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WMnet
Climate Change in the Curriculum Programme

Final Evaluation Report

WMnet Climate Change in the Curriculum Programme

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1. Executive Summary

- The WMnet Climate Change in the Curriculum Programme was an ambitious project established in June 2005, with a wide-ranging set of aims and objectives, seeking to integrate approaches to teaching and learning on the topic of climate change using emerging technologies.
- The external independent evaluation has sought to look at the approaches taken and outcomes resulting from the programme, matched against aims and objectives set at the beginning of the programme.
- Climate change is a topic that is widely accessible, being reported in the media regularly, and discussed at international national, regional, and local levels.
- Climate change is a complex area of learning, which requires understanding at a variety of levels, including emotional, scientific, political, and cultural levels.
- The WMnet Climate Change in the Curriculum Programme has provided learners with a holistic range of activities, through which they could gain the width of perspectives to inform at the levels of awareness, understanding and action related to this topic.
- Schools have no statutory requirement to include climate change in the curriculum. Educational access to the topic arises in cases where schools have a widely developed approach to cross-curricular issues of this nature, or where there are instances of interested head teachers or teachers.
- Promoting climate change in the curriculum is likely to require a focus on cross-curricular approaches to curriculum change and integration, and to the support of senior teachers and teachers through national guidance and courses as well as through provision of appropriate activities.
- There is a real question as to whether this is an area of learning that is too complex for young learners, and if so, how this could be tackled. However, many aspects of climate change have been undertaken in primary schools, and benefits for specific learners and groups of learners (including the gifted and talented) have been identified.
- The programme has involved marketing expertise, and has disseminated information through a range of channels, to inform teachers and schools about this initiative.
- Web-casts have been able to inform at an expert level, but the use of these resources has been low.
- The debate and discussion event was welcomed by pupils who reported on it, it was reported to have informed them, and to have led to a number of specific actions being taken at individual, group, school and home levels.
- Climate change is a unique area of learning, where 'real' science can be tackled by young people (on the GLOBE web-site). It is an area that allows science to be tackled from the point of view of questioning, rather than providing facts. The involvement with GLOBE has led to at least two schools becoming active at a data collection level.
- Specific materials are being developed as a part of this programme, but these have not yet been placed onto the portal.
- So far WMnet have recorded 52 schools involved across the programme. Although involvement by schools has been variable, a number of schools and pupils have been involved in events that have informed them, have led them to act on issues of climate change, and have provided a stimulus to encourage scientific data collection or a changed attitude to learning.
- By looking at progress and outcomes against originally stated aims and objectives, some aims and objectives have been met to a greater extent than have others. A major challenge for the programme has been the low take-up by schools, arising from the fact that this is not a major curriculum requirement. However, this is in itself important; it is difficult to see how such a resource could have been established through mainstream educational or curriculum activity. There is now a clear potential for its wider use.
- The ways in which teachers and learners can access resources and facilities on the portal needs to be carefully considered. Access through questions rather than statements might enable users to find appropriate resources more easily. The recorded web-casts might be better presented in the form of selected elements in question and answer form, for example.

- Although the rate of access and use by learners and teachers has been low, there is a useful bank of resources available. This bank should be maintained, and access should be reviewed and enhanced where possible.
- Experiences with the web-casts can allow this medium to be used more effectively in the future. For example, it was clear that when technology goes wrong it puts presenters off. There needs to be some discussion with presenters about these possibilities, and the sorts of things to do when this happens. Similarly, pupils need to be prepared so that their time is not wasted. It is important also that the visual nature available during web-casts is used adequately. Otherwise, an audio-cast would suffice.
- More work with senior teachers in schools on climate change should be undertaken. In the past the shape of ICT in the curriculum has been supported through the work of ICT co-ordinators and availability of courses at senior teacher level (such as NCSL SLICT courses). Similar approaches for climate change should be considered if this is an important aspect to shape for the future curriculum.

2. Introduction

2.1   Background

Within documentation produced in September 2005 by WMnet describing aspects of the Climate Change in the Curriculum Programme, there was a clear statement about the reasoning for and intentions of the programme: "The proposed WMnet Climate Change in the Curriculum programme is designed to make climate change a major focus in WM schools during the school year September 2005 to July 2006. The programme is a set of activities and projects linked to the theme of climate change that increase the use of broadband technologies and foster new ways of teaching and learning. From those activities will emerge resources and learning objects such as videos, animated presentations, lesson plans and guidance to be freely available through a range of technologies and formats to the UK education community under the WMnet Climate Change in the Curriculum banner."

2.2   Aims of the Programme

The aims of the programme were stated in the WMnet programme documentation:
a) "To effect a change in learners' perception of the curriculum such that the curriculum is seen to be more relevant.
b) "To provide a stimulus for collaboration and partnership between schools in the region and beyond.
c) "To create and sustain links between working scientists, particularly those in the region and learners in schools.
d) "To promote e-learning both in and out of school.
e) "To exploit the potential of emerging technologies that make use of broadband connectivity.
f) "To develop curricular resources and learning objects of national relevance and utility."

2.3   Objectives of the Programme

A range of objectives of the programme were detailed within sections of the WMnet programme document: "While the programme may be expected to have its greatest impact on school geography and environmental science, evaluation will also seek evidence of changes in learner attitudes to school science as a whole. It is intended that the programme will make a contribution to a shift in the perception of school science and university science, both of which are currently facing a significant decline in popularity. It is anticipated that the activities will have an impact on the school curriculum in the following areas:
1) All sciences including ecology and environmental science – data capture and interpretation.
2) Geography – weather.
3) Citizenship – personal and collective responsibility.
4) RE – ethical issues.
5) ICT – use of a range of applications and skills.
6) International partnership and twinning – pairing with schools abroad, with video-conferencing to compare and discuss.
7) Media literacy – judging the reliability of evidence, spotting bias.
8) Sustainable development – discussions of solutions.
9) MFL – debates with peers in other countries."

2.4   Planned Projects and Activities

Within the WMnet programme document, a number of planned projects and activities were listed:
1)   "KS3 science and geography. A review of the QCA model schemes of work in science and geography, beginning at KS3 which highlights areas where climate change issues are relevant and appropriate and builds on similar exercises undertaken elsewhere.
2) Web-cast and broadcast debates from e.g. the youth parliament to facilitate the debate over the ethical issues surrounding the global warming hypothesis.
3) Links to meteorological web-cams, monitoring equipment and databases providing live data feeds, including providing data and video feeds from environmental centres in the region.

