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Climate change education through the You and CO₂ programme: modelling student engagement and teacher delivery during COVID-19

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ABSTRACT

While there has been an international call for action from the United Nations secretary general, individuals' abilities to engage with climate change and actions to mitigate it can vary. In 2020 and 2021, COVID-19 and related school closures caused significant upheaval across the world; schools made immediate shifts to remote delivery, increasing workloads and decreasing access to outdoor spaces and opportunities to connect with nature. In this paper we will explore a rural, mid-Wales school's approach to climate change education (CCE), and their experiences running the CCE programme 'You and CO₂' through interviews with teachers and analyses of creative interactive digital narratives (IDNs) the students created on the programme. The paper will discuss what the school was doing before the COVID-19 pandemic, the effect of the pandemic on CCE in the school, and how the You and CO₂ programme raised the aspirations and confidence levels of the school's humanities department for teaching CCE. The findings in this study highlight the importance of localised knowledge, and engagement with local groups in successful delivery of CCE programmes, which was reflected in students' IDNs.

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Climate change education; sustainability; carbon footprint; pedagogy; Bourdieu; STEAM

Introduction

We live in a time of climate emergency. The global temperature has already risen by 1.1°C relative to pre-industrial levels and we are currently heading towards 3° of global warming by the end of the century (IPCC 2022). While there has been an international call for action from the United Nations secretary general, individuals' abilities to engage with climate change and actions to mitigate it can vary. There are various factors at play in this: physical structures surrounding them (Hoepfner and Whitmarsh 2011); values and cultural habitus influencing individuals (Ross et al. 2021); and governmental/policy frameworks (Hoepfner and Whitmarsh 2011). Some individuals, however, are able to engage strongly with climate change and its mitigation. This has been observed through the adult-initiated Extinction Rebellion movement and also through youth-centred movements such as Fridays for Future and School Strike for

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Climate (Stickney and Skilbeck 2020). More recently a new youth-centred movement, Teach the Future, has emerged in the UK, calling for the urgent repurposing of the entire education system around the climate and ecological crisis (Rushton 2021).

Wales has developed a 'New Curriculum' (Donaldson, 2015) with mandatory uptake in primary schools from September 2022 and secondary schools from September 2023. The Curriculum aims to support young people to engage with climate change, act to mitigate it, and engage with governmental structures.

This project aligns with those values and explores young people's interactions with a cross-curricular Climate Change Education (CCE) programme delivered in schools, in which they learn about carbon footprints, engage with Interactive Digital Narratives (IDNs), and then produce their own IDNs.

In this paper we will explore a rural, mid-Wales school's approach to climate change education. The paper will discuss what the school was doing before the COVID-19 pandemic, the effect of the pandemic on CCE in the school, and how the You and CO₂ programme raised the aspirations and confidence levels of the school's humanities department for teaching CCE.

Background

Climate change education: an overview

Engaging individuals in climate change mitigation is affected by many factors, but prior work has highlighted the importance of the 'sense of urgency' to inspire action (Pruneau et al. 2010). Other factors influencing individuals' capacity to engage with climate change action are linked to social-economic and structural barriers. Values, habitus, and practice of individuals' communities strongly influence their capacity to engage in climate change mitigation, as well as their understanding of *how* to engage, particularly given that much power/capacity for formal change lies within white, middle class systems (Bourdieu 1977; Laidley 2013; Ross et al. 2021).

As was highlighted by Bourdieu in the 1970s, education systems in the global north are commonly dominated by white, middle class values (Bourdieu 1977). CCE programmes do not appear to differ in this respect within the global north, and have been associated with white, middle class values (Laidley 2013; Ross et al. 2021). However, it is important to note that there are many grassroots climate change movements amongst indigenous groups, young people, and local action groups that act to combat hegemonic value systems relating to climate change (Stickney and Skilbeck 2020). In these instances, where organisations challenge dominant structures/value sets, dialectical confrontation can ensue (Ingram 2011). These confrontations can manifest in differing priorities, expected courses of action and desired outcomes: clashes in habitus. These 'habitus clashes' may then become a barrier to further engagement due to the dissonance or discomfort they cause. While often uncomfortable for those implicated, such clashes can also create social space within individuals, communities, and organisations to embody new habitus that prioritise climate change action. This new habitus can then help those social agents see their potential to effect change in the actions they take to mitigate climate change (Ross et al. 2021).

It is useful to note that there are various terms to describe or denote climate change education employed across literature on the topic. In this paper, we use 'CCE' to refer to education relating to the science and/or ethics of climate change and its mitigation.

CCE and the Curriculum for Wales

The Curriculum for Wales ('Curriculum for Wales – Hwb' n.d.) aims to support young people to become 'ethical, informed citizens of Wales and the world' with capacity to engage critically in decisions they make that affect their environment, both locally and on a global scale. This

purpose is at the heart of the You and CO₂ project. The Curriculum for Wales also emphasises cross-curricular, inter-disciplinary learning, and the importance of engaging across subject areas in CCE programmes (Algurén 2021). As a STEAM (science, technology, engineering, arts and maths) project, You and CO₂ is a timely programme that connects with the ethos and focus of the new Curriculum for Wales. To achieve this, climate change must be related to local, perceptible phenomena, often at local level (McNeal and McNeal 2019) and explored with the support of ‘approachable messengers’ (Martin and Côté 2019).

Climate change in context: rural Wales in the spotlight

The current ‘cost of living crisis’ is negatively impacting communities in Wales (Sustainable Clothing and Textiles Cymru (SCTC) 2022). SCTC (2022) develops strategies to support individuals, families, and communities in addressing these financial challenges whilst also helping them to see the longer-term environmental impact of short-term financial decisions. The key element of their work is to help families make positive short-term decisions that also have long-term environmental benefits. They note that a substantial and limiting factor in this endeavour is that ‘current provision of sustainable education teaching in primary and secondary schools... is sporadic, and depends on the personal knowledge, enthusiasm, and commitment of individual teachers. Otherwise, everything is light touch’ (Sustainable Clothing and Textiles Cymru (SCTC) 2022). There is little substantive research on CCE programme delivery in Wales, but this finding does echo reports elsewhere on the importance of personal relationships and accessibility of delivery in CCE (McNeal and McNeal 2019).

The focus of this paper is on a community in mid-Wales, where there is slightly larger proportion of young people who have free school meals: 24.2% in 2022 versus 21% nationally (‘My Local School’ n.d.). The school is therefore likely to have students whose families experience financial difficulties, such as the current cost of living crisis, more strongly than in other areas. Cost of living is a challenge in this area; likewise, access to services and employment, particularly post COVID-19, can be difficult. It is vital that we understand how young people—and subsequently their families/communities—can respond to climate change mitigation, and how education can support this response. This study explores young people’s responses to You and CO₂ and how changes in their communities around COVID-19 may have affected their perceptions of their ability to act to mitigate climate change.

