the school feeding programme shall increase enrolment, attendance, cognition and contribute to learning, improve the nutrition status of school children by addressing nutritional needs and micronutrient deficiencies, provide a safety net for food insecure households; and enhance agricultural productivity by providing local farmers with a reliable and predictable market. (*Ministry of Education, 2021*)

However, several factors are impinging on its success. Ten discussions concerned lack of sufficient food as a problem in the schools and ‘too few ingredients’ to adequately provide meals for all learners. Due to local poverty (exacerbated by climate change) the inability of parents to act on their required contribution was regularly discussed; this led to a decrease in the overall budget for school feeding and consequent difficulty in affording sufficient quality ingredients. For example, in the six schools participating in our study, 1,301 out of 7,912 parents were not contributing to school feeding programme. According to staff in one school, almost 50 per cent of the learners were not eating at school due to the problem of affordability of fees. This issue compounds education barriers for those who do not receive adequate food at home, as noted by one student: ‘These students often fall asleep during class because of the fatigue they have’. In several schools, non-payment eventually leads to exclusion of learners and lack of parental contribution to the school feeding programme was mentioned in all schools as a cause of low attainment and drop-out. As one head teacher explained ‘Some students were dropping out because of some challenges related to the local lack of food. The students were not able to pay the school feeding’.

**Co-creation of Eco-Schools interventions and results**

The ARCOS interventions were designed according to challenges identified during co-creative sessions with learners, staff and parents guided by ARCOS staff. Given the common climate-change challenges experienced in Rulindo and Bugesera districts there are several similarities and common projects visible in each of the six participating schools. However, as the solutions have been co-created using local knowledge and expertise, there are variations and innovations within these projects, which have been developed based on specific issues such as soil erosion, high winds or prevalence of pests such as termites.
Co-created and tested ESD solutions included the initiation and operationalisation of a Green Learning Zone, a relatively small area of the school ground reserved to apply small climate-resilient actions, including seedling development and planting, waste treatment and management, kitchen gardens and small livestock farming with the target of creating entrepreneurship opportunities and outdoor learning opportunities. Each school has initiated about six model kitchen gardens in unused areas of the school grounds. The variety of plants included amaranth, cabbage, tree tomato, onions and aubergines, which were grown to support school feeding programme at schools, and some agroforestry trees surrounding the gardens which had some grafted avocados, mangoes, grevillea, markhamia and citrus from tree nurseries were established.

The following sections present an analysis of the co-creative dialogues held during follow-up visits to each school between the ARCOS research team, head teachers and teachers, as well as some parents and learners in July 2023, after a year since the start of ARCOS Eco-Schools implementation (Phase Four of the research).

**Role of the Eco-Schools programme in addressing barriers at the nexus of climate change (SDG 13), quality education (SDG 4) and the School Feeding Programme**

To address the primary problem linking food insecurity, household poverty and lack of contribution to the school feeding programme, climate-smart agriculture and permaculture projects (named kitchen gardens as one component of the Green Learning Zone initiated by ARCOS) were introduced. The gardens led to a large increase in the availability of fresh vegetables to supplement the RWF135 (Rwandan francs; equivalent to GBP0.08) daily allowance for each child. Three head teachers provided cost savings in figures, for example, ‘we have saved about RWF600,000 … we have not paid any francs for vegetables this term’; ‘For two months we didn’t buy any vegetables, maybe it might be like RWF500,000 saved’; and

The whole year they didn’t pay anything for vegetables, three terms! He was saying that per day we used 40 bags of vegetables and 1 bag can be 100 francs so per day they could need 4,000 francs per vegetables, and they saved the cost, the whole money from there was kept and was reused in buying other supplementaries like rice, pocho, potatoes, better quality food that can go hand in hand with the vegetables. So they appreciate it. They won’t stop. They won’t stop now they have got experience from this. (Head teacher)

The variety of fresh vegetables improved the nutritional value of the meals provided at school, as well as freeing funds to buy an improved quality and variety of starch to accompany the vegetables produced. The quantity of food now available in the schools because of the climate-smart agricultural micro-projects has also meant that schools are able to provide enough food for all learners. This has relieved the pressure on families who were unable to afford their school feeding contributions, the direct result being that those children who were previously not coming in, or sent home, are now able to return to school.
Due to the fact that they have the money to make their own field of vegetables they can tolerate those children that doesn't have the money. The students are not sent out because they do income compensation and they can recover the absence of money, and the drop-out had reduced because of that fact. (Parent)

Parents who are unable to pay but still wish to contribute are now even able to make in-kind contributions in the form of casual labour in the school vegetable plots.

