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concrete2cookers

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portfolio
submission
ref 2014

concrete2cookers

A research project to develop knowledge of how carbon emissions are caused by buildings. The medium of gaming offers a connection between research data on carbon emissions and encouraging low energy behaviour in school children.

Output 2
Kate Carter

project overview

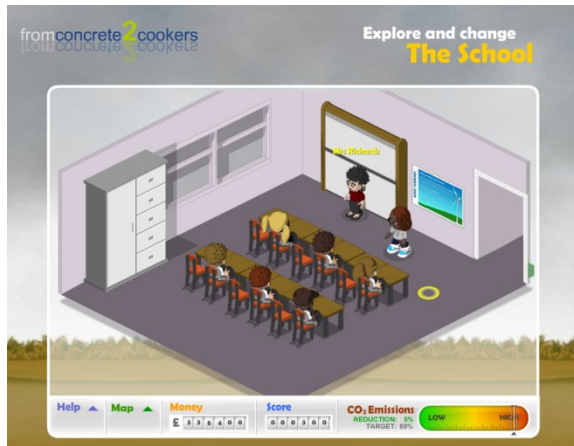


Figure 1: Game play in a classroom

‘concrete2cookers’ helps school children understand how carbon emissions from buildings can be reduced. A web-based game and associated class content create an immersive learning experience that sets knowledge of carbon emissions in the context of a school building. The project was awarded £127,000 by the EPSRC (EP/F066589/1 grant ref). Since its creation over 70 schools have used it. It is being re-launched for 2014 due to its enduring popularity. The aim of the project was to find ways to bring research data to life and give it meaning for young people.

‘Gamification’ enables a bridge between research data on carbon emissions from TARBASE (a Carbon Trust and EPSRC funded consortium) and the pedagogical context of schools. Deterding *et al.* (2011) define gamification as “the use of game design elements in non-game contexts”. Huatori and Hamari (2012) further define ‘gamification’ as requiring both systemic and experiential conditions, with increasing levels of abstraction. More complex gamification involves: rules and uncertain goals; and suspense and hedonic pleasure. This medium used for concrete2cookers, provides an immersive environment in which decision making and ethical judgement are exercised. The impact of carbon emissions can be quantified, and related to specific actions. The aim is to understand the changing behaviour in young people and the impact this has on long term attitudes to, and development of knowledge of carbon emissions.

‘concrete2cookers’ encompasses both carbon emissions from the ‘fabric’ of a building, and the things we use in buildings, providing a unique concept. Most eco-games and projects focus on one or the other. The game allows children to create a character and move around the school. They are involved in a range of situations: read posters to learn key facts; respond to situations they find, i.e. a light left on in an empty classroom; and make decisions about changes to the building. Each decision results in financial

implications and carbon reductions for the player. The aim is to achieve lower carbon emissions. An 80% reduction in carbon emissions is the maximum achievable within the game, which is in line with UK targets for reduction by 2050.

The research team formed around an ambition to develop innovative approaches to learning about carbon emissions for young people. The team had expertise in architecture (Kate Carter), social participation/value (Derek Thomson) and low carbon research (Phil Banfill & Andrew Peacock), and interest in the ideas of ‘gamification’ which led to the successful funding bid.

A full time researcher (Lorna Ross) was appointed with expertise in school engagement work and knowledge exchange from the hydrogen centre. She worked with the research team, and led the evaluation studies and workshops in schools to establish the impact of the project. Game designers, Junction-18, specialists in educational software, were appointed to develop the game for online use.

The research team and game designers worked collaboratively with four schools. Class groups and teachers were involved in the co-creation of an educational experience to stimulate children, their teachers and, by extension, the children’s families to recognise the impact of buildings on carbon emissions.

concrete2cookers the game



Figure 2: Simple instructions

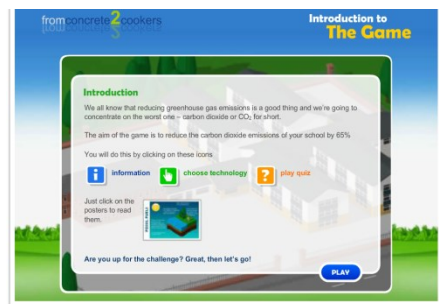


Figure 3: Explaining game content



Figure 4: Choosing a character

A success factor for the project was to create an educational game that would be appealing for use in the classroom by teachers; and perhaps more importantly, engaging for young people. The game is set up to allow teachers to log in for a whole class group, or for individuals to use independently.