You and CO₂: the programme

You and CO₂ was designed in line with the new Curriculum for Wales in 2018. Since its development it has been trialled in schools across the UK and downloaded for use by educators across the world. The initial development of the programme and pupils’ responses to it was discussed in Rudd, Horry, and Skains (2020). An overview of the three workshops that make up the You and CO₂ programme is given below.

Workshop 1: an exploration of carbon footprints. The students are introduced to the concept of a carbon footprint and learn about the chemical combustion of fossil fuels to generate carbon dioxide using molecular modelling. The students then calculate their own carbon footprint based on the first two hours of their day before forming groups and discussing how to reduce the group’s carbon footprint by one third.

Workshop 2: reading and comprehension using the IDN No World 4 Tomorrow. The students read a custom-written IDN containing six different endings and dozens of permutations to explore how everyday decisions can have a much wider impact. The

IDN takes place on a lunar colony to dissociate it from a geographical location, which facilitates its use in diverse educational settings but also to protect the students from any climate anxiety, giving them the safety of exploring the consequences of their actions in a fictional environment. The IDN also helps students to understand how they as individuals have a role to play within both societal and governmental structures to effect change at a larger scale. The students then complete a comprehension exercise to explore how the themes developed in the IDN relate to their own experiences and day-to-day lives.

Workshop 3: students write climate change IDNs. The students combine computer coding and creative writing to compose their own interactive narratives on the theme of climate change. They are introduced to a simple platform for creating IDNs called 'Twine' and use its simple programming functions to create their own IDNs based on their understanding of climate change. Previous IDNs have included mining for make-up components, citizen assemblies, litter picking, and the environmental impact of air travel for holidays.

The programme has multiple aims: from workshop one students should understand the term 'carbon footprint' and where carbon emissions come from so that they can understand and engage with the growing global conversation about carbon footprints. This also enables them to understand how they as individuals play a role in climate change. Going into workshop two the programme moves students into thinking structurally, societally and politically through the *No World 4 Tomorrow* IDN. In actively engaging with the storygame, students gain an understanding of how they as an individual fit into the broader picture and how they have influence to make changes on an individual and a societal level. Through the third workshop students explore how climate change is relevant to them, as they write about their own interests and conduct research on how climate change could directly affect them. Higher attaining students typically bring together individual and collective action in their IDNs. Overall, the programme aims for students to feel empowered as a result of participation: to understand that while climate change is a problem, it has a solution; and that, regardless of their individual interests and talents, they are part of a global collective trying to save the planet.

Climate change education in a post-COVID world

In 2020 and 2021, COVID-19 and related school closures caused significant upheaval across the world, which caused substantial changes in the priorities of many organisations, communities, and individuals. Schools made immediate shifts to remote delivery, increasing workloads and decreasing access to outdoor spaces and opportunities to connect with nature (Rushton 2021). While the need to address climate change did not alter, the capacity of organisations, communities, and individuals to engage meaningfully with existing CCE programmes was substantially impeded (Salazar et al. 2022). In contrast, CCE programmes that were suited to remote provision had increased engagement thanks to these circumstances (Salazar et al. 2022). Some CCE projects whose in-person activities were planned for Summer 2020 had to switch to remote-learning (Kluczkovski et al. 2021). Kluczkovski et al. were unsure whether their adapted programme had more engagement as a result, but they did find that positive relationships developed between schools and families through these remote-delivery interactions, and they hope to build on this post-COVID. There is little evidence of work relating to CCE and its implementation in Wales during COVID-19. As such, this study offers a unique perspective on how COVID-19 affected delivery and engagement with a CCE programme delivered during the COVID-19 pandemic, and how young people engaged with it. Teachers' reflections are not considered in literature relating to CCE throughout the COVID-19 pandemic; this paper provides useful insight into understanding changes in dynamics in schools' implementation of CCE prior to and following

the pandemic. Careful theoretical consideration of those changes is needed to understand barriers/facilitators to young people's engagement with CCE and wider community action.

Theorising climate change education: the h-ACE model

CCE as a field is relatively under-researched, with comparatively few qualitatively-based models. The holistic Agentic Climate-Change Engagement (h-ACE) model of CCE (Ross et al. 2021) (a development of the Bicycle Model (Cantell et al. 2019)) is outlined here and underpins analysis of the students' responses and IDNs.

Cantell et al. (2019) model links bicycle parts to elements facilitating/impeding learners' engagement with CCE programmes, as described below:

- Wheels: thinking skills and knowledge
- Frame: the learner's identity, values, and worldview
- Chain: the translation of knowledge and skills to action
- Pedals: individuals putting effort into applying their knowledge to actions
- Saddle: motivation of the learner
- Brakes: barriers to an individual's action
- Headlamp: shows the way forward with hope.
- Handlebars: steer the learner towards the future.

The h-ACE Model developed the Bicycle Model further by locating the bicycle in a model space with three axial continua is shown in Figure 1. The continua are described here:

- The blue continuum shows young how young people can connect knowledge of and action to mitigate climate change in their responses to the CCE programme.
- The orange continuum locates an individual's sense of agency and how they act individually and/or collectively (e.g., with governmental structures) to mitigate climate change. Individual agency here connects to values and habitus (Bourdieu 2002), class/cultural practices (Bourdieu 1977; Ingram 2011), and their experiences of climate change (Laidley 2013).

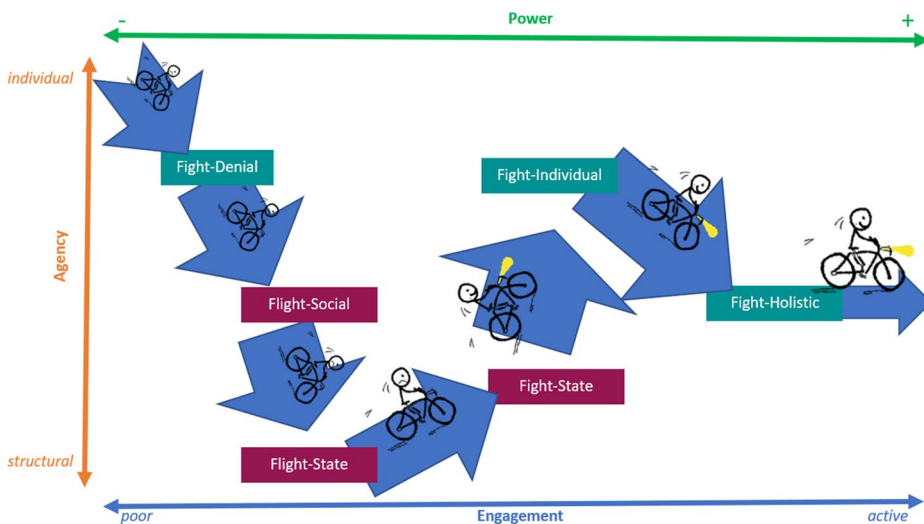


Figure 1. The h-ACE model of climate change education. Adapted from Ross et al. (2021).