They are using it in school feeding because for example if the government was offering 135RWF per day in primary school, so that is not much for the kids to be fed, and when the total amount of the kids was over [payments outstanding] the students should go out of the school feeding programme, that's how it was. But the parents are celebrating that the school is tolerating for that because they are getting the support from the green learning zones and kitchen garden. If the parent can come and give a day of casual work, of watering … but otherwise the whole year without having to buy vegetables is like a saviour to them because of the Eco-Schools programme. (Teacher)

Several parents attended the co-creative meetings at the schools and were able to provide their perspectives of the school feeding contribution of the Eco-Schools programme. Among the experiences shared, there was a dominant theme concerning relief among parents who may previously have struggled to provide a daily meal or school feeding contributions, and now were able to attend their own daily activities and work with improved peace of mind. The improvements in the school feeding programme made by the Eco-Schools projects and subsequent improved nutrition of learners and reduced pressure and responsibility of parents, were also directly linked by some teachers and parents to a change in the attitudes and general supportiveness of parents toward their children's education.

Due to the fact that the school has the school feeding programme they work safely. They know that their kids will be eating at school, they won't be coming home starving, so they work safely. And when the school needs their support they do it with good heart, with commitment because they know that their kids will be safe there, they will be happy to stay there, and they can work their daily activities without worrying about disturbance (Teacher/parent)

The schools highlighted the contribution of the Eco-Schools programme over and above the government school feeding scheme in supplementing, upgrading and improving equity in the availability and provision of food for all children within Eco-Schools, regardless of their family circumstances. One teacher suggested that the improved nutrition of the children because of the measures introduced for the Eco-Schools programme may lead to measurable impacts in terms of the children's growth and reduced stunting which is both a testament to her perception of the impact among her students and her own children, and a novel but potentially transformative suggestion for future Eco-Schools programme monitoring.
Role of the Eco-Schools programme in addressing barriers at the nexus of quality education (SDG 4), the Competence-Based Curriculum and climate change action (SDG 13)

Because Eco-Schools is foremost an education programme, there is a strong emphasis on the importance of integrating the climate action projects within curriculum learning. Training was carried out with both teachers and Eco-Schools committee members that included practical explanation of how the Eco-Schools seven-step framework can help to fulfil curriculum areas through project-based learning (Table 2).

Several teachers explained that while previously the CBC guidance requested that teachers adopt an LCP, without purposeful and substantial projects the teachers struggled to understand how to do this successfully. With the introduction of the climate action projects in the schools, however, along with the teacher training provided by ARCOS, they have managed to bring their teaching practices more in line with the LCP approaches of the CBC.

Before we used the knowledge, it was not competence, now ARCOS it helped us how to apply [the CBC]. We saw some trainings about the CBC, basically the programme, but now we have the experience from ARCOS we apply because now the students are involved in the activity, you give them the activities they can do, they are making some discussions in the groups, then they can form some … For instance, when we are teaching the sciences, geography, physics and biology and social studies in primary then they go there in nature. You can give them an activity related to nature and then they find the solutions. Then you help them to make a conclusion. It’s very easy now, it’s not like before. Before you take a book and you read to them … now today they can teach themselves and you are there as a facilitator, and you make a conclusion with them and they understood well what you are teaching. (Teacher)