4) Support for international collaboration between schools over climate change, using video technology in the communication of the experiences surrounding climate change and to explore national variations in the perception of the threats from climate change, e.g. Caribbean, Bangladesh, Europe.
5) An inter-school collaboration project which utilises the experience of the WMnet Crossover D&T project.
6) Topical activities, e.g. 'spring watch' supported by on-line community tools for school collaboration.
7) New pedagogical models. One or more projects explicitly developing innovative pedagogies, notably enquiry based learning, building on work of a successful and active group of WM teachers (Teachers In Development Education).
8) Live, video-conference, on-line 'ask the expert' sessions during which academic experts from WM universities, museums, libraries, Hams Hall, Botanical Gardens etc., answer questions from learners in schools.
9) Email forums. Expertly moderated and answered online forums for schools on Global Warming issues.
10) Climate change portal. A section of the WMnet portal drawing together links and publicising the activities, also acting as a gateway to other climate change resources mapped onto the national curriculum and strategies.
11) Climate modelling tools and animations. The creation of interactive on-line simulations of global warming and the consequences of climate change with scope for students to vary the models, assumptions and premises; this to involve the evaluation of existing visual simulations. Animation techniques and Virtual Reality methods to enhance presentations of global warming simulations and models for a range of learner ages and abilities, including those with special needs.
12) Geographical Information Systems. There will be opportunities to share climate change data through GIS systems.
13) Teacher and adviser panel (in partnership with subject associations) to identify and review useful resources, sites and links, mapping them against national curriculum subjects to encourage embedded work on climate change in a range of subjects.
14) Feedback Forum. There will be facilities which encourage learners to indicate their response to the materials and initiatives plus their recommendations for improvement."

2.5   The Aims and Focus of an External Independent Evaluation
Overall, this report is concerned with an external independent evaluation designed to look at a wide range of aspects concerned with this programme. The individual elements explored within the evaluation are listed in Table 1 following.

Evaluation aspects	Specific aims, objectives and criteria to consider
Monitor progress in terms of agreed and published outline and action plans	Targets will be set early in the project and progress assessed independently towards them
Examine each programme project and activity to explore depths and extents of uses	KS3 science and geography QCA model schemes of work review
	Web-cast and broadcast debates
	Links to meteorological web-cams
	Support for international collaboration
	An inter-school collaboration project
	Topical activities
	New pedagogical models
	Live, video-conference, on-line 'ask the expert' sessions
	Email forums
	Climate change portal
	Climate modelling tools and animations
	Geographical Information Systems
	Teacher and adviser panel
	Feedback forum

Evaluation aspects	Specific aims, objectives and criteria to consider
Identify specific uses and cases of uses in schools, and examine these in terms of specific learning or attitudinal outcomes	KS3 science and geography QCA model schemes of work review
	Web-cast and broadcast debates
	Links to meteorological web-cams
	Support for international collaboration
	An inter-school collaboration project
	Topical activities
	New pedagogical models
	Live, video-conference, on-line 'ask the expert' sessions
	Email forums
	Climate change portal
	Climate modelling tools and animations
	Geographical Information Systems
	Teacher and adviser panel
	Feedback forum
Consider how far the evidence gathered indicates the extent to which aims of the programme have been met	To effect a change in learners' perception of the curriculum such that the curriculum is seen to be more relevant
	To provide a stimulus for collaboration and partnership between schools in the region and beyond
	To create and sustain links between working scientists, particularly those in the region and learners in schools
	To promote e-learning both in and out of school
	To exploit the potential of emerging technologies that make use of broadband connectivity
	To develop curricular resources and learning objects of national relevance and utility
	All sciences including ecology and environmental science – data capture and interpretation
	Geography - weather
	Citizenship – personal and collective responsibility
	RE – ethical issues
	ICT – use of a range of applications and skills
	International partnership and twinning – pairing with schools abroad, with video-conferencing to compare and discuss
	Media literacy – judging the reliability of evidence, spotting bias
	Sustainable development – discussions of solutions
	MFL – debates with peers in other countries

Table 1: Elements of the WMnet Climate Change in the Curriculum Programme explored in the evaluation

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3. The Final Report and the Evidence Base

3.1   The Final Report

The purpose of this final report is to indicate the level and extent of outcomes and findings that can be identified, shown by the range of evidence and feedback accessible, linked to specific elements of the programme, across the range of activities undertaken. This final report attempts to place the intentions of the WMnet Climate Change in the Curriculum Programme in context (in Section 4), offers a view of the ways in which the programme has been undertaken and used (in Section 5), provides a summary of outcomes and conclusions (in Section 6), and recommends possible future ways forward (described in Section 7).

3.2   The Evidence Base

The evidence base available that was used to inform this report is detailed in Table 2 following.

Form of evidence	Frequency
Internal project and WMnet documents	12
Documents produced by WMnet for dissemination purposes	6
Attendance at project meetings	2
Observations of activities in various sessions	6
Teacher interviews	4
Pupil interviews	9
Pupil questionnaires following the Climate Change Debate	30
Interviews with key personnel	1
Interviews with project personnel	1
Documents produced by expert speakers	1
Emails from the project manager	14
Sets of internal project statistics	4
Additional related documents from WMnet collaborators	5
Expert reviews of web-casts	7
Reviews of the Climate Change portal	3

Table 2: Evidence base for the evaluation

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4. Climate Change and Learning

4.1 Climate Change is a Widely Accessible Topic

The topic of climate change is being promoted by discussions at world scientific and government conference, European Community (EC), and national levels. Aspects of the topic are being made accessible through policy discussions at these levels. The topic of climate change is not hidden; indeed, it is popularly and regularly reported in the media, in newspapers as well as on television and radio, including being reported in free papers such as the regional Metro. However, although aspects of the topic are commonly accessible through the media, aspects of the topic also provoke discussion, concern and sometimes, strong reactions. Take, for example, an on-line report entitled 'The EC's message to the people of Europe: Make do and mend' by Sandy Starr (accessed at http://www.spiked-online.com/index.php?/site/article/343 on 24 August 2006). The report says that: "The latest European campaign on climate change is driven by killjoy arguments for rationing and restraint." It goes on to say that: "Inasmuch as climate change poses us with a challenge, it needs to be met with the most ambitious and innovative solutions that our finest minds can muster. Wagging the finger at us for enjoying the hard-won conveniences of modern life, and telling us to be more austere, does not constitute any kind of solution. In fact, that stance has little to do with taking a scientific approach to the climate, and is more about those in authority forging a new morality for which the climate is a useful pretext." From educational and learning perspectives, therefore, this topic provides both a potentially stimulating focus, but also a number of distinct challenges.

