

Chapter 21

The Role of Informal Education in Climate Change Resilience: The Sandwatch Model



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Abstract This paper explores the role of informal education in enhancing climate change resilience for beach and coastal systems using a multi-stakeholder approach called the Sandwatch programme. Sandwatch is an action-oriented, volunteer network working to enhance beach environments using a tried and tested pedagogical approach called MAST—Monitoring, Analysing, Sharing, Taking action. School students and community members learn and work together to scientifically monitor their beach environments, critically evaluate the problems, share their findings, and design and implement sustainable activities to address the issues, enhance the beach environment and build resilience to climate change. Sandwatch is an informal education tool, often conducted as an extra-curricular activity in school settings. In 2014, at the end of the United Nations Decade of Education for Sustainable Development, Sandwatch was recognized as one of 25 success stories from around the world of education for sustainable development practices in action. In 2017, an impact assessment of the Sandwatch programme was conducted using a flexible tool, the “most significant change” technique. Analysis of long-running Sandwatch programmes from nine countries showed: (i) the importance of using a participatory approach that includes hands-on learning outside of the classroom; (ii) evidence of different ways in which learners had been empowered such as by adopting a natural resources management career path; and (iii) the outreach potential of the Sandwatch programme to take action for sustainable development and enhance climate resilience.

Keywords Beaches · Conservation · Education for sustainable development · Most significant change · Extra-curricular

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Introduction

This paper presents the Sandwatch programme, which started in 1998, and in 2014, at the end of the United Nations Decade of Education for Sustainable Development (DESD), was recognized as one of 25 most successful projects from around the world showing education for sustainable development (ESD) practices in action. The paper discusses the impact of the Sandwatch programme and its role in building climate change resilience.

The Sandwatch programme provides a framework for children, youth and adults, with the help of teachers and local communities, to work together to measure the changes in their beach environments using a standard methodology, and then critically evaluate the problems and conflicts. They then design and implement activities such that beach environments become more resilient to climate change. The programme consists of a network of action-oriented, volunteers, teachers, students and communities, coordinated by the non-profit Sandwatch Foundation, and supported by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) and other development partners.

Education for Sustainable Development

In December 2002 the United Nations General Assembly proclaimed the United Nations Decade of Education for Sustainable Development (2005–2014, DESD). Following that UNESCO was announced as the designated coordinator of the Decade. The vision for DESD was described as “a world where everyone has the opportunity to benefit from education and learn the values, behaviours and lifestyles required for a sustainable future and for positive societal transformation” (UNESCO 2006). The way forward to a sustainable future for the planet was intertwined with education and the DESD was planned to tackle it head on.

The DESD was characterized by two different phases. From 2005 to 2008 efforts were focused on defining and promoting ESD, identifying and working with activities already taking place and developing monitoring and evaluation mechanisms. Phase two, 2009–2014, encompassed advancing ESD in the context of quality education. UNESCO shifted the focus of ESD to three sustainable development issues which would be addressed by education. The issues were climate change, biodiversity and disaster risk reduction (UNESCO 2014).

Extensive materials exist as a result of the DESD and the wealth of knowledge gained, shared and transformed was extremely significant. In 2007, UNESCO created a Monitoring and Evaluation Expert Group and they commissioned a review, to date, of processes and learning for ESD. Tilbury’s (2011) review upheld that learning within the framework of ESD was about:

- Learning to ask critical questions
- Learning to clarify one’s own values

- Learning to envision more positive and sustainable futures
- Learning to think systemically
- Learning to respond through applied learning
- Learning to explore the dialectic between tradition and innovation.

In order to address sustainable development issues such as climate change, sustainable consumption, disaster risk reduction, among others, “ESD requires participatory teaching and learning methods... to empower learners to take action for sustainable development” (UNESCO 2014, p. 20).

Climate Change

Climate change is one of the most serious threats to sustainable development around the world. Evidenced by a slow, gradual upward rise in air and sea temperatures since the industrial revolution in the 1700s, now in the 21st century climate change is impacting all aspects of human society and natural systems.