The knowledge and attitudes towards carbon emissions held by children was established early in the project through surveys of attitudes and actions relating to low carbon behaviour. The research formed the baseline on which to frame the initial game development.

The game was then developed through a series of iterative workshops with the children, games designer and the research team. The graphic format was devised to be engaging, simple and easy to use, and was based on the emerging 'gamification' theories for education. Nearly 100 children and their teachers from four schools were involved in designing the characters, the teaching spaces and the way the game worked. Feedback cycles were built in through schools workshops, beta testing and input from educational experts in Learning Teaching Scotland (now Education Scotland), a Scottish Government executive agency.

The game is designed around the school buildings used for TARBASE research on carbon emissions from existing buildings TARBASE was a 4 year, £1.4M research project co-funded by EPSRC and the Carbon Trust.



Figure 5: Starting the game with carbon and cost gauges

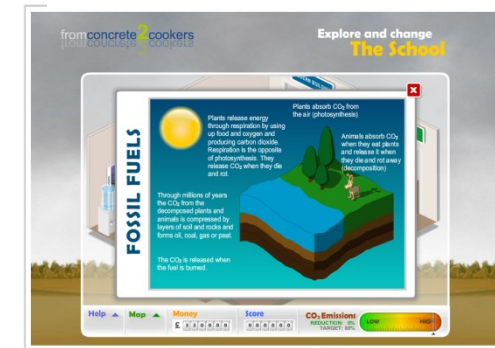


Figure 6: Typical 'poster' in game

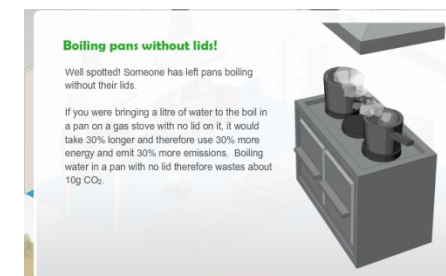


Figure 7: Carbon reduction 'activity'

curriculum alignment

Information for Teachers

fromconcrete2cookers is an exciting and timely game which encourages children to explore their school environment and spot ways of reducing the school's carbon emissions. The players will make decisions based on knowledge gained in the course of the game and their available budget, which increases as they answer questions correctly. As a teacher, you will be able to register your class so they can explore the game together.

concrete2cookers provides a context for interdisciplinary learning involving curricular areas such as the sciences, social studies and the technologies.

The educational materials provided below support the individual outcomes and experiences of Curriculum for Excellence. They are designed to stimulate further discussion in the classroom and inform planning.

Development of the four capacities in children and young people will be supported by this game (i.e. successful learners, confident individuals, responsible citizens, effective contributors). The game helps to successfully deliver, in an interdisciplinary way, the cross cutting themes of sustainability and citizenship. It can be used to support the purposes of learning in the sciences, and other curricular areas.

The materials can be used to support the skilful use of varied learning and teaching strategies that are useful, for example in the sciences.

The sciences experiences and outcomes are designed to stimulate the interest and motivation of children and young people and to support staff in planning challenging, engaging and enjoyable learning and teaching activities.

Our Materials

concrete2cookers and the Curriculum for Excellence

This mind map explains how concrete2cookers links with Learning and Teaching Scotland's Curriculum for Excellence.

These materials are released under the Creative Commons "Attribution Non-Commercial Share Alike" licence. You can change and adapt them provided that you state their original name from www.concrete2cookers.org. You cannot make money from any adaptations of these materials and, if you make your derivative works publicly available you must do so using the same licence.

- 1. Introduction:** What's it all about?
- 2. Main sources of carbon emissions**
- 3. The school boiler and fuels**
- 4. Lighting**
- 5. Insulation**
- 6. Solar Energy**

Figure 8: Information for teachers

The project was also developed to ensure a close alignment of the research material with the newly emerging 'Curriculum for Excellence' in Scotland. Subject areas from the new curriculum were mapped to aspects of 'concrete2cookers' to provide a framework for utilisation in the classroom. The steering committee included teachers from four schools who contributed to the mapping. The 'Curriculum for Excellence' is based on developing four capacities in children:

- successful learners,
- confident individuals,
- responsible citizens,
- effective contributors

The research team used these as the framework for developing a suite of materials for teachers that would compliment use of the game within the classroom. Three topic areas were identified in the mapping: Technologies; Social Studies; and Science. In each topic outcomes were used to develop particular aspects of the learning material. This took the form of activities expanding on the themes from the game.