Table 2: The Eco-Schools seven-step framework

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<tr>
<th>Step One: Creation of an eco-committee at each school including parents, teachers and students.</th>
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<td>Step Two: An environmental review is carried out by the eco-committee to identify problems and prioritise themes for action.</td>
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<tr>
<td>Step Three: All teachers are asked to find ways to refocus curriculum work around the key themes identified during the review. Teachers integrate the IVAC approach (Investigation, Vision, Action, Change) into the lessons plan and schemes of work.</td>
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<td>Step Four: Action plans are collaboratively developed with adaptation measures elaborated.</td>
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<td>Step Five: The planned actions are communicated to the whole school using eco-board and during student assembly before class every day. This step is very important as awareness on critical environmental problems is conducted, and each student can understand the extent and commit to contribute.</td>
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<tr>
<td>Step Six: The eco-committee and the whole school implement at least one adaptation micro-project. Ongoing monitoring and reporting offers an opportunity for students and parents to work together to review and make improvements.</td>
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<tr>
<td>Step Seven: The school adopts and shares an Eco-Code, which embeds their environmental commitments into school governance, practices and procedures.</td>
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An important barrier to quality education previously identified during the knowledge co-creation workshops for the TESF research programme included the lack of teaching aids available in classrooms. However, when this issue was raised with head teachers and other teachers during the discussions, the issue was dismissed. Their explanations stressed the new way of viewing nature and climate action projects as the teaching aids, and a new role for teachers in facilitating group work and enquiry.

The problem was of saying that we don’t have materials that could help us to touch … everyone was saying that if I want to count I need many balls to count, but now they know that they can even count trees, leaves … I count 1, 2, 3. So what Eco-Schools has helped in using the outdoor learning space as a tool as like a material. So what they were saying they don’t have sufficient teaching aids, so now the eco-system is becoming the teaching aids as they don’t have other supportive teaching aids. (Teacher)

The accounts given by these teachers also demonstrate some of the perceived benefits in terms of the improved comprehension and retention of the concepts being taught. Several expressed that this new teaching approach has removed the pressure on teachers due to classroom overcrowding and indiscipline, and therefore made their role easier.

When they are coming out they bring curiosity and they become attentive, they say ‘oh they are going to conclude the session, they are going to add on what we have been talking there outside’, so they come inside to follow up and with rested mind with a fresh mind, eager to be attentive to what has been said outside the classroom. (Teacher)

Perhaps most striking in terms of the follow-up discussions held in the schools were some of the descriptions given in terms of improved academic performance among the learners since the Eco-Schools programme had been introduced. For example, ‘past years they could have like 15 students who failed, but this year they are only having five’; ‘On average we are having 22 marks different, when even last year some failed’; and ‘The quality of education has been improved, they are saying they had 52 students do the exams, and 51 went to boarding school, and last year they didn’t have any’ (Teacher).

In trying to understand how the practical skills learned during through the project-based learning and climate action transferred to exam success, teachers highlighted the difference between knowledge that has been learned through rote learning or cramming style revision using textbooks, and knowledge that has been gained through practical involvement and experience.

When you are a teacher who is involved in the practicals of the Eco-Schools programme you recognise that kid. Because his answers are not theoretical, they are practical, he’s saying something and then you see that he is recalling what he has done, it is something different from what is written in the notes. He’s not answering the notes, he’s saying ‘this one
plus this’ because of what he’s seen, but you see the notes are written in another way. This kid is different from the one who has memorised the notes. (Teacher)

However, beyond academic performance and test results of learners, the greatest achievement of the Eco-Schools programme in terms of delivery of the CBC was described by several teachers in terms of a three-way connection between improved quality of life, gaining the skills to achieve it, and forming a deep contextual knowledge of what it means. For example, as explained by the staff members, later, clean water does not just appear, it comes with new skills to access it and understanding of how to use (and reuse) it. Food at school does not just appear, it is grown by the learners during lessons teaching nutrition and health.

Before there was a challenge, the challenge was some people don’t have a heart of love, they can bring water fetched anywhere, they can bring water in many forms, use it in their home without considering where is that water coming from. So after getting those tanks to catch water from the rain this had a good impact educationally in their success, even in the well-being of their students, we know where the water that we use is coming from instead of knowing that, this one bring water that is black water, this one bring water with some materials we don’t know, then when we put them together it is chemistry which was causing some disease for the students. (Head teacher)

Other impacts at the nexus of quality education (SDG 4) and climate action (SDG 13)

Aside from direct impacts happening within the schools in terms of support and integration of the school feeding programme and CBC, indirect impacts are being seen which are affecting learners and their families, ultimately contributing to the dual aims of SDGs 4 and 13. In a similar way to the indirect negative impacts of climate change (Sims, 2021), these changes could potentially have longer-lasting positive effects than those direct impacts being experienced in school.

Improved confidence and self-esteem

Difficult to assess during an exam, but nevertheless an important impact expressed by several of the teachers, is an improvement being seen in the confidence of learners due to the new inquiry-based forms of learning taking place.