- The green continuum shows power, as linked to an individual's perception of their ability to enact change through their actions taken both individually and collectively (Bostrom, Hayes, and Crosman 2019; Bourdieu 1977).

The model space shown in [Figure 1](#) (Ross et al. 2021) demonstrates how a potential journey towards active, holistic engagement with climate change action may look. Individuals' or groups' current sense of agency, engagement, and power can be located within the model space, to help them or teachers working with them discern what skills or support they may need to help them act to mitigate climate change at individual level, in their communities, and more widely.

Methods

School selection

Hazel Grove School (English language pseudonym) is a small secondary school in mid-Wales, with circa 500 students on roll. To maintain school anonymity, we have not given full details of school statistics. According to Welsh governmental statistics ('My Local School' n.d.), 21% of Hazel Grove School students qualify for Free School Meals (FSM), within an area whose average proportion accessing FSM is 12.5%. At the school, 28% of students have Additional Learning Needs (ALN); Local Authority averages are in brackets: 1.1% (1%) with a 'Statement of Special Educational Needs (SEN)'; 14.7% (8.2%) with 'School Action Plus'; and 12.3% (13.8%) with 'School Action'. Given that FSM is a common indicator for schools/individuals at risk of low-attainment (Office for Students, n.d.) and Hazel Grove's high proportion of students accessing FSM, this may explain to some degree the school's relatively low Welsh Baccalaureate attainment.

Ethics

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee. The research pertaining to the student participants was approved by the Department of Psychology Ethics Committee, College of Human and Health Sciences, Swansea University, REF: Project 1368.

Parents/carers were notified in advance that the students would be participating in the research project and were given the option to withdraw their child or their child's data if they so wished. The students were also given the option not to have their data included in the project and many of the students chose to use this. Approximately 60 students participated in the You and CO₂ programme; 20 students uploaded IDNs for us to analyse.

The research pertaining to the teacher interview was approved by the School of Management Ethics Committee, Swansea University REF: SOM-REC-STAFF 154. The teacher gave consent to the interview in writing and, again, verbally at the start of the interview. The teacher consented to her interview being used for research purposes on the condition that a pseudonym was used.

Programme delivery

The programme was delivered in Autumn 2021 by teachers at Hazel Grove School after they had been trained in its delivery by the project team. Jane, the school's Acting Learning Leader for Humanities Education, managed delivery of the You and CO₂ programme, ensuring that it was a cross-curricular STEAM endeavour. The programme was run across all of year 8 (aged 12-13), with roughly 60 students participating. Workshop 1 was delivered by science teachers. Geography teachers, supported by the schools' Nurture Teacher (a role which usually involves supporting students in small, emotionally supportive groups), delivered workshop 2 and

workshop 3. The school Nurture Teacher's strong ICT skills were used in programme delivery, as she differentiated resources to help students and staff with using Twine. Due to school timetabling constraints, the gap between sessions varied between one day and two weeks, which meant that there were differences across students' experience of the programme. However, ensuring consistent gaps between session deliveries would not be feasible within a school timetable structure for many schools.

The IDNs provide insight into students' perception of their capacity to act to mitigate climate change, and were analysed with this in mind. After programme delivery, an online discussion with Jane (pseudonym) was organised and held in December 2021. This session was attended by Jane as the in-school Lead, Dr Ross as data analyst, and Dr Rudd as You and CO₂ project lead. Full details of data construction and collection are given below.

Data construction and collection

After the in-school workshops, students' IDNs were uploaded anonymously as html files for delivery to the You and CO₂ researchers. Not all students who participated in the sessions uploaded their stories, but in total 20 stories were submitted. The content of the stories varied substantially, ranging from the life-story of a carrier bag to polar bears to organised litter picks. As Twine story files are in html format both for coding and execution, the downloaded html files could be displayed in an internet browser for the purposes of analysis.

The online interview discussion with Jane lasted 48min and was recorded on Zoom. It was undertaken after school and followed a structured interview format (Bryman 2012), with discussion points being outlined for Jane prior to the full conversation so that Jane was aware of the planned direction of the discussion. The discussion touched on the usual delivery of CCE programmes in school, and how You and CO₂ differed from other programmes in its delivery. Extra-curricular clubs and projects relating to climate change were discussed and student engagement with those was explored, as well as unpicking general barriers/facilitators to young people's engagement with CCE and any effects of COVID-19 on delivery or engagement. To maintain participant confidentiality, video/audio files were separated. The audio file then became the 'working file' from which verbatim transcriptions with timestamps were taken. This was then edited further by Dr Ross, so that all speech was clearly attributed to discussion participants. This then was checked by Dr Ross by her listening to the discussion and concurrently reading the file for accuracy. Once files were checked and speech correctly attributed, the discussion was analysed formally.

Data processing and analysis

IDNs

Inductive analysis of IDNs was undertaken (Bryman 2012) with consideration of the challenges that young people had experienced due to COVID. These were mapped onto the h-ACE model to provide insight into students' perceptions of agency, engagement and power vis-a-vis climate change mitigation. Open coding was undertaken and students' responses were thematically analysed, drawing on the h-ACE model, to explore barriers and facilitators to students' effective engagement with the programme around the COVID-19 lockdowns and partial school closures.

The IDNs were read four times. The first time explored their functionality, topic/content, and if they were complete. Story maps as overviews of the Twine coding (Figures 3–6) were captured to explore choices, connections, and consequences available within IDNs. MS Word files were then created by extracting content from each element of the Twine code, according to story maps where possible, prior to thematic analysis. The IDNs were then replayed in Google Chrome to recheck functionality, and connections made between actions/consequences.

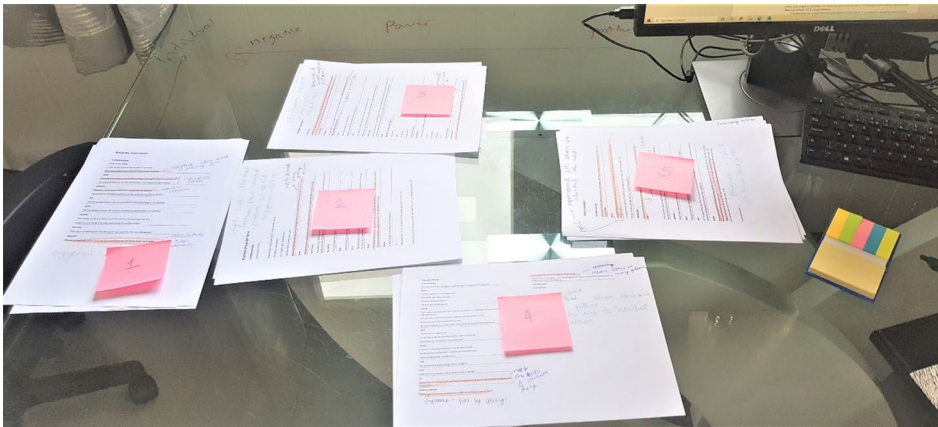


Figure 2. Final analysis – glass table top.