'concrete2cookers' strongly engages the cross cutting themes of sustainability and citizenship. Users build confidence through interdisciplinary working, and responsible attitudes towards sustainability.

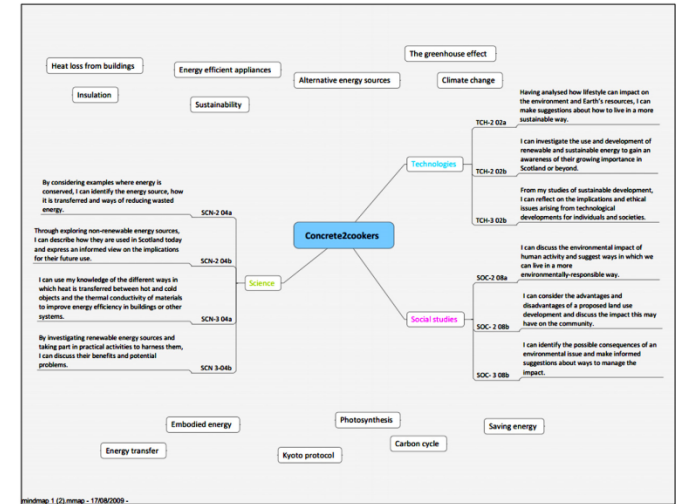


Figure 9: Curriculum mapping

Support teaching material pages from concrete2cookers:

- 5. Insulation:** What is insulation? Insulation is something that slows down the rate at which heat passes through materials. You have probably seen the special bags used for carrying frozen or chilled meat. You have probably seen the special bags used for carrying frozen or chilled meat. You have probably seen the special bags used for carrying frozen or chilled meat.
- 8. I.T. Equipment:** It is estimated that office equipment accounts for 15% of the total amount of energy used in the UK, and that is likely to double by 2020. Most of the energy consumption is by Information Technology (I.T.) equipment, especially tower PCs. You probably have some tower PCs in your school. Computers use a lot of energy. In fact, each year the total CO₂ emissions caused by UK computers are the same as the emissions from all the aeroplanes that fly in the UK!
- 3. The school boiler and fuels:** You probably don't think about how your school is heated. But the radiators and hot water that heat the school come from the boiler. Let's look at the last question first. A boiler is like a big kettle. It is used to heat water. A boiler is like a big kettle. It is used to heat water. A boiler is like a big kettle. It is used to heat water.

Figure 10: Support teaching material

Impact and Output

Throughout the project, studies were made to examine the effectiveness in understanding the need for carbon reduction. Evaluating the understanding of carbon emissions before and after exposure to the game revealed a better awareness and understanding of carbon emissions in buildings. This was measured using surveys to establish the common actions children took that impact on carbon emissions (eg turning lights off; heating on when cold; closing doors, etc.). The aim of the project was to instil behaviour in young people that would have impact on their behaviour in later life. The immeasurable nature of this legacy provides a barrier to knowledge of the lasting impact. However, the positive impact on attitudes and behaviour experienced by children who played 'concrete2cookers' suggest the game provides a good format to influence young people to lower carbon emissions.

Over 2000 individuals have accessed the website, and played 'concrete2cookers'. 70 schools from Edinburgh, Glasgow, Fife, Moray, Orkney, Stirling, Scottish Borders, Highland and Aberdeen Councils have made use of the game, with very positive feedback. Demand for the game continues, with interest from teachers in England and beyond in making use of 'concrete2cookers' and we are working to expand the login to encourage this.

School Dissemination

Workshops held in 16 primary schools with teachers were used to introduce the game, and also to evaluate the likelihood of uptake in the classroom. Feedback was predominantly positive. Teachers' comments include:

"Excited about this resource and will be using it very soon"

"I think the game is great. The information is in bitesized chunks..."

"It links perfectly to responsible citizen's capacity in the new curriculum"

"Game set out keeps children on task and interested. They will learn more in this way"

Following the workshops, the game was made available for download as well as online in response to teachers concerns about firewall restrictions and the aging computing infrastructure within schools.

Education departments continue to improve conditions for use of digital resources in schools, and the simple nature of the software platform required for use of concrete2cookers make it a practical resource for most schools.