The students are the ones who present what they learned in the field, they see what’s going around, they see the changes, they see the degradable and biodegradable, if it is that assessment they have, they make a small report, after making that report they are the ones to present, and the teacher is there to compliment. And you see it makes self-esteem, self-confidence, to be confident that they are capable to express what they have found in front of others. The concept that every kid can be able to express his
Here there were some interesting discussions based on how learners of both genders are differently responding to the Eco-Schools programme. While it was expected that, in common with Rwandan culture, the boys would take the lead on project implementation and reporting, several schools mentioned that it was in fact the girls who are flourishing through involvement of climate action projects. One teacher identified a need for more research to understand the different effects of the Eco-Schools programme between girls and boys.

About this issue of gender, from my point of view even in our club or our Eco-School parliament we have mixed, we have a voice in each group. When we get an activity, an Eco-Schools activity because on Friday we do an activity, we see that the performing students are girls, we need the research, we have pairs, boys and girls in each class, but only the girls do the activity in our club, in the creativity of the songs, the competitions, the girls comes first. (Parent)

The confidence seen in the learners, combined with their improved academic performance and better nutrition and health, along with the amenity improvements clearly visible in the school grounds overall create a new sense of pride that was clearly expressed in all the schools. The schools articulated this pride together as a mission or vision for the school, behind which the leadership, staff and students can unite, and towards which the projects can be developed that both deliver climate action and improved health, and provide a vehicle for the CBC.

We see it in the presence of the students, last year some dropped out, there are early pregnancy for females, but nowadays the bad attitude has changed, they like this school, they see that school excel in all, in the sports results, at the national results. Even our teachers they are regularly at school. Even me when I hold a meeting with the teachers I say ‘It’s me who arrives early at school, it’s me who goes back late, so you have to be like me’. So we have a vision as the Eco-School has taught us, IVAC investigate, vision, action, change, that vision helped us to lead and to have a vision of the school. (Head teacher)

**Replication of agricultural projects at home**

Since the Eco-Schools implementation in Rwanda, 31,000 parents and community members have trained and replicated waste management practices, tree-planting, vegetable gardening and greening activities at their farms and around their homes. The replication of agricultural projects in the communities around the schools demonstrates that the learning in schools is relevant and effective, and therefore provides an important marker of the success and progress of the Eco-Schools programme. Replication is initially expected via learners who are able to transfer
learning directly from school to home, and in doing so improving their health and nutrition at home as well as school:

Parents are informed because we have formed the Eco-School committee to balance the students, teachers and parents near the school. The parents use the kitchen gardens in their homes, they plant some vegetables in their gardens. They grow some vegetables and some fruit trees in their home. (Parent)

The students have been educated for how they can do that, how to practise it at their home, so it’s very important for our students, we think how can we spread that for fighting malnutrition, in order to educate them, to educate our parents, how we can do, and what the benefit is for that, it is very important for us to help them in order to fight that malnutrition at home. (Student)

Alongside the new partnerships forming between schools and parents regarding the role of Eco-Schools in school feeding, the involvement and training of parents within the Eco-School committees in each school further ensures the transference of new agricultural and climate action techniques between homes and communities. Parent meetings and general meetings held regularly provide further opportunities to see the projects and learn the skills, and one school discussed the use of the Green Learning Zone school as a demonstration model for wider community members. This role of helping schools to become local hubs for lifelong learning is an important factor in achieving local transformation through the Eco-Schools programme.

So the eco-committee is the committee that combines parents, students and school leadership. So they meet, they make some eco-committee meeting, they assess the things that have been given by the school parliaments, and they look about the solutions together, and if they decide to do something they do it together. So you see it is like a committee which brings the stakeholders together if I can say that. So this eco-committee it has three parents, they are the ones to teach the other committees of the school, with 17 parents, there are 20 altogether who will disseminate the knowledge to the other parents. So it is like a channel, they start with few. (ARCOS Staff Member)

However, the Eco-Schools learning taking place between schools and parents is not a one-way process, as parents are also bringing their own skills and knowledge of local and traditional farming methods into the schools. The incorporation of Indigenous knowledge and practices offered several contextual solutions to environmental issues being encountered; for example, in one school parents taught students to plant seedlings together with *Euphorbia turcali* in order to reduce termite attack. Another notable example was the new establishment of a medicinal garden at the school intended to reinvigorate the traditional knowledge of beneficial herbs and natural remedies: ‘A parent was the one who taught the school to make the kitchen garden. And the parents who didn’t know that skills came here to learn from the students’ (Teacher).