Understanding and concern about climate change has been evolving since the 19th century (Bhandari 2018) as the scientific evidence pointed toward the fact that human-caused greenhouse gas emissions were influencing the global climate. But it was not until 1992, that the United Nations Framework Convention on Climate Change (UNFCCC) was adopted at the Earth Summit in Rio de Janeiro, and subsequently ratified in March 1994. A few years prior to the adoption of the UNFCCC, in 1988, the Intergovernmental Panel on Climate Change (IPCC) was created by the World Meteorological Organization and the United Nations Environment Programme. The objective of the IPCC is to provide governments at all levels with scientific information that they can use to develop climate policies. Among other, roles the IPCC produces assessment reports on changes in climate every 4–5 years.

The 5th IPCC Assessment Report presents unequivocal evidence for warming of the climate system and that many of the observed changes are unprecedented over decades to millennia (IPCC 2014). The report further states “Continued emission of greenhouse gases will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems” (p. 8).

In many small islands and coastal areas, climate change is impacting the environment through rising temperatures, varying rainfall patterns, changing wave energy, increased magnitude and frequency of extreme weather events, ocean acidification and rising sea levels.

History of the Sandwatch Programme

Figure 21.1 shows some major milestones in the evolution of the Sandwatch programme between 1998 and 2017.

Sandwatch was developed as an open access programme, and all the tools are freely available on the website so that any group can implement Sandwatch. The Sandwatch methodology (MAST) uses simple, easy to use measurement techniques that require little to no equipment and can be done by people of all ages and backgrounds.

1998–2005

Sandwatch can trace its early beginnings to an environmental education workshop held in Trinidad and Tobago in 1998, organized by UNESCO. The workshop participants, teachers and students, saw first-hand the problems facing their beaches—erosion, pollution and poorly planned development—and proposed a Sandwatch project to address the problems. At this time, one of the preliminary objectives of Sandwatch was to make science interesting for students and one way to do that was by taking principles learned in the classroom and applying them outside the classroom on the beach (Cambers and Ghina 2007). Sandwatch can be envisaged as a multi-disciplinary programme that can be integrated into any discipline, a science class, a language class, a social studies class, an art class or developed as an after-school activity.



Fig. 21.1 Major Sandwatch events 1998–2017

Beginning in 2001 with a regional workshop held in Saint Lucia, teachers and students from 18 Caribbean countries were trained to use simple, standardized methods for the measurement of beach changes including erosion and accretion, wave and current action, water quality, beach ecology, pollution and human activities that impact the beach. During this first training workshop, a specific methodology involving four steps was adopted: (i) Monitoring beach changes; (ii) Analysing the data; (iii) Sharing information with communities; and (iv) Taking action to address issues affecting the beach (MAST). MAST has become the foundation of the Sandwatch programme.

An example of the use of the MAST methodology is exemplified by a Sandwatch primary school team located in the Bahamas. Students, with the help of their teachers, measured the beach over several months, and after analysing their data they concluded one of the main issues impacting the beach was tourists standing on top of a small patch reef and damaging the corals. The students then conducted a questionnaire survey to determine visitors' views about the beach and the reef and worked with a local environment group to design a brochure on proper reef etiquette, which was distributed to nearby hotels and rental properties (Cambers et al. 2008b).

As Sandwatch progressed, teachers and students addressed many different beach issues including erosion, pollution, beach littering and the illegal placement of coastal structures. Teachers also began applying some of the Sandwatch methods to their formal teaching of the curriculum, e.g. in Cook Islands, aspects of the Sandwatch MAST methodology were integrated into the science and social science curricula (Cambers et al. 2008a).

2006–2015

The Sandwatch programme, which had started as an environmental education programme, further evolved alongside two major historical developments, (i) the 4th Assessment Report of the IPCC (2007), which presented unequivocal evidence about the cause of observed climate change and resulted in the award of the Nobel Peace Prize to Al Gore and the IPCC for "... their efforts to lay the foundations for the measures that are needed to counteract such change" ("The Nobel Peace Prize" 2007); and (ii) the DESD, "a global movement which seeks to transform education policy, investment and practice" (Tilbury 2011, p 7).