Edinburgh International Science Festival

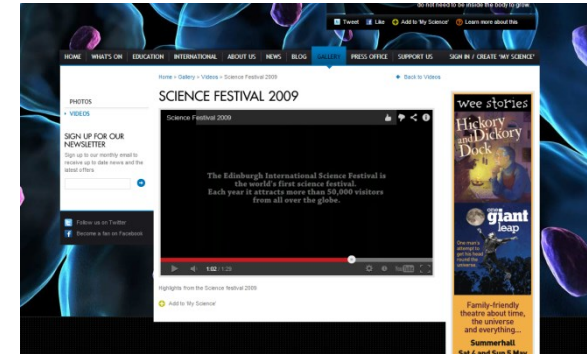


Figure 11: Science Festival website screenshot

The game was hosted at the Edinburgh International Science Festival in April 2009. The event attracts 50,000 visitors and we used the event to try our beta version of concrete2cookers. Over 500 children used the game over two weeks, with feedback used to develop the interface. A user survey showed that 95% gave it 4 or 5 out of 5. The age of children trying concrete2cookers out was between 6 and 16 years, and their feedback reinforced our decision to target the project at late primary and early secondary schools.

"its eco-friendly and fun at the same time"

"It was educational and fun and there wasn't too much information to have to read at once"

"Would give it 10/5 – really good!"

Edinburgh City chambers launch event

At the final phase of EPSRC funded work on the project a launch event held at the City Chambers in Edinburgh. This was attended by all participating children, and teachers.

The enthusiasm and dedication of the children was celebrated and presentations were given by Alex Hill of the Met Office and Alison Dobson of Learning Teaching Scotland. The event was reported in the Evening News, a local paper.

GLOW & Global Science

The researchers on the team were enrolled as Science Ambassadors through Global Science, part of the STEM (Science, Technology, Engineering and Mathematics) network. East Scotland representative from Global Science, Frank McKeever, was on the project steering committee¹ for the project. He offered support and advice on integrating activities into schools.

'concrete2cookers' was hosted on GLOW, the national intranet for Scotland's state schools community. Learning & Teaching Scotland (LTS) said:

¹ The steering committee included the research team, representatives from the four partner schools and an EPSRC mentor, and met quarterly to guide the project development.

"This game is a fantastic resource that supports the new Curriculum for Excellence by meeting its outcomes and experiences. It is an example of interdisciplinary work which is real and relevant and the game gives schools the opportunity to get departments to work together." – Brydon Cochrane, LTS.

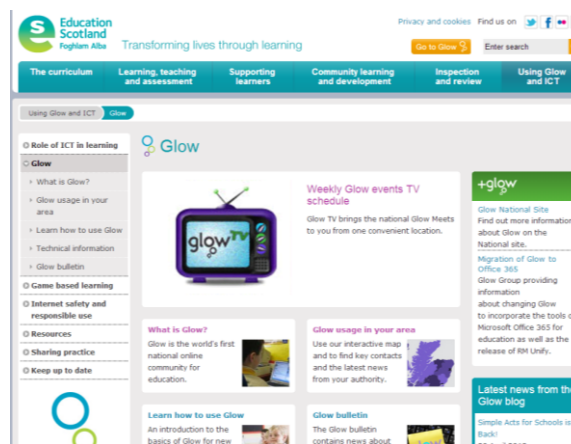


Figure 12: Education Scotland website screenshot

Legacy and the future

Further funding has been secured to re-host the game on a secure server for the next ten years. Some minor development work will also be undertaken to improve the log-in for teachers and pupils. There is continuing demand from schools for access to the game, and it is anticipated that the idea will be used to generate a new game based resource for older children involving some more complex learning.

Work on concrete2cookers has fostered further research on carbon emissions in schools. This led to a KTP (Knowledge Transfer Partnership) with

FES FM Ltd, a facilities management company, from 2009-11, which worked to reduce carbon emissions in their PPP school estate. Building on the success of both of these projects, EPSRC Research in the Wild (EP/K012789/1 grant ref) funding has been secured to take forward an innovative digital project, to co-create a Learning Energy System. This £330,000 project will harness live digital data with apps designed to transfer control of energy systems to the school community. Research will be based on the need to adapt systems to recognise user behaviour and builds on the positive outcomes of 'concrete2cookers'.

The game is available to teachers, pupils and parents at concrete2cookers.com. A teacher can register a whole class creating usernames with a 6 character password, allowing users to return to the game and attempt to improve their score.

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