During the conversations several teachers and parents emphasised a change that has occurred in the attitude and improved follow-up of parents to their children’s education. The reasons given varied from value of the school feeding programme,
and increased presence at school due to involvement in the Eco-Schools committee or general assemblies, as we have seen. There was also a link made to the parents’ involvement in the TESF project and trainings received after lack of parental support and involvement was identified as a barrier to quality education at school. Both parents and teachers gave examples of how the increased parental support for children has resulted not only in better support to schools, but also in particular the academic performance of the learners.

Due to the fact of the eco-committee I do a follow-up on my kids. Because whenever they call me that my kid is not performing, I come to school and see what is going on. The other time I was not involved I was thinking that it is not that important to go to school and make a personal follow-up of my kids, so I had a student who could be like 20th, another one was 28th, now one is 10th, another one is 12th, 10 students in front! (Parent)

Discussion – Eco-Schools Rwanda and ‘the triple crisis’

The UN has identified a dramatic triple crisis of inclusion, quality and relevance, which our findings support. This research project particularly addressed the intersection between climate change (SDG 13) and quality education (SDG 4), exploring how climate change impacts and poor conditions in schools are contributing to this triple crisis, and conversely how the integration of climate action projects through project-based learning in the six schools can reverse the cycle, producing better quality education. In this section the findings will be discussed alongside the UN’s triple crisis, and within each crisis the mechanisms at work through the Eco-Schools implementation and their impacts will be elaborated.

The findings of this research have confirmed challenges of low attendance and drop-out in six schools as described in literature (Nizeyimana et al, 2020). However, the knowledge co-creation processes in the schools have revealed deeper causal factors underlying negative experiences of teaching and learning in schools. While this study encountered a variety of education and environmental challenges contributing to low attendance and drop-out, including overcrowding, insufficient school materials, lack of parent support, malnutrition and ill health, it also found that these challenges are all exacerbated both directly and indirectly by climate change. For example, overcrowding in schools is made worse by teacher absenteeism caused by stress, ill health and poor working conditions (all of which are made worse during drought or extreme weather). Parents whose incomes are suffering due to poor harvest caused by drought or heavy rainfall are less likely to afford the materials needed for their children’s schooling. Lack of food and water scarcity is affecting the health, energy and concentration of learners in classrooms, and natural disasters damage school infrastructure and interrupt schooling. This research also revealed a paradox within education policy implementation happening in the schools. This is that while the school feeding programme was introduced to ensure every child receives a meal at least once a day, improving nutrition, concentration and enrolment, all the schools in our study experienced problems with non-payment of parent contributions to the school feeding programme with subsequent non-attendance, exclusion or drop-out.
The introduction of measures designed to address climate change impacts in the schools therefore has had a significant impact on education inclusion. Evidence provided by schools has shown that the establishment of climate-smart agriculture in kitchen gardens, improved sanitation through rainwater handwashing stations for example, or tree-planting for shade, has directly impacted the comfort and health of learners, reducing absences caused by illness and improving concentration in class, and also increased their willingness to come to school through improving the variety and taste of meals, and improving the general conditions and amenity value of the school. Of particular importance is the focus of these climate action projects on supplementing the school feeding programme, meaning that schools can reduce or remove the burden on families who are not able to afford their contributions, and these learners can return to school.

The knowledge co-creation processes also revealed a strong will in schools to overcome education challenges, and the teachers who had received training on the CBC tended to support the premise of LCP. With bare spaces and few natural features in school compounds, what the teachers lacked was the substantial and purposeful projects, engaging outdoor spaces, ideas and specific technical knowledge to successfully implement the CBC approach with their own classes. The supported introduction of climate action projects and training provided by ARCONS on their use as project-based learning within the curriculum is therefore providing a vehicle for the LCP approaches required for teachers to transition to the CBC. Teachers repeatedly spoke in transformative terms of the changes in their teaching approach since the introduction of Eco-Schools, and the subsequent impact on the learning, knowledge retention, confidence and attainment of their learners. Striking also were the accounts from parents who, through involvement and training in the Eco-Schools committee and climate action projects, are re-evaluating and supporting their children’s education. Parents are coming to school more regularly to contribute practical help and technical knowledge and increasing follow-up with teachers regarding their children’s progress in class.