On the first reading, concepts of agency, power, and engagement within IDNs were considered. Points of clash were explored, where school expectations and students' responses did not align. This was to gain understanding of how young people prioritised and valued CCE and acting to mitigate climate change. After the second reading, IDNs were categorised into groups depending on the overall type of response to CCE they exhibited. IDNs were then grouped thematically and response-types noted by the analyst. For the final reading, stories were printed and annotated for evidence of barriers/facilitators to students' agency, power and engagement with climate change mitigation.

The interview data was explored following analysis of IDNs for both data triangulation (Bryman 2012) and to gain insight into teachers' experiences of the programme, and how COVID-19 affected CCE programmes.

Interview

The interview was transcribed and fully read through three times. Thematic analysis, focussed on the h-ACE model continua (agency, power, and engagement), was undertaken on the first reading to gain insight into the school context, without detailed coding. On the second reading, formal coding within the rubric of the h-ACE model was carried out. Jane's views of barriers/facilitators to students' engagement with the CCE programme, their ability (and perception thereof) to enact individual/collective agency were explored. The transcript was annotated and highlighted digitally using MS word. On the final reading, the transcript was printed out and further notes made on it to solidify coding patterns and link those to the h-ACE model. Jane's views and experiences of pre- and post-COVID teaching of climate change were then used to explore challenges in re-igniting students' engagement with programmes moving forwards from COVID-19.

Results and discussion

In this section, we have analysed the teacher interview and the student IDNs to understand: Hazel Grove School's pre-COVID-19 CCE; how the students responded to the You and CO₂ programme as reflected in their IDNs' dominant themes; and how running the You and CO₂ programme helped the Hazel Grove teachers to re-start CCE and develop a place-based curriculum tailored to their learners. For each area of analysis, we discuss how our results highlight the challenges in implementing CCE programmes following COVID-19 lockdowns and partial school closures. The challenges are contextualised with reference to existing literature to draw out implications for practice and incorporation of You and CO₂ (and other CCE programmes) into school curricula.

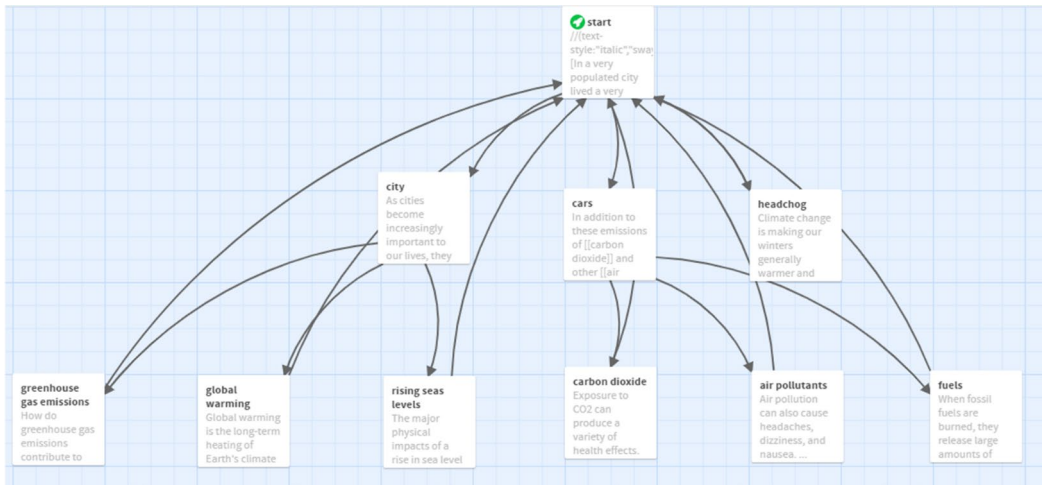


Figure 3. Scuffy Sammy Story Map.

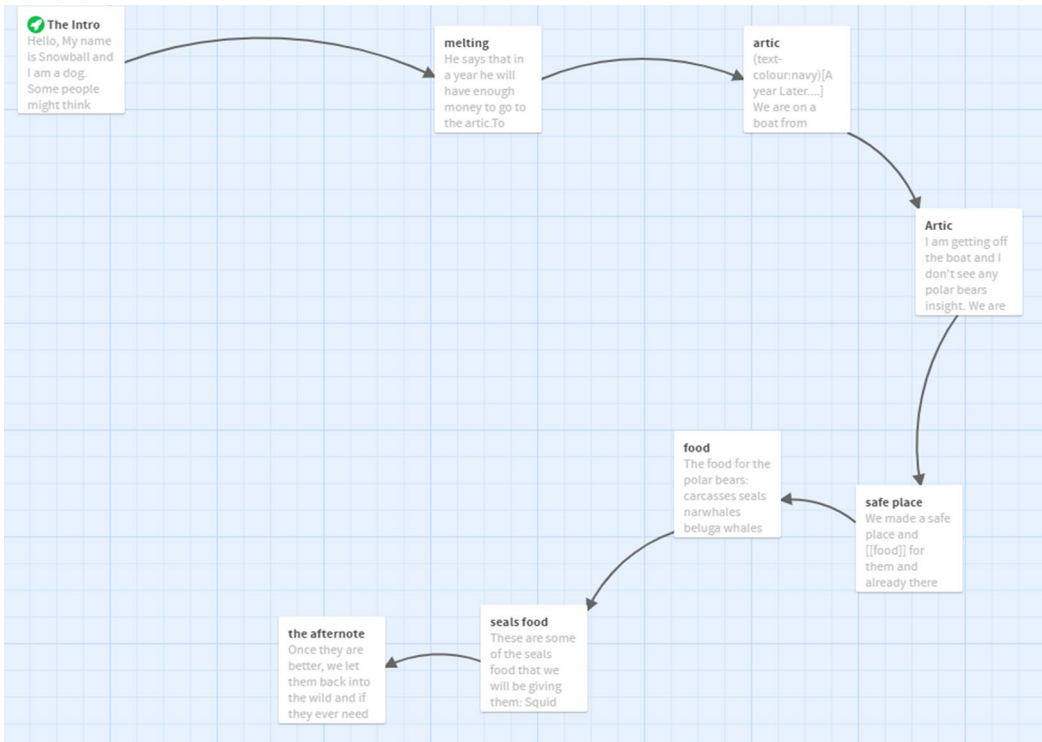


Figure 4. Snowball's Adventure Story Map.