4.2 Climate Change from a Learning Perspective

It is clear that the topic of climate change is complex from the point of view of learning. Overall, learners need to have awareness of the issue (to know that the issue exists), have physical access to information, have perceptual access (to recognise the potential value of information sources), and to understand the forms of message in terms of validity, for example. The importance of understanding the underlying science is clear; how pupils can gain access to this understanding is clearly important. Climate change is not a simple topic; gaining understanding of climate change requires understanding at a number of levels:

- At an ideological level (an understanding of why climate change creates strong responses, including emotional and ideological responses, from individuals and groups).
- At a political level (an understanding of why climate change is handled differently in different countries and by different political groups, what government climate change policy exists, and the impact or involvement of climate change in government education policy).
- At an economic level (an understanding of the key issues from an economic point of view and how different approaches can be taken from economic perspectives).
- At a scientific level (an understanding of what the scientific evidence says about climate change and the issues that lie behind key discussions and debates at a scientific level).

4.3 Climate Change from an Educational Perspective

Climate change is not explicitly stated as a curriculum need for schools (indeed, the WMnet programme has needed to look at the mapping of climate change within the current National Curriculum in England, in order to provide ease of access for teachers and learners, and to structure the resources to match the ways in which this topic tends to lie within schools). An understanding of climate change potentially falls into a range of curriculum areas (and each area has its own detailed and specific knowledge needs):

- Personal, social and health education (PHSE).
- Citizenship, cultural, ethics and moral education.
- Politics and economics.
- Geography.
- Science.

Because climate change as a topic is distributed across a range of subject areas, from an educational perspective the topic is likely to appear within a school curriculum under certain circumstances. It would be likely to appear if:
- A school had widely developed or integrated approaches to cross-curricular development.
- A head teacher or senior teacher took a particular interest in the topic.
- A subject teacher took a particular interest in the topic.

4.4 Climate Change from a Developmental Perspective

As climate change is a complex topic with regard to learning, and in England its integration into or place in the curriculum is likely to be linked to specific educational opportunities, WMnet clearly face a number of challenges in terms of providing ICT-based and on-line opportunities to support this area. To succeed in terms of supporting climate change at an educational level, WMnet have needed to:
- Work with existing cross-curricular activity.
- Support the development of cross-curricular activity.
- Support specific head teacher or teacher interests.
- Support specific learner needs.
- Integrate with existing technological uses by teachers.

The evidence within the remainder of this report focuses on activities within the WMnet programme that have sought to support the interests of head teachers and teachers, and the specific needs of learners. The approaches that have been identified, and that will be considered here, are:
- How teachers and learners have been informed about the programme and activities available.
- How learners have been informed by expert perspectives.
- How teachers and learners have been involved in debate, discussion and action.
- How teachers and learners have been involved in scientific processes.
- How teaching materials have been conceived and developed.
- How school level involvement and commitment in aspects of the topic has been gained.
- How the portal has been structured and populated.

5. Activities and Outcomes

5.1   Informing Teachers and Schools

WMnet has been aware of the need to disseminate messages to schools, both to teachers and learners, about this topic. WMnet has produced a number of documents that have been available both on the web-site and that have been distributed both to local authority (LA) key personnel, and to schools and teachers to inform them about the topic in general, as well as about WMnet activities to support teaching and learning needs of the topic. The information documents produced have been:

- An A4 'Climate Change' poster to introduce teachers and schools to the programme, and to its constituent activities (making a commitment, questions and answers, teaching resources, enquiry-based learning, data, sharing and collaboration).
- An A4 'Pledge Poster' to ask pupils and teachers what they are doing about climate change, by offering a range of actions that could be selected and taken.
- An A4 'Activities for Primary Schools' sheet, to alert teachers to possible activities that they could undertake with pupils (the Climate Change Pledge, Ask a Question, topical activities such as GLOBE Springwatch activities, international data exchange, exchanging opinions across the world, and enquiry-based activities to be developed by TIDE~).
- An A4 'Activities for Secondary Schools' sheet, to alert teachers to possible activities that they could undertake with pupils (the Climate Change Pledge, Ask a Question, a debate on climate change, international data exchange, exchanging opinions across the world, and science investigations).
- A double-sided A4 'Ask the Expert' sheet, to alert teachers to the expert sessions being web-cast.
- A letter to teachers and schools, inviting them to the Climate Change debate, and offering reasonable travels costs to cover attendance.

Additional ways to support the dissemination of information to teachers and schools have included:
- Involvement of a marketing company (Mango Marketing).
- Involvement of high profile key speakers in the field (such as Bill Giles OBE).
- Launch of individual activities at key events (such as the Climate Change Pledge at BETT 2006).
- Pupils and teachers to discuss trial activities with schools likely to be interested.
- Email alerts through national groups (Becta and professional associations).
- Collaborative activities with key associations (such as the Association of Science Education and Science Across the World).
- Involvement with activities likely to be of value or not otherwise accessible (such as the opportunity for teachers to undertake a range of data gathering activities with their pupils and upload the results into an international database that is managed by NASA and used by climate change scientists across the world).
- Encouraging WMnet constituent LAs to make information available to schools (such as the document to alert teachers and schools to an afternoon workshop session in Worcestershire LA, focusing on climate change).

5.2   Informing from Expert Perspectives

Five web-casts with different subject topic experts were planned, run and available for view, both at the time they were run, and afterwards by accessing the portal. These web-casts were designed to inform learners from expert perspectives (the web-cast topics and schedule are shown in Table 3 following).

Title	Expert(s)	Date
Weather and climate change	Bill Giles	25 January 2006
Implications for food production and the countryside	Peter Kettlewell and Paul Beckwith	8 February 2006
The role of oceans in changing our climate	Harry Bryden	1 March 2006
Transport and climate change	Lee Chapman	15 March 2006
Impacts of climate change	John Thornes	29 March 2006

Table 3: Subject expert web-cast topics and schedule

In each case, the web-cast experts were located in a studio in their own institutions, a link to a school in the region was created (so that pupils could be involved and ask questions of the expert), and the web-cast transmission and recording processes were managed within a separate location by WMnet. The sessions were advertised as being appropriate for pupils in Key Stages 4 and 5. Across the five web-casts, two web-casts involved school pupils in Key Stage 4, and two involved pupils in Key Stage 5. Personnel and time involvement for this activity was high. A great deal of liaison had to be done even before the web-cast took place, and on the day itself the personnel involved in each location were commonly:

- A subject expert (two on one occasion), a WMnet officer, and technician support in the expert's institution (at least 3 people).
- A WMnet officer, technical support on-site, a teacher, and about 10 pupils in the link school or educational establishment (at least 13 people).
- A WMnet officer and WMnet technical support in the web-cast transmission and recording location (at least 2 people).