The 4th Assessment Report of the IPCC and the emerging global importance of climate change inspired a revision of the Sandwatch manual to integrate climate change adaptation into all chapters and activities, and the manual was retitled: *Sandwatch: adapting to climate change and educating for sustainable development* (Cambers and Diamond 2010).

Since the revision of the manual in 2010, Sandwatch groups have explored the relationship between healthy coastal environments and the adverse impacts of climate change. An Australian Sandwatch group began exploring ocean acidification. Students collected a range of materials from the beach including shells, sand, limestone and granite rock and treated them with acetic acid (vinegar). All samples containing calcium carbonate reacted with the acid and produced bubbles of carbon dioxide gas. This prompted the discussion about how increasing ocean acidification, a result of

carbon dioxide dissolving in the ocean, may affect marine organisms, local fisheries and the global food chain (Wilson 2013). An exchange with a visiting student from a small Pacific island atoll country, Kiribati, heightened the students' understanding of the impacts of climate change (including sea level rise and ocean acidification) on people living in low-lying island countries.

At the end of the United Nations Decade of ESD (2005–2014), a survey was conducted by UNESCO to identify good practices and success stories in ESD. Sandwatch was identified as one of 25 success stories of ESD practices in action and showcased at the World Conference on Education for Sustainable Development (ESD), in Aichi-Nagoya, Japan from 10 to 12 November 2014 (UNESCO 2014).

Sandwatch tools include a methods manual which was first created in 2001, revised and published by UNESCO in 2005, and further revised and published in 2010. The manual is available online in English, Spanish, French and Portuguese. Other tools include training videos in English and Spanish to accompany the methods manual, the Sandwatch website (www.sandwatchfoundation.org) and newsletter, and the Sandwatch International Database and its training videos. These tools have been created with funding from UNESCO, along with other partners such as the University of Puerto Rico—Sea Grant College Program and the Government of Denmark.

The MAST methodology has been applied to other environments e.g. deserts (Yembuu et al. 2016). In 2014 the Sandwatch methodology was incorporated into a UNESCO education course “*Climate change education inside and outside the classroom*” and delivered to participants in four regional workshops in Africa, Caribbean and Pacific regions, (UNESCO and Sandwatch Foundation 2014).

The explosive growth in communications technology and social media globally over the last 15 years helped expand the outreach of the Sandwatch programme. In the early 2000s Sandwatch launched a global communications strategy leveraging the emergence of affordable access to the internet in small communities around the world. Initially utilizing email, simple website design, and desktop publishing, Sandwatch was able to recruit and empower numerous small community organizations and demonstrate to them the ease in which they could quickly develop a truly global audience and initiate mutually beneficial partnerships.

Sandwatch has continued to expand and develop its digital communications strategies and most importantly share such skills with partners around the world via regional workshops and seminars. This includes the use of tele-conferencing, video editing programmes, the use of social media forums (Twitter, Facebook, YouTube) as well as a host of other applications and online utilities. In addition, assistance is provided with traditional media such as authoring news articles, press releases, grant applications and finding local sponsorship opportunities.

Methodology to Assess the Impact of the Sandwatch Programme

With the Sandwatch programme approaching the two-decade mark of implementation, it was timely to try and assess the long-term impact of Sandwatch so as to plan for the future development of the programme.

However, while the MAST methodology for measuring and analysing changes in the beach environment is standardised, assessing the contribution of Sandwatch to ESD in the context of climate resilience is extremely complex. The uptake of certain learning skills can be assessed, e.g. using a compass to measure and understand changes in wave direction and how this impacts the movement of the sand, and then applying that learning to the understanding of mathematical functions. But ESD is about education for living, empowerment, leadership skills, citizenship, listening to others, conflict resolution in complex situations and so much more. Standard quantitative assessment methods, such as logical framework analysis, and indicators such as the number of active ongoing programmes, or the number of students trained, just did not address the diversity of Sandwatch or the complexity of ESD.