CCE in Hazel Grove prior to COVID

Hazel Grove School had an active programme of activities, such as eco clubs, UNICEF initiatives, and a pollution monitoring programme prior to COVID 19, which raised the profile of CCE in the school. Jane felt that prioritisation of climate change mitigation within value-sets and habitus was supported *via* school eco-clubs and pollution monitoring projects. Jane also noted ‘there

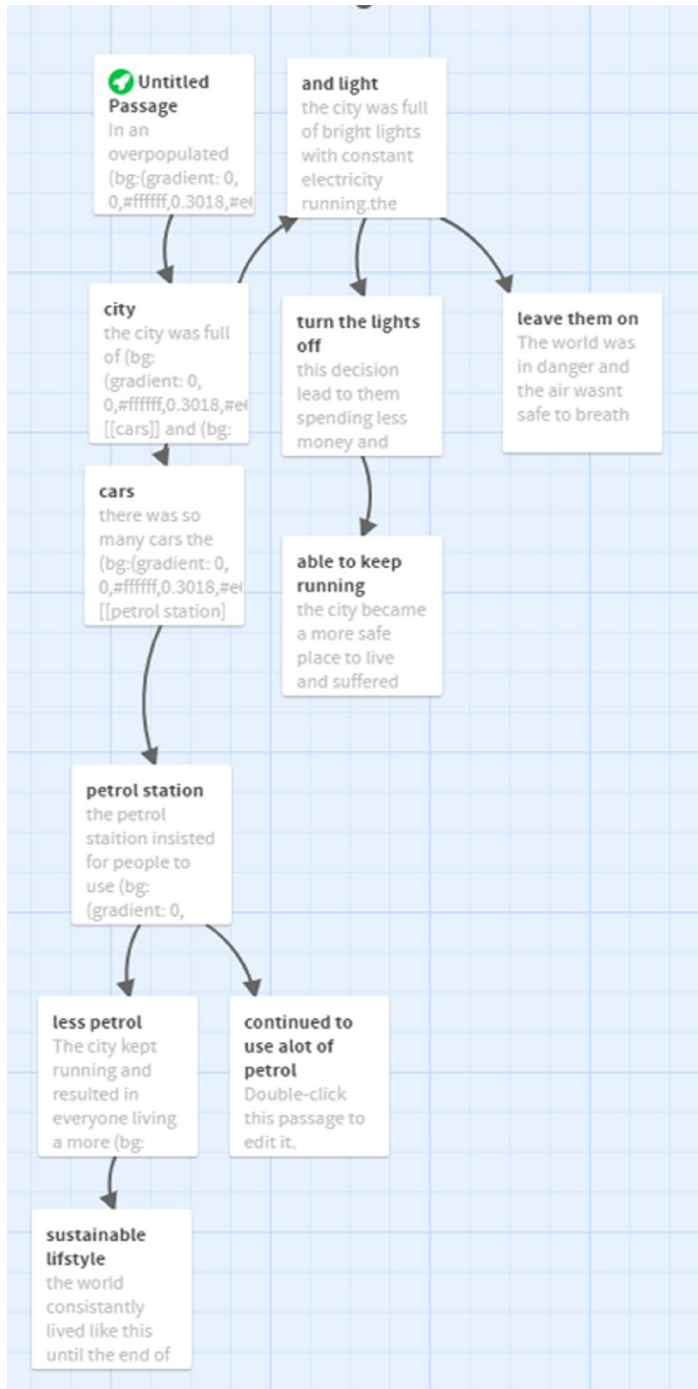


Figure 5. CO₂ Climate Change Story Map.

was a little bit [of CCE delivery] in science. We had an eco-club. And we had level two, level two Silver Award, yeah, with Silver Award for Eco Club... there were some things that UNICEF used to do this one thing we got involved in... and it was like to monitor pollution’.

Feeder primary schools supported/ran such activities and Jane felt that this fostered positive engagement in CCE for some students. The work students carried out in their feeder schools helped them to engage with climate change mitigation at Hazel Grove and understand what

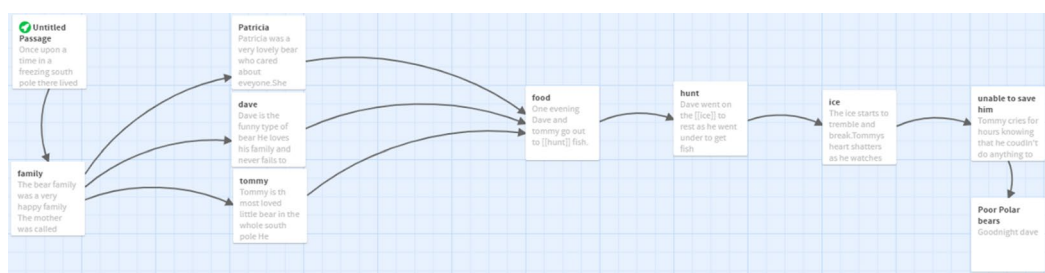


Figure 6. Polar Bear's Paradise Story Map.

actions could be taken and why it was important to act. In effect, some students arrived at Hazel Grove already 'trained' in climate awareness:

I know there are really good eco committees in our primary feeder schools. And so when those pupils come up, we just don't have to train them. If we don't have to do anything, they just come up and they're like, 'Yeah, we do it, you know'.

However, families in Hazel Grove's catchment area often face complexities in their lives which means that school and learning are not always prioritised by all pupils. Jane felt that this impacted and was influenced by the lack of employment opportunities in the areas, which meant engagement with CCE was not held as valuable:

There's still a lot of unemployment in the area. Lots of businesses that replaced the pits¹ have gone as well. So they're not really invested in themselves, let alone the environment, unfortunately. So it is about aspirations. So it is looking at, looking to the future and aspiring to something to improve our own place and our own sense of self.

Pruneau et al. (2010) have argued that inspiring learners to mitigate climate change requires them to feel a sense of urgency. Addressing the socio-economic factors and structural barriers to engagement with CCE is crucial; Laidley (2013) suggests that this can be done through accessible, approachable 'messengers' working with learners. Stickney and Skilbeck (2020) highlight the prevalence and importance of grassroots organisations, such as young people and action groups working together at local level; an example in Hazel Grove's case was drawing pupils' interest through the eco-communities Jane described as existing in primary schools connected to Hazel Grove. She felt the presence of science and eco clubs helped to raise pupils' awareness of the issues facing their local communities, such as pollution, and was important to engaging them as they progressed through school; prioritising climate change as needing action is a key step in engagement with climate change action (Pruneau et al. 2010; Ross et al. 2021). Given the challenges experienced by families around Hazel Grove School, such as unemployment and low aspiration, Jane felt that working locally and building communities of action helped empower young people and raise their aspirations, whilst concurrently addressing climate change problems. This understanding and subsequent approach to CCE echoes that of SCTC (2022), whose work on fast fashion focussed on the economic challenges affecting families, where their short-term changes had both financial and environmental gains. Jane made reference to CCE programmes running locally which connected to UNICEF, so that children were able to link their individual and collective local action, and then connect that to wider actions at international level.