Each web-cast lasted about 30 minutes, so the time involvement prior to and during the web-cast for all non-pupil personnel was in the order of 8 hours (allowing for some 30 minutes preparation time per person). If pupil time is accounted as well, this comes to some 18 hours of time in total. Clearly this level of time commitment is worthwhile if the resources produced are used by others both at the time of recording, and afterwards, through access from the portal. Use of this range of expert facility live, coupled with resources accessible afterwards on the WMnet portal, has been low. In March 2006, the access recorded was as shown in Table 4 following.

Title of web-cast	Numbers logged onto web-cast	Numbers of activity sheets downloaded
Weather and climate change	6	177
Implications for food production and the countryside	3	112
The role of oceans in changing our climate	3	87
Transport and climate change	6	72
Impacts of climate change	-	76

Table 4: Recorded access to web-cast facilities up to March 2006

It is clear that access to activity sheets has been far greater than access to the web-cast recordings themselves. It is not clear why this is the case, but some discussion about ways of structuring web-casts that they are easily accessible will be undertaken later in Section 7.

When considering the web-casts themselves, different web-casts have been approached in different ways, and have highlighted different issues. Aspects concerned with three specific web-casts are discussed here.

For the web-cast conducted by Bill Giles on 25 January 2006, a short video (2 minutes 10 seconds approximately) was run prior to the web-cast, and pupils from a school were involved afterwards in asking specific questions. Overall, the structure of the session was well set out and was likely to maintain interest and engagement. There was some introduction to set the context of the session after the initial film, but it was not clear how many centres were watching, or what the level of the content might be. The lecture from Bill Giles was structured around certain main points or notes, and these helped keep the viewer interested, as ideas were clearly connected with each other. Bill Giles described climate change, gave reasons for believing that climate change is happening, discussed the effect of greenhouse gases since 1990, how mathematical models have indicated potential outcomes, the effects that global warming would have on London, a trend in increases in instances of tornadoes, what can be done, and the need to involve schools, power producers, and local politicians. The material was explained at a steady pace with excellent intonation to emphasise points. There was one shot of Bill Giles mainly throughout, but there was no clear need for graphics or other resources, as he was able to carry the session using intonation, interest and clear explanation. A slide of notes or points on a document camera or on a MS PowerPoint

slide might have helped some learners to more easily access the material. The lighting was appropriate, but the camera level was lower than the initial video – it was at eye level, so it felt more like a conversation. Bill Giles looked at the camera and addressed the viewer, thus making the viewer the second person in the conversation, and in this way maintained interest. The audio quality from Bill Giles was excellent throughout. The remote site audio was not always clear. The questions from pupils were hard to hear, and the content of questions was often already covered in the preceding talk. Bill Giles did not ask the audience for their views, which would have exploited the medium more (maybe this happened because weather presenting is a non-interactive transmission). The session was well rounded off. The reported duration of the web-cast was 54 minutes 39 seconds, but it actually ran for only 31 minutes.

The web-cast conducted by Peter Kettlewell and Paul Beckwith on 8 February 2006, ran for 25 minutes 48 seconds. There was a technical fault preventing connection with one remote site for part of the session. There was no introduction to the session, and it would have been useful at the start for a presenter to give some detail of the level of the session, expected duration, to introduce the specialists, and to say something about Harper Adams University College, to at least give some context for what was to follow. Presenters sitting in a row provided a rather flat approach, both in terms of image and interaction. One image throughout was visually hard. Sitting in a slight arc would have improved speaker and presenter dynamics, and presenters could have looked at each other more easily. They could also have looked at the camera with a more distinct movement. Pre-sets on the video conference equipment would have been useful, especially if set to close up on each speaker (this would have added to visual engagement). The information was complicated to follow in audio form, and after 25 minutes it was hard to follow. Perhaps to address this issue it could have been edited down or added to. A document camera might also have helped, as some of the verbal responses were hard to follow and to structure. Having bullet points to follow would at least have given a framework for processing the detail. At the remote site, the head of geography in the school selected pupils to take part, and they had previously prepared questions (but these were not sent in advance to the presenters). WMnet and local authority personnel were at the remote site two hours before the web-cast was due to run. A connection problem arose, which prevented access from the remote site, and this meant that pupils were sitting for a long time without involvement in the activity. Connection was eventually possible, 21 minutes into the session. Questions from the remote site were hard to hear (it might have been useful for the presenter to repeat the question for clarity and for the recording). Allowing the questioner a chance to respond to the answer – to see if they understood the response – would have been useful (this greater interaction would have exploited the technology more), but this approach might not have been done due to time constraints. Audio from the expert site was of good quality throughout. The speakers were clear in their points and answers. However, questions were answered in a rather short form, and not dynamically. Presenters or lecturers speaking to an empty screen or camera might not be stimulated in the same way as they are in a lecture hall or classroom. Experience showed that when the technology goes wrong, it appears to affect and put off presenters. Additionally, it is difficult to have something else for students to do if things go wrong, especially if they are in an area that is not a classroom environment. Overall, visual elements were largely unexploited. Indeed, this session could have been run as an audio or radio-cast, as the video added little (other than perhaps visual validity of the experts). Personnel time involvement in this activity was high: at the remote site, the head of geography, a school technician, the project manager, and a local authority officer were all involved; others were working at the presentation and recording sites also.

The web-cast conducted by John Thornes on 29 March 2006, worked more effectively, in a number of respects. Twenty minutes before the web-cast was due to be broadcast, pupils used the audio to check the system. The position of the microphone was changed to check volume and clarity. At the start, a short video was played. The presenter appeared to be well prepared, with slides prepared in advance. The topic and the presenter were introduced. The presenter opened up issues of climate change very quickly, then used slides to identify climate, baseline climate in the West Midlands, and to show possible scenarios for the 2020s, 2050s, and 2080s, modelled with low emissions or high emissions of greenhouse gases. He discussed the differences between natural global warming and enhanced global warming, and showed predicted enhanced global warming figures (which are also available on the internet). He discussed

impacts in the UK, as well as advantages versus disadvantages that can arise from global warming. Questions from pupils in a school at a remote site were easy to hear, and focused on specific points that added to the presenter's discussion.