It was important to try and assess the impact of Sandwatch on those involved in the programme, whether students, teachers or other involved persons. One major constraint was that there was no funding available for the assessment, so any method selected had to be through self-evaluation. After reviewing various methodologies, the most significant change (MSC) technique was selected to evaluate Sandwatch. This technique is a qualitative and participatory form of monitoring and evaluation, based on the collection and systematic selection of stories of reported changes from development activities. The technique was developed to meet the challenges associated with monitoring and evaluating a complex participatory rural development programme in Bangladesh, which had diversity in both implementation and outcomes (Davies 1996). Since then the technique has been extensively used especially in developing countries (Davies and Dart 2005; Serrat 2009).

The methodology involves the collection of significant change stories from the field operators, and the systematic selection of the most significant of these stories by panels of designated stakeholders or staff. The designated staff and stakeholders are initially involved in searching for project impact and the selection process progresses through several different levels so as to identify the most significant stories.

Starting in April 2017, the MSC technique was applied to the assessment of the Sandwatch programme. The Sandwatch Foundation contacted Sandwatch champions in 18 countries with individual emails to ask if they would like to contribute stories about how Sandwatch has brought about positive change in their country. They were asked to have a discussion with their Sandwatch teams to identify the most significant change brought about by Sandwatch over the past three to five years. A simple template was provided with five basic questions:

WHAT was the change?

WHO was involved?

WHEN did it happen?

WHY is it significant?

WHAT was the impact of the change and why is it significant?

Over the course of five months ten stories were received from nine countries: Australia, Bahamas, Cape Verde Islands, Cuba, Kiribati, Madeira, Puerto Rico, St. Vincent and the Grenadines, Trinidad and Tobago. A matrix was developed identifying for each story, the identified change(s), their impact, and why the group considered them to be significant. The matrix was analysed by a team from the Sandwatch Foundation. The individual stories are available on the Sandwatch Foundation website at <http://www.sandwatchfoundation.org/most-significant-change-stories.html>.

Results and Discussion

The most significant change stories were inspirational and provided valuable insight to the wide reach of the Sandwatch programme. Major themes emerging from the stories reflected the power of reaching out to other groups, changing attitudes to the environment, influencing the way education is perceived and delivered, and inspiring students to adopt environmental career paths. These themes all reflect realisation of the Sandwatch vision “*Sandwatch seeks to change the lifestyle and habits of children, youth and adults on a community-wide basis, and to develop awareness of the fragile nature of the marine and coastal environment and the need to use it wisely*” (Cambers and Diamond 2010).

For the purposes of this discussion, the stories are presented and discussed using the major outcomes of the DESD: participatory teaching, empowering learners, and taking action for sustainable development, as stated in the final DESD report “ESD requires participatory teaching and learning methods ... to empower learners to take action for sustainable development” (UNESCO 2014, p. 20).

Participatory Teaching and Learning Methods

The Sandwatch approach requires going out of the classroom, into the field and experiencing the natural environment at the beach. In some countries, from a formal education perspective, this approach is met with resistance due to the significant extra work required for obtaining the necessary permissions, arranging transport, and consideration of safety issues.

The story from a primary school teacher in Trinidad and Tobago illustrated the importance of participatory, hands-on learning outside the classroom and that this also requires confidence building for the teachers.

I have been exposed to this programme for just about three years now and I can say that I have changed immensely due to this programme. From my experience of doing beach clean-ups, I have learnt the importance of keeping the environment clean and the impact of

pollution to life on earth. I have also seen hands on learning taking place, as students are actively involved in activities. I now see things differently and think differently as I am more confident and empowered to participate in activities and speak out at things that are wrong. I have learnt and adapted new and innovative teaching techniques. I have also learnt that education goes beyond the traditional paper and pencil technique.

Mrs. Ali, Teacher at Mayaro Government Primary School, Trinidad and Tobago.

Many of the other stories also touched on the necessity of demonstrating to concerned parents, teachers and school principals that education goes beyond the four walls in the classroom. In the beginning many parents considered the beach as an environment to have fun and not a learning environment, but gradually this resistance was overcome as Sandwatch demonstrated the importance of new and innovative teaching techniques, particularly engaging students through hands-on learning. In some countries where field visits were too difficult to arrange, interested teachers and Sandwatch champions implemented Sandwatch activities as an extra-curricular option, e.g. through environmental clubs.