Echoing the SCTC (2022) and Pruneau et al. (2010), Jane noted that through local action and active participation in communities where climate change action was valued, young people engaged more readily with CCE. They were already 'trained' to engage with CCE programmes on arrival at secondary school. Young people had already prioritised climate change action, and habitus clashes where value systems did not align had been addressed to empower young people to see their own potential agency and power, and to facilitate engagement (Ross et al. 2021).

Considering Jane's pre-COVID experiences through the h-ACE model shows the importance of meeting learners' needs through locally-based, tangible projects. The different elements of the bicycle could be adjusted: wheels for providing thinking skills and knowledge locally, which framed their identity and worldview. The school-based projects facilitated students' knowledge into action, applying pedals to the chain that drives the chain, to move students through the h-ACE model space. Jane's experiences of pre-COVID CCE were that students were empowered to act and engage with CCE because of the programmes and community-actions in place:

there are really good eco committees in our primary feeder schools. And so when those pupils come up, we just don't have to train them. If we don't have to do anything, they just come up and they like, 'Yeah, we do it, you know'. (Jane, interview)

The effect of the COVID-19 pandemic on Hazel Grove and CCE within Hazel Grove

The impact of the COVID-19 pandemic on all schools was significant, leading to school closures, online learning, and increased financial disparity (Marchant et al. 2021). Jane noted that prioritising CCE and schooling generally was complicated by COVID-19 and the related school closures. The increased financial disparity also exacerbated a pre-existing barrier to pupils engaging with CCE: 'Money is a barrier... You know, a lot of people have suffered in that way during lockdown, you know as well as wider distrust and disengagement with wider establishments and authorities in the area'.

Jane further expanded upon distrust of authorities:

Well, I've never seen year 7 like that, lack of willingness to engage with "authorities" from some students—worse since lockdown too and linked to the already tricky circumstances of some students' families.

In addition, the school suffered constraints on running CCE due to structural issues. COVID-19 and the related restrictions substantially and negatively impacted affected staffing, with knock-on negative effects in student engagement. Jane described one particular difficulty that arose in Hazel Grove School: 'And then the teacher that ran [the eco] committee went on maternity leave and with COVID and everything, that's kind of gone away again teacher dependent and COVID interrupted/changed lots of plans, priorities shifted'. The school capacity to run programmes reduced, as did staff and students' ability to engage with them. This reduced CCE engagement and capacity has not changed at Hazel Grove even after easing of lockdowns and social restrictions. Jane feels that families (and subsequently students) continue to find prioritizing climate change mitigation challenging: 'I think a lot of that has been a result of lockdown. And if those aren't priorities for our families, they're not going to be priorities for our pupils'.

Staffing was not just a structural issue (i.e. number of teachers available for the classroom) but also a key factor in how well young people engaged with CCE. Jane felt that young people's engagement with CCE linked to who delivered sessions and how well invested in the programmes they were. She felt that 'It depends on the staff and the support from the staff, really, whether the proactive view of climate change and getting involved with the eco stuff happens depends on the person doing it... but if, as teachers, they're not invested then it doesn't translate as well'. This is also linked to who is delivering the message and their relationships with students, which Jane viewed as a key factor in the success of any CCE programme: 'It's about—it's about how well it's delivered. Whoever it's delivered by in that sense, you know, to help them establish those connections with people'.

How You and CO₂ was used in Hazel Grove School

Hazel Grove's staff were positive about running You and CO₂ following initial contact from the programme lead. Jane felt that the You and CO₂ programme linked well with the Curriculum for Wales, that the programme held a particular affinity for the element of the curriculum linked to students becoming 'ethical, informed citizens of Wales and the world' ('Curriculum for Wales

– Hwb' n.d.). Following the initial development of You and CO₂ (Rudd, Horry, and Skains 2020), it was decided that a 'train the teachers' model would be the most effective to use. Therefore, in September 2021, the You and CO₂ programme lead trained Hazel Grove teachers from the geography, information technology, and science departments to run the You and CO₂ programme. As You and CO₂ is cross-curricular, covering maths, chemistry, creative writing, and computer coding, the school hoped that using each teacher's specific expertise (i.e. science teacher teaching the maths/chemistry-based workshop 1) would enable good delivery of the programme. The students completed the You and CO₂ programme over a period of two weeks. Twenty students voluntarily submitted their IDNs and these were qualitatively analysed. Table 1 offers an overview of the different types of responses found within students' IDNs.

Story responses

In this paper, all spellings and phrases are kept as written in IDNs; where necessary, explanatory notes or additions are clearly indicated. Table 1 gives detail of types of response, their categorisation and whether IDNs were complete. Five sub-types of response emerged from data analysis, each of which is discussed below in more detail.

Passive individual

In this type of IDN, no link is made between actions that mitigate climate change and knowledge of climate science. IDNs had factual content but no choices of action were given to the reader in choice-pathways available in the IDN. Passive knowledge of climate science was suggested but it was unconnected to any potential local action or community engagement. Three stories shared these characteristics. Figure 2 shows the story map for student-created IDN 'Scruffy Sammy', indicating factual headings and content, but no actions and detail of content. In the same figure, the IDN 'Rubbish Richard' also shows links to knowledge of landfill and decomposition time of plastic.

- 'As cities have become increasingly important to our lives, they have become a big source of greenhouse gas emissions' (Scruffy Sammy).
- 'Richard is a 300 year old plastic bag... stuck in landfill for over 270 years' (Rubbish Richard).

Conforming collective

Conforming Collective responses were not grounded in knowledge but connected human actions to causation and mitigation of climate change. Responses did hint at an understanding of links between action and climate change, but lacked reference to personal responsibility and individual action or collective action at local or wider level. Instead, collective actions, as something that happens regardless of individual choices made, dominated these stories. 'World War Environment' links pollution to global warming due to collective action: 'A war broke out with all the world involved. Polluting artillery was used warming up the earth'. 'Molly's melting ice' links humans to source of gases that cause climate change: 'Global warming is the world getting warmer because of humans of toxic gases that humans release'. Neither story, however, explicitly links pragmatic actions to the effects of climate change.

Pragmatic individual

Pragmatic Individual IDNs showed a response to the CCE programme that linked knowledge of climate science to individual actions and their effects. However, themes were not related to

specific local level actions or concerns, although there was consideration of 'city' problems in 'Life in the City'. The structure of 'Snowball's Adventure' (Figure 4) contains no suggestion of collective actions to mitigate climate change.

Snowball's owner, however, is shown to take actions to save animals in the story, where he 'says that in a year he will have enough money to go to the artic. To save the Polar Bears an all of the animals in the artic'. In 'Life in the City', we see a link to individual choice-making: 'life in the city is quite busy. Making the right choices is key to eaving a world for out future'. The story is unfinished, however, so we cannot see its development and whether the writer might also have been able to engage with collective action.