The project manager for WMnet, in liaison with other WMnet key colleagues, put together a review of experiences from web-casting. WMnet personnel were involved in web-casting in this programme for the first time, and they recognised that they had gone through a steep learning curve. To ensure that the points they had learned were recorded for both their own benefit and for the benefit of others, the project manager listed these as key points within a feedback document.

The key points taken from the project manager's review document are:
- Technical testing.
    - The advantages of using the JANET Video-Conferencing System, in terms of support provided, the quality of support and system, and free access to a multi-conferencing unit.
    - Systems need to be registered in advance.
    - A pre-test needs to be arranged.
- Using questions from pupils.
    - Preparatory activities are needed, and these provide benefit when they are run in the school.
    - Sufficient questions need to be prepared, especially if the link is lost.
    - Questions need to be prepared and sent in advance, which is better for the experts, and provides a better flow in terms of information.
- Preparing pupils.
    - How questions are managed.
    - Rehearsing, especially in view of audio delay, but also in terms of volume and projection, and that both parties feel more relaxed after trial experiences.
    - Allowing pupils time to experience what it is like to be connected, before they go live.
    - Aspects of permissions need to be addressed.
    - Gaining an understanding of the width of audience involved in the web-cast.
- Preparing the expert.
    - Gaining an understanding of the width of audience involved in the web-cast.
    - Briefing the expert on the level of understanding of the pupils, the technology being used, and the questions that will be asked.
- Room layout.
    - Position of the 'talking head'.
    - The background to be used and distractions removed.
    - Consider lighting, the position of windows, and the fact that too much light uses higher bandwidth.
    - Consider group size.
    - Camera position and alignment to the screen.
    - Use a cheap autocue, so that questions and guidance can be projected behind the camera.
- Use of microphones.
    - Ensure they are switched off when not in use.
    - Ensure the lead is long enough to reach all pupils.
- The need for a chair of each session.
    - To manage time.
    - To open proceedings, and to introduce all personnel present.
    - To manage the microphone.
    - To close proceedings.
- Visual elements.
    - Electronic presentations are subject to an independent time lag, and are difficult to read.
    - Use larger text, or put these directly through the video-conferencing system.

- Viewing web-casts.
  - There can be technical difficulties, which may be local, but need to be resolved.
  - They need to address an issue for the viewer.
  - Timing may be a problem, especially if the web-cast has to be reviewed before it is used.
- Marketing and publicity.
- Recording web-casts.
  - A procedure is needed for extracting the audio elements.
  - Use of a Codian 'box' needs to be considered.
  - Use full screen to avoid flickering.

5.3   Involving in Debate, Discussion and Action

An event was run to involve teachers and pupils in debate and discussion about climate change, and to take them to the point of encouraging selected appropriate action to help address some of the issues considered. The event was run at the Young People's Parliament, Millennium Point, Birmingham, on 3 February 2006, and was entitled "Climate Change - what on a warmer earth has it got to do with me?". The event was designed to engage a range of young people in debate, discussion and action, as well as exposing them to awareness of issues through a range of key speakers. There were 12 schools involved in total (although 9 attended from Birmingham LA, there was only one from Dudley, Staffordshire and Warwickshire LAs). The day started with a Climate Challenge video and quiz (the quiz was set by one of the teachers attending the event). Each teacher and pupil was able to respond to each question using an electronic voting system attached to each seat in the auditorium. Immediately following voting, the responses gained from the audience could be shown using the electronic system available, with results projected onto the auditorium screen.

Responses to questions through the voting system were recorded at the time. The questions, responses possible, and number of votes gained for each response are shown in Table 5 following.

Question	Possible responses	Votes gained
Which of the following is not a greenhouse gas?	Water vapour	140
	Carbon Dioxide	4
	Nitrogen	23
Trees change_____ to_____?	Manure to methane	9
	Oxygen to carbon dioxide	10
	Carbon dioxide to oxygen	147
Which of the following countries releases the most greenhouse gases?	USA	114
	China	43
	Russia	8
How much has the average global temperature increased in the last 100 years?	0.6 ℃	36
	1.6 ℃	85
	6 ℃	44
Which of the following is NOT a possible effect of global warming on the UK?	Warmer summers	14
	More forest fires	58
	Glaciers melting	94
Where are some of the clearest and most obvious effects of global warming being observed?	Central America	5
	Arctic	147
	Australia	13
Which of the following was the location of a world summit on global climate change?	New York	16
	Kyoto	117
	London	31
Which of the following is not a cause of global warming?	Deforestation	36
	Burning fossil fuels	7
	The hole in the ozone layer	123

Question	Possible responses	Votes gained
Global warming can only be prevented by the leaders of individual countries - it is out of the hands of the general public.	Agree	20
	Not sure	14
	Disagree	134
Less developed countries have very little industry and so do not really contribute to global warming.	Agree	46
	Not sure	30
	Disagree	90
The only way that global warming can be prevented is by setting strict rules and then having strict fines for anyone who breaks them.	Agree	59
	Not sure	25
	Disagree	83
If the richer industrialised countries of the world significantly reduced their levels of greenhouse gases, it would make life much more expensive for the general public.	Agree	60
	Not sure	41
	Disagree	63

Table 5: Questions asked and votes gained for responses in the morning quiz

These results indicate that this form of debate, discussion and working session are likely to be of value. There is evidence from some questions of lack of certain forms of knowledge (particularly scientific knowledge) associated with climate change, which needs to be actively addressed if understanding of the concepts and issues by young people are to be widened and gained more broadly. The wide diversity of opinion shown by responses to certain questions suggests that young people can gain through involvement in discussion and debate with others.

After the quiz, there were talks from four specialist speakers (from DEFRA, the Environmental Services of Birmingham City Council, Friends of the Earth, and the University of Birmingham). Speakers were asked to provide their presentations in forms that could be put onto the WMnet Climate Change web-site. These documents provide a potentially useful source of information, which can be viewed independently by those who attended as well as being accessible by those who could not attend the conference itself. After lunch, young people needed to work in school groups, and feed back to delegates. A debate by key speakers followed, which was web-cast, with questions raised from the audience. A further quiz, concerned with possible actions that could be taken to prevent climate change, was also undertaken, and votes were cast by those present in the same way as during the morning session. The questions, possible responses, and numbers of votes gained are shown in Table 6 following.