The significant change story from Australia showed how the Sandwatch approach helped students set global issues such as climate change in their local and regional contexts. At the start of the implementation of the Sandwatch approach, students became more aware of local issues relating to the coast including littering, vegetation damage from pedestrians, and erosion events relating to storms. The local issues were then used as a lead-into global issues such as climate change and sea level rise and how these could affect local beaches. The school then linked up with a school in Kiribati and with the help of a locally based Kiribati student discussed everyday life and culture in Kiribati including issues that this low-lying atoll nation faces under projected climate change scenarios where the highest point is only 3 m above sea level. This exchange strengthened cross cultural experiences and fostered a greater understanding about people whose homes and lifestyles are now under immediate threat due to climate change. It also encouraged students to think about climate change issues at the global level and how they could respond to those issues. Energy conservation ideas for the home were among the responses that could be implemented at an individual level and so contribute to the mitigation of climate change.

Overall the stories emphasised the value of direct interaction with the natural environment and the importance of interacting with other Sandwatch groups and communities from other countries. Regional and international conferences have been very popular with the Sandwatch community, and exchange visits have also been beneficial. The Sandwatch group in Trinidad and Tobago have organized exchange visits with schools in Brazil and the UK, which have enriched the students' global and cultural experience of the world as well as the reach of the Sandwatch programme.

Empowering Learners

Several of the stories from countries where the Sandwatch programme has been operational for ten or more years, including the Bahamas, Puerto Rico, St. Vincent and the

Grenadines, and Trinidad and Tobago, highlighted how the Sandwatch programme had inspired students to choose environmental conservation in their further (tertiary) studies and career paths.

One of these stories from a student in Puerto Rico showed how participation in the Sandwatch programme had influenced her career path. This story was particularly insightful, showing a depth of understanding about the need to understand psychology to motivate other people to conserve the environment.

I have loved everything ocean-related since I was little. Once I started working on the Sandwatch programme, I saw the ocean from a different perspective. I don't simply go to the beach anymore and see how fun and beautiful it is; now I pay more attention to details that changed from one visit to the next. My love for marine ecosystems also grew, and lit a passion inside me for protecting the environment. The Sandwatch programme experience led me to become interested in oceanography as an academic career path. I entered the University of Puerto Rico at Mayagüez in the Geology major, intending to continue my studies along the marine geology path, following that passion for environmental protection. However, during my time in the university, I realized that the only way to preserve nature is by educating others. This made me want to dedicate myself to the education field, but from a different perspective. I changed majors and am currently studying psychology with the end goal of specializing in educational psychology. The objective is still the same: save the ecosystems, but this time, I will reach it by helping create a generation more conscientious about the environment. In the future, I hope to have my own school, with my own educational system, in which I'll foster education through projects like Sandwatch, in which children learn by having the most direct contact possible with nature.

Nayrobie Lee Rivera Estévez, Puerto Rico.

Empowerment has many different components. The story from Trinidad and Tobago described how the Sandwatch programme has empowered many young people to become leaders and confident individuals able to take their knowledge and experience beyond their classroom environment, and beyond the context of Sandwatch, for example, having the confidence to judge the secondary schools' environmental debate competition.

The Sandwatch programme has also been taken up at the postgraduate level. The story from Cuba described how one educator from Cuba had applied his 16 years' teaching experience with Sandwatch to his Ph.D. research and had made several presentations at conferences and seminars on the role of environmental education and secondary school students

The Sandwatch project has allowed me in these 16 years, to learn new knowledge on the pollution and erosion of the beaches, to use different instruments, to meet personalities in this field, and to initiate myself in the world of research. In addition, I have worked with groups of different students and shared the experiences so that students and parents have undertaken actions to conserve and protect the beaches, an ecosystem that the new generations must protect.

Dr. C. Raudel Cuba Jiménez—Escuela Provincial Pedagógica de Matanzas.

Taking Action for Sustainable Development

The Sandwatch methodology (MAST) with its focus on taking action to conserve the beach environment based on monitoring and analysing the beach changes, and then sharing the results with the local community, has inspired generations of students, parents, teachers and community members to join young Sandwatchers in taking positive action for sustainable development.