Pragmatic collective

Pragmatic collective IDNs showed the importance of collective action with peers and/or government to mitigate climate change, but did not reflect individual actions. The themes in these stories did not reflect local issues and were somewhat abstract relative to the Welsh context. IDNs of this type demonstrate understanding of effects of collective action as causing climate change. This is shown in 'Polar Bear's Paradise': 'It was all the humans fault, the ice caps were melting'. The writer of 'CO2 Climate Change' demonstrated the understanding of collective action relating to use of electricity: 'the city was full of bright lights with constant electricity running the lifestyle of living was a lot of money but sometimes people debate if they would "turn the lights off" or "leave them on"'. Story Maps in this category were more complex and linked actions to consequences, as shown in Figures 5 and 6.

Pragmatic holistic

IDNs within this group showed active engagement with knowledge of climate science and the importance of both individual and collective action in mitigation of climate change. Responses of this type also acted to challenge dominant power structures. Actions depicted in the IDNs indicate the writers' capacity to envisage 'hope' in their future. Some IDNs engaged with resistance from government to change, as noted in 'Waste Washers': 'He gathered a bunch of his friends, and went to the government and asked if they could start to clear all the rubbish. The government said NO'. In 'the remains', barriers to young people engaging with power were also noted: 'The time when the teens were the issue but teens were "too young to understand" and needed to 'go back to school' when petitioning for change'. Transnational action was commented on in 'secrets of jeff', where the protagonist embarks on a trip to Russia to garner support for his research and activism. Social media also presented as a tool for activism, as per 'Into the Future': 'you grab everyone's attention. You pay a video showing what was to happen if everyone doesn't change the way they live'. These stories begin to address local concerns with practical strategies that young people can implement.

Local-level responses versus abstractified IDNs

Within the IDN responses, there are various themes addressed, ranging from the life-cycle of a plastic bag to the problems facing polar bears due to melting icecaps. While all these issues are substantive problems, the IDNs developed by young people at Hazel Grove do not reflect local challenges and concerns relating to climate change, as were discussed by Jane and that formed part of local responses to climate change prior to COVID. The IDNs are not grounded in local issues and potential mitigations of climate change at local level, which as noted above (Laidley 2013; McNeal and McNeal 2019) is key in effective CCE programmes. Jane reflected on

Table 1. IDNs by response-type.

Response type	Complete	Incomplete
1- Passive Individual: IDN contains little/no link to actions but draws on some factual knowledge of climate change	1	1
2- Conforming Collective: Links to collective human actions causing/mitigating climate change but not grounded in fact	3	1
3- Pragmatic Individual: IDN refers to individuals' actions causing/mitigating climate change, and connected to factual knowledge but little/no reference to need for collective actions	2	1
4- Pragmatic Collective: IDN makes reference to collective actions and their effects. Grounded well in facts but little to no reference to individuals acting to combat climate change	2	0
5- Pragmatic Holistic: The 'aim' of the programme! IDNs show knowledge of facts, effects of individual and collective actions on climate change mitigation/causes	9	0

young people's responses to the programme and the challenges faced in supporting their engagement at local level, as had been the case prior to COVID-19.

Local and relatable subject matter is key in supporting young people to engage effectively and meaningfully in CCE programmes (Laidley 2013; Pruneau et al. 2010). For COVID-affected Hazel Grove, the local context of climate change action was not tangible for many students and engagement with action/activism was reduced (Dunlop and Rushton 2021; Salazar et al. 2022). Student IDNs created by students at Hazel Grove School reflected this shift through the subject matter tackled and the lack of concrete actions in many of the outputs. The different types of reaction shown in the IDNs framed some of the different responses and how students may perceive their power as effective in mitigating climate change, their engagement with the programme and their agency in actions (whether they acted individually or with others).

The lack of local contextualisation was apparent through the different types of response to IDNs. Here, drawing on the h-ACE model is useful to contextualise and link students' responses to their perceptions of agency, power and engagement with CCE and mitigation of climate change. *Passive individual* responses to the programme focussed on lifecycles of plastic bags. Although this may be an issue affecting students in the vicinity of Hazel Grove (Jane did note that pollution has been a theme in community programmes), there was no action to mitigate associated with the plastic-bag problem in Rubbish Richard (Student IDN). The same was apparent in *conforming collective*-type responses. The themes drew on concepts which were unlikely to directly link to local-area challenges such as war-related pollution and melting ice caps. The theme of knowledge of wider environmental problems permeates the IDNs; students 'knew about' climate change and could talk about problems linked to it, but their perception of their ability to effect change and mitigate those wider-world challenges was somewhat limited. The problems appeared to be abstract to young people in these responses; *passive individual, conforming collective, and pragmatic individual* IDNs did not display a sense of urgency around climate change as their response to the programme, which appeared to link to lack of local focus and concrete courses of action to mitigate climate change. However, moving the model space, and tracking potential routes towards holistic engagement with CCE and empowerment to act to mitigate climate change, there was evidence of tangible actions, relating to localised solutions and ways for young people to act.

This localisation and connection to concrete action echoes Laidley (2013) and Pruneau et al. (2010), where understanding local problems and courses of action supported active and meaningful engagement with CCE. However, as found by Salazar et al. (2022) and also commented on by Dunlop and Rushton (2021), CCE was less practical due to COVID-19. This was apparent here; Jane commented that it was harder to run programmes. This was exacerbated by changes in staffing. It appears that for some students, not having access to the programmes that had run prior to COVID had made it more challenging for them to link wider climate change issues, such as melting ice caps, to more localised matters such as rubbish in cities. This shows the importance of coherent, consistent CCE programmes to empower young people, which was noted by SCTC (2022). However, CCE programmes are not coherent (Sustainable Clothing and Textiles Cymru (SCTC) 2022) and where there is no provision, local environmental problems (and often related socio-economic matters) remain unresolved (ibid.). This was noted by Jane, who viewed Climate Change Education as fundamental to support students as, 'it is looking at, looking to the future and aspiring to something to improve our own place and our own sense of self'. Understanding how young people respond to CCE programmes through observation and interaction with them, as well as grounding their outputs/responses to CCE in the h-ACE model allow for educators to make adjustments to their curriculum and its content. This allows practitioners/educators to meet young people where they are as approachable messengers (Martin and Côté 2019) and to minimise any potential habitus clash, which could act to deter young people from further engagement with CCE programmes. With this in mind, Jane

considered how the You and CO₂ programme may be adapted and integrated into the curriculum at Hazel Grove School, which we discuss in the next section.

Teacher response to running You and CO₂

Overall, Jane received the programme favourably. She felt it fitted well with the new Curriculum for Wales, and 'that ties in really, really well to the humanities AOLE [Area of Learning and Experience]'. She started to consider how the programme might be adapted and adopted in her setting:

... So looking at bringing that into the the unit of work and having a look where food comes from could be a way in which they could bring in that element as well. That could be part of what we do in geography is like food miles as part of climate change and reducing, you know, something you could do to reduce your carbon footprint.