Question	Possible responses	Votes gained
Which is the most important individual action? (Waste)	Recycle more	99
	Stop using ready meals	13
	Re-use where possible	50
Which is the most important action for the local community? (Waste)	Supply recycling bins at schools	38
	Supply more recycling boxes to homes	90
	Tax the community on the amount of waste produced	39
Which is the most important action national government should take? (Waste)	Invest more on recycling centres	37
	Raise awareness of issues through advertising etc.	102
	Tax non-recyclable packaging	26
Which is the most important action individuals should take? (Energy)	Turn off lights and take appliances off standby	97
	Persuade people by educating them	36
	Use renewable energy where possible	33
Which is the most important action the local community should take? (Energy)	Reward people for insulating their houses	39
	Fit council buildings with energy saving devices, e.g. automatic light switches	64
	Set limits for how much energy people can use (and fine over-consumption)	64

Question	Possible responses	Votes gained
Which is the most important action national governments should take? (Energy)	Impose annual energy quotas	21
	Put climate change into the National Curriculum	27
	Invest in renewable energy resources	119
Which is the most important action individuals should take? (Transport)	Choose more fuel efficient cars	16
	Think carefully about how you travel and walk, cycle or use public transport where possible	131
	Choose alternative fuels to petrol	23
Which is the most important action local communities should take? (Transport)	Subsidize public transport	79
	Set up cycle lanes and bus schemes	71
	Reward car sharing	17
Which is the most important action national government should take? (Transport)	Pressurise multi-national companies to provide alternative transport options	80
	More campaigns, e.g. national bike day	44
	Tax aviation fuel	41

Table 6: Questions asked and votes gained for responses in the afternoon quiz

Clearly one way of measuring the value of this conference would be to explore the extent of action taken by those present after the conference. Some time after the event, all schools were contacted, and many agreed to take part in an evaluation of the event. A questionnaire was sent to the schools; these were completed by pupils, and returned electronically or by post. Four schools returned responses (from 30 pupils in total). Responses and results from those questionnaires are detailed here.

Pupils were asked whether they found the event useful or interesting:
- 5 found it very useful.
- 22 found it interesting.
- 2 found it neither useful nor interesting.
- 2 found it not very interesting.
- 0 found it not at all useful.

Pupils were asked which parts they found most useful:
- 11 said the videos were most useful.
- 9 said the talks were most useful.
- 11 said the voting on questions was most useful.
- 7 said the discussion in groups was most useful.

Pupils were asked whether they had visited the WMnet Climate Change web-site, and 13 said they had. They were also asked whether they had taken any actions to prevent Climate Change since the debate:
- 8 said they had, personally.
- 2 said they had, with a group.
- 3 said they had, at school.
- 16 said they had, at home.
- 10 said they had encouraged others to take action.

Overall, therefore, of 30 pupils responding, most (26 out of 30) found the event useful or interesting, they were able to identify particular elements that they found useful, many accessed the WMnet Climate Change web-site, and many had taken action since the event to prevent Climate Change. If this level of outcome is indicative of the wider outcome from the entire audience, then the event could be judged to have informed pupils, involved them, and led them to take positive action.

5.4   Involving in Scientific Processes

Understanding the scientific processes and knowledge in climate change is an important need for pupils. It is important for pupils both to recognise that the science is emerging, evolving, and in the process of being undertaken at this time, as well as recognising that there is great debate about the validity and implications that can be drawn from the scientific results that have emerged so far. Two critically important aspects for pupils are concerned with the fact that this topic provides them with opportunities:

- To examine emerging science, and how results are examined, to make contextual sense of them.
- To be involved in providing authentic research data collection for use by scientists.

One way in which schools and pupils have been able to become involved in direct scientific processes has been through the collection of local data to inform scientists at a worldwide level. GLOBE is a worldwide data collection and holding facility for data concerned with climate change, set up on-line, to do this. GLOBE has worked with the WMnet programme, and has provided 4 training sessions for teachers (involving in total 17 schools). Teachers of geography, science, mathematics, ICT and PHSE or citizenship were alerted, both through direct mailing from WMnet and through LA representatives. Teachers were told that they could: "Contribute to international research on climate change … to contribute to an international database that is used by serious scientists in their research into climate change. The database is managed by NASA and contains a variety of environmental data. As it is a significant scientific resource it is important that data is collected and uploaded according to a set of rigorous standards. This world-wide collection of data is available to schools for their own investigations. On-line tools enable schools to graph and map the data to suit their needs. In the UK, the GLOBE Programme runs one-day training sessions for teachers to explain the rigour required and demonstrate ways to make effective use of the data. If you or a colleague would like to attend one of these events, please contact GLOBE …". Four training events were run in separate locations, and numbers of attendees at each event are shown in Table 7 following.

Event location	Number of teachers attending
Warwickshire	4
Worcestershire	6
Birmingham	3
Herefordshire	6

Table 7: Location of GLOBE training events, and numbers of teachers attending

In these sessions, teachers were provided with a resource pack and CD, details of URLs, and the facilities that GLOBE offers and supports. It was explained that GLOBE collects data concerned with climate and weather, and geophysical data. It was shown that it is possible to use the data to explore models, to look at rainfall prediction, and tropical storm visualisations, for example. It was explained that data that schools can collect, that can feed into the worldwide scientific data banks, cover weather, phenology, water, soil, land cover, and sustainable development. All data sources need to be located in data banks through global positioning system (GPS) identifiers. Twenty-four satellites are used to locate position. LANDSAT produces an image (showing a 15km square) for a school when it has collected 250 pieces of data. Data can be collected from anywhere within that 15km square. GLOBE scientists set the protocols necessary to ensure validity of data. For example, for weather, the protocols consist of: clouds (type and amount); contrails (type and amount); temperature (maximum, minimum, current); precipitation (rain and snow fall). The training event run by GLOBE showed teachers ten different cloud types, identified how they could be distinguished through use of a model, showing the type of cloud related to height, shape and features. Teachers were shown how to estimate cloud cover (with 4 pupils in 4 different views), and the three types of contrails (short-lived, persistent, and persistent and spreading). The equipment needed to measure temperature was shown and different types were explored, as well as the equipment to measure liquid precipitation (rainfall or snow, measured in millimetres and pH). The phenology features used for measurement were also shown and explored (how living organisms react to seasonal climate change, budburst, green up, green down, and seaweed reproduction). The support provided by the UK and worldwide web-sites was demonstrated.