Many of the Sandwatch groups addressed the problem of littering and pollution by conducting beach clean-ups. For example, in Madeira, in the North Atlantic Ocean, off the coast of Portugal, the Sandwatch groups' clean-up efforts inspired other schools, hotels and resorts to carry out similar activities on their own, and they were further supported by the local council and private businesses.

In the Caribbean, Sandwatch students in Bequia, in St. Vincent and the Grenadines, expanded the beach clean-up concept to community clean-ups. While in Kiribati, in the central Pacific, after seven years of focusing Sandwatch activities on primary and secondary school students, attention turned to a specific community where the beach was extremely polluted and had become a dump for scrap vehicles.

In recent years the issue of plastics polluting the oceans has received widespread publicity. More than 30 years ago a coastal clean-up programme was started in the USA and spread to become the International Coastal Clean-up programme (Ocean Conservancy 2011). Not only did this programme focus on coastal clean-ups, but also on categorizing and recording the different types of debris found, so that its origin could be determined and efforts could be focused on the cause of the problem—the polluters. This programme and its methodology was adopted to become one of the standard methods conducted by Sandwatch groups, and is included in all editions of the Sandwatch methods manual. Many Sandwatch groups also take part in the annual international coastal clean-up, as well as their own individual and national events. During the first Sandwatch competition in 2005, students from a secondary school in St. Lucia identified pollution from the nearby Choc River as a major issue resulting in high levels of debris and pollution on the beach. The group focused, not only on cleaning up the debris, but more importantly trying to influence the attitudes of the residents living near the Choc River and others who were dumping their garbage in the river.

The stories demonstrated other ways in which the Sandwatch programme had reached out to others to take action. Sandwatch in western Australia is led by a conservation organisation. This organisation recorded increased participation by families from the school involved in the Sandwatch programme in weekend “*Coastcare*” events, highlighting the level of understanding and the importance those families now place on coastal conservation actions.

Sandwatch students in the Bahamas and their coastal community saw for themselves the benefits of replanting natural vegetation such as sea oats to stabilise eroded sand dunes as several hurricanes impacted the island over a period of years.

Conclusions

Results from the Sandwatch impact assessment show that in today's advanced technological environment, Sandwatch is still relevant, perhaps more relevant than it was 20 years ago, as it requires individuals, students and teachers going outside of the controlled classroom or office setting, and experiencing and understanding first-hand the infinitely complex, natural environment in which we live and interact. The most advanced physical and mathematical climate and environmental models in the world cannot do full justice to that complexity.

The role of education for all in addressing the challenges of climate change cannot be over-emphasised. Climate change affects every person and every aspect of our lives, our health, what we eat and drink, our very survival. On our crowded planet, the framework of ESD presents a comprehensive approach to addressing the issues and making the required behavioural changes. Sandwatch, along with other programmes, has a continuing and leading role to play to creating positive change in both the informal and formal educational system such that we all become part of the action that needs to take place.

The results from the Sandwatch programme's most significant change stories have clearly demonstrated the value of participatory teaching and learning methods, and how the use of such methods is empowering learners of all ages to take action for sustainable development.

The main objective of the impact assessment was to plan for the future development of the Sandwatch programme and one of the main learnings is to harness the pool of experience and knowledge from the generations of students, who have passed through the Sandwatch programme and are now young adults, in how to move the Sandwatch programme forward.

One of the first proposed actions is to expand the collection of most significant change stories from past students who have been involved in Sandwatch over the past five years. Then, depending on obtaining the necessary funding, regional consultations can be held, to brainstorm and develop proposals on new ways to expand and sustain the Sandwatch programme over the next five years. From this pool of young adults, a Young Sandwatchers Network and Advisory Board can be formed to devote some of their time to advance the Sandwatch programme and guide the Sandwatch Foundation in its future activities.

Empowering students and young adults to conserve their beaches and the wider environment, and to use them wisely, while involving their friends, families, teachers, and communities in sustainable activities that also build climate resilience remains central to the Sandwatch vision.

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