The level of transformation being seen in teaching and the increased role and responsibility being taken by parents mean it is possible here to draw a comparison between the impacts being seen through ARCONS’s implementation of Eco-Schools, and the emancipatory vision expressed in UNESCO’s Reimagining Education report whereby pedagogy and assessment are reorganised around the principles of cooperation, collaboration and solidarity, and learning involves diverse groups of people in exploring challenges and possibilities (ICFE, 2020).

This knowledge co-creation project has found that, operating at the intersection where climate change challenges are interrupting delivery of quality education, the Eco-Schools programme is managing to reverse some of the cycles to address the crisis of relevance in education. In a problem-based process whereby priority local challenges are identified and addressed through research, collaboration and innovation, schools are also teaching skills, knowledge and values needed to address climate challenges, and improve their students’ quality of life and livelihoods beyond school. Even after just one year of implementation, it was clear during the research that learners and parents are finding a new value and relevance in education. This is manifesting in the replication of projects leading to better health and nutrition at home, increased presence of parents at school, and improvements in the learners’ classroom and examination performance.
Conclusion

The ARCOS knowledge co-creation project aimed to gain a shared understanding of the challenges that are currently preventing the successful implementation of the CBC in Rwandan schools and co-create solutions using the Eco-Schools PBL methodology. In line with emancipatory ESD approaches, the research used a relational knowledge co-creation methodology that engendered open and deliberative discussions during interviews and focus group sessions.

The findings provide real-life Rwandan context for what has been described as a triple education crisis (UN, 2023). The challenges identified were broadly consistent with literature from Rwanda and across the East African region and beyond (Nzabalirwa and Nkiliye, 2012; Ndihokubwayo and Habiyaremye, 2018; Nizeyimana et al, 2020), which identify deficiencies in teacher resourcing, training and morale, linked to classroom overcrowding, poor concentration, attendance and attainment among learners, and lack of parent support. This research also found that these problems are all closely related to, and exacerbated by, the increasing severity of climate change in multiple direct and indirect ways. Ultimately, the challenges posed by climate change to learners, schools and families, particularly in the areas of water, food and poverty, are directly affecting the ability of schools to provide a quality education due to poor conditions, hunger and ill health. The negative relationship happening at the intersection between climate change and quality education is interrupting successful implementation of both the CBC, and the School Feeding Programme policies of the Government of Rwanda and affecting national progress toward SDG 4 and SDG 13 through education.

However, by integrating PBL into the CBC teaching and learning practices and involving parents and wider community members in the co-creation of climate action solutions to address priority education barriers, the Eco-Schools programme can support schools to simultaneously address the triple crisis of inclusion, quality and relevance in the schools. In the six Rwandan Eco-Schools this also succeeded in expediting implementation of both the CBC and the School Feeding Programme, with immediate and highly visible impacts on education quality and climate resilience in the schools. Further mixed-methods research which includes some quantitative data collection is recommended to analyse the anecdotal evidence given of cost savings, attendance improvements, reduced dropout and improved academic performance. As advised in the schools this should also include analysis of variation between boys and girls, and also some metrics around growth and health.

The research findings suggest that the knowledge, values and skills being learned through this education transformation is consistent with UNESCO’s relational vision of education as a ‘new social contract’ (ICFE, 2020). The conclusions of this research therefore oppose views that the Reimagining Education report is idealistic, utopian, and not grounded in reality (Carney, 2022; Elfert and Morris, 2022; Stanistreet, 2022). On the contrary, the changes happening in the six schools through Eco-Schools programme implementation are showing that it is possible to transform education in even the most challenged schools, at a relatively low cost, within a very short space of time (one school year) and without large-scale curriculum reform or infrastructure. Ultimately the findings of this research promote wider, more positive and optimistic progression towards education transformation through the emancipatory and relational
vision of ESD, and related GEP targets. The research proposes a new paradigm around the ‘third relationship’ between climate change and quality education which might be called ‘climate action to enable quality education’.

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**Conflict of interest**
The authors declare that there is no conflict of interest.

**References**


Climate action to enable quality education