From the training sessions, it was clear that teachers and pupils could collect data as a part of this project, which could then be accessed on-line, to enable scientific concepts concerned with climate change to be considered, developed or challenged. Pupils as a consequence would be able to ask questions, hypotheses could be formed, and understanding could be enhanced or acquired. It was clear that high level thinking skills could well be involved when pupils either collected or viewed data. Although this was clearly advantageous, teachers were likely to need to support pupils appropriately at those points in time.

All training was completed by 5 December 2005. At the end of January 2006:
- 7 schools had registered on a GLOBE web-site.
- 1 school had entered data (but this school had previously done this, prior to the training).

By the middle of May 2006:
- 9 schools had registered on a GLOBE web-site (although details on the international web-site were more complete than those shown on the national web-site).
- 3 schools had entered data.

It appeared that at least 2 schools had been encouraged to be involved in scientific processes that were likely to inform pupils about climate change issues. A third school had continued to be involved.

One of the schools encouraged to use the GLOBE facilities had involved gifted and talented pupils from across the primary school. The teacher involved had studied geography at university, and the head teacher had asked her to go on the course to see whether this facility could provide a basis for gifted and talented pupil activity. Following the course, GLOBE work was involved in a 12 hour module, entitled the 'Children's Universe Module'. This module involved working in 12 sessions, 6 for 1 hour during the school day, and 6 for 1 hour after school. The teacher covered a number of aspects in these sessions: looking at weather, cloud formation, temperature and rain gauges in the outside weather station, temperature change, and climate around the world (using data from GLOBE). However, the teacher found that data was not easily accessible; she needed to locate it, found there was too much information on some pages, and that it was not well signposted. The site was used with 3 or 4 pupils from each year from Year 2 to Year 6. The teacher said that although these pupils could cope with the work she put together, she would not use it with an entire class of Year 4 pupils, for example. She found that the site was very adult-oriented (that it would have been better if it had been child-oriented).

The GLOBE site was used across 4 weeks of work, and was used both for data access and for data collection and recording. Across the four weeks, the pupils were involved in activities concerned with:
- Week 1 – weather changes.
- Week 2 – clouds (sheets were printed out from the site, and these were found to be useful), data was logged, and this was put onto the site.
- Week 3 – rain gauges.
- Week 4 – data from the site was used to compare with their own data, and their own data was put in, on cloud formation, rainfall, temperature, and weather conditions.

The teacher said that pupils enjoyed collecting data, and the sheets were found to be useful. The pupils also did some activities on litter (and one sheet was used with the entire Year 4 class). The teacher said that pupils liked the idea of the data being used by someone else; that this meant that the experience was 'real', and the practical work was helpful and was liked. The teacher felt that the activities had helped understanding, particularly in Years 2 and 3, but also in Year 4. The teacher said that Year 2 pupils did a lot on contrails, and that this had helped their awareness a great deal, and more broadly about how to look at weather. The teacher said that in terms of climate change and beginning to understand the concepts of climate change over long time periods, Year 5 and 6 pupils were more aware of time scales, but that Year 2 pupils were so young that the application of time for them was less.

The teacher thought the project for gifted and talented pupils was useful:
- ICT use was involved, and pupils enjoyed using it.
- New approaches were involved for pupils.
- Pupils were able to import data.
- Pupils were able to grasp concepts.
- That pupils need to see the bigger picture of climate change.
- There is a need to bring societal concerns into the classroom.
- It was useful to have a series of primary activities to use.

The teacher said that she would undertake these activities again, and that she would like to explore other activities, such as green-up, and habitats. Although the teacher felt that the GLOBE web-site was valuable, she felt also that it could have been simpler, and that it could then have been used more.

The responses from a second school encouraged to be involved in data collection using the GLOBE facility varied in some respects. The school was an existing eco-school, and it was interested in concepts of sustainability. In this school the teacher involved had collected temperature data with a group of pupils, and had entered this set onto the GLOBE site. Half a term's data was collected and recorded. However, the teacher was not sure about the use of GLOBE data within a curriculum context. She found it was difficult to get pupils to record data, and that they needed help in putting data on the data base. She felt the experience was useful for pupils, but she was not sure about its value to others. She was not convinced about the effort of doing it, and felt that there was not enough feedback for pupils to maintain their interest or to take their learning further forward. Three or four pupils, all from Year 5, were involved, all volunteers from the eco-school committee. Pupils had found it difficult to collect data during the time available for lunch, and they were now collecting data 4 out of 5 days during the week. Although the teacher recognised the value for these pupils, she was concerned about how to make these from of experiences available to the rest of the class. She also felt there was value in sharing and exploring shared data with other schools, but had not had any experience of this to date.

5.5   Developing Teaching Materials

TIDE~ is a teacher's network working across all 14 LAs in the West Midlands. It is the largest network of its type in England, and its focus is on global issues, concerned with aspects of citizenship, sustainable development, diversity and identity. The network has done some international work. Advisers, head teachers, and teachers are all involved in the network; a group is elected to work on specific tasks, and a small team is employed, to help enable the network, and to work on curriculum development, in project form, that leads to publications. This group was involved with WMnet as an ideal partner, since the WMnet work focused on sustainable development, which was the aspect most developed by TIDE~. TIDE~ had been involved in work on climate changes for 2 or 3 years prior to the WMnet programme, and materials were already in production and being prepared for launch at a conference. WMnet agreed to:
- Hold a conference to launch the existing materials and to launch the Climate Change programme,
- Support one (or possibly more) groups of teachers to develop curriculum materials to go on-line.
- Support core group meetings, advising a working group, indicating what is available, and being involved in some mapping work (the likely structure is shown in the diagram following).
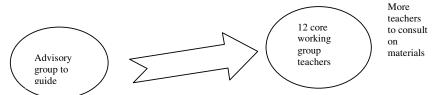

Figure 1: Likely structure of groups to work on curriculum development materials

The plan was to do undertake initial work in the Spring Term 2006, and to have materials available in the summer 2006. TIDE~ felt there were advantages of developing through an on-line medium:
- Sharing ideas of what might be worth developing would be supported more easily.
- Consultation on materials could be wider.

TIDE~ had previously produced paper-based publications with on-line back-up resources. Although TIDE~ had undertaken some consultative work on the TIDE~ website, TIDE~ had not published on the web. Some TIDE~ materials had been taken and put on the BGfL web-site already. It was felt that WMnet could extend access to resources (being online), and the form of resources (for example, in video). Current TIDE~ web-site materials were only campaign materials, information about TIDE~, and a children's web-site for use by other children.