However, Jane also reported shortcomings. The teachers felt a disjoint between the workshops and this was echoed by the students. They felt that there was no sense of overview in the programme.

And it felt bitty because they did the science and there wasn't an obvious connection that we were able to make a process and we just didn't see it then with. So you've done this in science now we're going to do this in geography. I'm going to write this story.

She did feel that this may have been linked to the in-school delivery of the programme and she felt that 'keeping it, then within a department would allow us to do that [link the programme well]. Much better isn't it, you know?' She was also aware that doing that would undermine the cross-curricular nature of the programme.

Teachers did not always feel fully equipped to deliver the sessions because of their specialisms, but according to Jane fully silo-ing the programme according to teacher specialisms was also unhelpful. Jane felt that having a solid grounding in the knowledge linked to content would help teachers to draw links between different elements of the programme and help students to do so. To do this, Jane suggested that it might be prudent to extend the scheme of work. Examples she shared were given more in-depth consideration calculating carbon footprint or more options for adapting to individual school contexts: e.g. computer games, different lunch options, school transport options etc. Jane also wanted to have provision of accessible tutorials on use of Twine as '[the IT teacher in the school] used Twine, but she made her own PowerPoint to help them [students] step by step'. This type of differentiation would not be possible in all settings. In general though, Jane felt that teachers and students alike enjoyed the story-telling elements of the programme and that they worked well for learners.

She did, however, highlight the difficulty with this programme and the requisite knowledge for its confident delivery by professionals. At Hazel Grove School they delivered it in separate departments due to the knowledge needed but they felt the programme 'may not have had the impact in terms of pupil, of pupil enjoyment that perhaps it could have, had it had stayed within one department and one teacher'. As such, there are areas that should be considered as the You and CO₂ programme moves forwards.

There were barriers to student engagement that were outside of the effect of the programme delivery as well. Student habitus and outlooks are linked to students' embodied values and capacity to engage agentically with hegemonic structures. Jane felt that school/family priorities did not always align, which meant that homework elements of the You and CO₂ programme were not engaged with fully, as she described: 'We tried to get them to do their story and map their story out before it here as a homework task. But our kids are not going to doing homework. So it fell a bit flat on its face'. She also described general disengagement with social institutions, likely connected to the complex history of the area. There is substantial

unemployment and Jane felt that that affected families' engagement with those from outside their community; she felt relationships were crucial to fostering engagement.

Specific to the programme itself, Jane noted that because students in the school did not tend to have a broad world view or engagement with wider structures and institutions, it was quite challenging for them to build connections between different elements of the programme. In particular, they found it hard to make sense of the journey to space in the programme's purpose-built *No World 4 Tomorrow* IDN, which made it harder for them to fully engage in the programme. However, Jane did note that some students and their families did engage with climate change personally, and were making changes to their own lives:

So we have we have pupils who are engaged in those issues personally... I wouldn't say it's a big thing that our kids talk about... And if those aren't priorities for our families, they're not going to be priorities for our pupils

Running the You and CO₂ programme helped the Hazel Grove teachers to think about how to teach CCE in their school more effectively, taking into account the student habitus and outlooks and broader effects of the local areas economic status and pandemic legacy. Jane noted the potential for cross-curricular learning within the curriculum and had already started to realise what this might look like in Hazel Grove:

and maybe they can compare the price of ingredients. If they only use fair trade products, what would the cost of the dish [be]?... And actually that ties in really, really well to the humanities AOLE because part of the demand is now business studies.

The key element that Jane brought into her reflections on CCE and implementation of the You and CO₂ programme was the centrality of local issues and activism in successful CCE. Rather than focussing on abstractified, remote locations, settings, and problems, Jane sought to relate future CCE programmes to tangible local issues, as had been the case prior to COVID through the work she had engaged in with primary schools and local community groups. The following section discusses the potential developments for the You and CO₂ programme in light of the feedback and analysis presented thus far, and how adjustments might be made in other settings to incorporate it into practice.

Pragmatics of You and CO₂: programme updates

The teachers at Hazel Grove felt there was no over-arching, explicit link between the workshops to connect the 'science' to the trip to space (in the *NW4T* story). Development of a resource to help students to connect the main concepts in the workshops would be useful to support students to better engage with the programme; this resource has now been developed and included in the programme materials. *NW4T* is deliberately removed from students' every day settings to enable greater engagement across a variety of cultures and contexts. Thus it is important for practitioners running the programme to relate its content to local issues, so that young people can relate it to elements of their daily lives and to actions within their control.

Siloed subject-specialist knowledge was a barrier to teachers' confidence in delivering the programme. Full, comprehensive training materials with detailed but accessible explanations of concepts for teachers should be provided so that the programme can be delivered by non-specialists. Extension of resources so that they provide enough knowledge to non-specialist teachers and are adaptable by teacher to their local context. For example, some students do not eat breakfast but the carbon footprint of their gaming or hobbies could be explored.

Teachers did not feel fully equipped to deliver the prepared resources on use of Twine; one teacher needed to develop their own resources to instruct students on Twine. Teachers may not have been able to access the full and comprehensive range of resources and tutorials to

support their use of Twine. This suggests that improvements could be made on promotion of the pre-existing materials and their content, so that teachers are fully versed in what is already available.

Culturally sensitive case studies should be developed so that young people can explore how others may engage with climate change programmes, understand their own potential to engage with power structures and enact agency individual and in wider institutions. Further adaptations in the programme's available IDNs are underway at present.

Conclusions and next steps for 'You and CO₂'

This paper has explored the challenges that COVID-19 posed for effective implementation of CCE programmes, with consideration of both pre- and post- COVID-19 practice in a medium-sized comprehensive, secondary school in mid-Wales. Interview data from a member of staff set the scene for understanding practices and their benefits prior to lockdowns, and how lockdowns impacted on students' responses to a CCE programme post-lockdown. The findings in this study highlighted the importance of localised knowledge, and engagement with local groups in successful delivery of CCE programmes, which was reflected in students' IDNs. However, the programme was found to be adaptable and flexible, as the teachers who delivered it reporting that they could see how it might be adapted to suit their learners. This suggests that other schools and settings may be able to adapt it to suit their learners and the skillsets of practitioners. This has been undertaken by Jane who, since completion of work in Hazel Grove, has informed the project team that You and CO₂ has been adapted and incorporated into the school curriculum, to coincide with the roll-out of the new Curriculum for Wales.

Note

1. Many villages and towns in Wales, as well as in other parts of the United Kingdom, relied heavily on coal mining prior to closure of many pits during the latter part of the twentieth century. These areas continue to experience economic and social challenges, which can affect young people's outcomes.

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Ethics

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