The joint conference led to 120 people being registered (about one third were teachers, about one half were advisers, and other people came from ITE, LA centres and agencies, and there was a small group of students). Feedback afterwards was positive. It was reported that the key speakers went down well, but not short talks (from DfES, Ofsted, or QCA). Workshops were said to be effective, and overall it was felt that the programme for the conference was more strategic than focused at classroom level. Ideas about what could be done for the WMnet programme were offered during the conference, and 2 teachers indicated willingness to be involved in a working group. These 2 key teachers maintained involvement throughout the TIDE~ work.

By June 2006, the materials had not been completed, and it was anticipated that they would be prepared in readiness for the Autumn Term 2006. Draft materials were reviewed in June 2006, and although the materials offered fewer perspectives on the social and emotional outcomes and implications of climate change than those available on scientific aspects, for example, there was a useful focus taken on 'thinking through' rather than 'getting messages'. Links to subject areas needed to be completed, and a subject curriculum introduction to the curriculum tool was suggested at that time.

5.6   School Level Involvement and Commitment
Philosophy, concerned with environment and environmental aspects such as climate change, are already an integral feature of the wider policies and approaches adopted in some schools. Some schools and head teachers consider environment and environmental features to be one of the fundamental driving factors that necessitate current education in its widest context. In these cases, schools already have policies and curriculum approaches implemented that take environment and environmental aspects widely into account. Where this is the case, those schools will want to know how WMnet Climate Change resources can be integrated into what they have already, rather than these resources being treated in a bolt-on way. The philosophies and approaches of the WMnet resources need to be apparent to schools, whether they have adopted environmental concerns as fundamental elements of the curriculum at this stage, or not.

Some schools use their outside environments to support thinking and activity concerned with environmental aspects. Some schools have extensive grounds, with different areas of the garden developed to support different aspects of environmental concern and activity. These external environments are important features, and the approaches that some schools have taken are worthy of consideration in this respect. WMnet Climate Change resources need to be considered in terms of how schools might plan these into or use them with their external environments.

Some pupils have become motivated strongly by being involved in environmental work, and by being involved in environmental activities in schools. When questioned, these positive motivations appear to arise because of the nature of the work involved, particularly when the activities undertaken are in 'outside' areas. Outside activity is an important feature for these (and probably other) pupils. How WMnet resources work with, and support, activities that can be undertaken 'outside', could have a high level of significance for a number of pupils. WMnet Climate Change resources should support 'outside' activities where possible, and certainly not restrict these in any way.

WMnet Climate Change in the Curriculum Programme

The most problematic feature of understanding climate change by pupils is likely to be the grasping of concepts concerned with time lapses over significant time periods. Pupils aged 5 to 8 years, (or even 11 or 12 years, for that matter), have a limited understanding of historical time concepts, partly because their lives have been short, and partly because their experiences of changes over times of some 4 or more years have been limited. Climate change understanding requires pupils to grasp concepts of time lapse, often over a period of at least 5 years (and sometimes a lot longer). How WMnet Climate Change resources can support the development of historical time lapse concepts is not only important, but likely to be of particular value to schools and teachers, as this aspect may be less well developed, even in schools where environmental aspects are embedded widely across policies and the curriculum.

In one primary school that has integrated environmental aspects broadly at curriculum levels, for example, the head teacher started by looking at possible contributions that teachers and teaching assistants could offer with respect to the environment. She was concerned with establishing appropriate ethos and aims, in terms of supporting and developing 'well-rounded youngsters', good citizenship, care, safety, and respect for the environment. The school is registered as an eco-school, and regularly provides data for the GLOBE data base. The school developed an outdoor classroom, based on a forest concept. Foundation and Year 1 pupils work weekly in an outdoor classroom, using the environment directly. From this starting point, the school developed the school grounds more widely. A Millennium Wood was established in 2000, with each pupil planting a bulb. Further developments were possible by winning competitions, by gaining support from young people on an EBP programme, from young people who did work on site, from a parent, and from pupils returning to do brick laying, making troughs, and levelling a plot. The extensive exterior garden areas include a greenhouse (for use by Young Enterprise, growing and selling items), a pond, a global garden, a shade garden, and a hide. The garden was completed in October 2004. Using the garden areas as environments, pupils are involved in Young Enterprise and in data collection (through GLOBE).

Involvement of key staff has been important in the overall development. One member of staff worked for the school for one day a week and for a horticultural college for the rest of the time, for example. This teacher has supported Year 4 pupils in data collection on climate change, and in active learning experiences such as planting in science, and charity work. She set up a 'Green Club', concerned with recycling. A weather station allows climate data to be captured (funded through the Seebright Foundation). Outputs are linked to a web-site, so that parents and others can see the data; weather data can be seen at any time via the web. The school IT room shows outputs from the weather station, pictures of the garden during bud burst, and contains GLOBE resources.

The teacher approached the environmental work through 6 weeks of intensive activity (involving all 29 pupils). The activities were run 1 day a week, working with three groups. Pupils have repotted plants, some have taken cuttings, composting, weeding, and maintaining the beds. Pupils have looked at creatures, and castes. Pupils have been involved in the data collection for 'green down' for GLOBE. Pupils have chosen a tree, used a GPS to locate the tree, elevation, latitude, longitude, chosen a branch with 4 leaves, used the GLOBE Plant Colour Guide, and discussed colours. The GLOBE 'bud burst' activity was undertaken on the same principles. Cloud cover data has been collected, including percentage cloud cover. Sustainable development has also been covered, looking at items discarded in the bin, looking at reuse, recycling, and composting, a degradation timeline. In all cases it was found that collecting data was easier than sending data; inputting and emailing data was an issue.

The teacher has used a range of resources with pupils:
- The DEFRA web-site on global warning, including interactive quizzes.
- Looking at differences over time and the impact on animals by comparing pictures.
- The eBBC on changing the world.
- A board game on sustainable development from a book of Primary Foundations (pupils worked in groups of 4 or 5).

- Global Footprints from the web-site.

The teacher has also encouraged pupils to involve their parents in climate change work. The climate change web-site from the World Wildlife Fund (WWF) was used by all pupils at home (except 2). The web-site offered ways to check how effective the home was in supporting the environment. It was found that parents appeared to engage.

The teacher has found that this work has been well received by pupils, and that it has caught the imagination of one pupil particularly (who is otherwise 'naughty' in other lessons). It was clear from discussion with this pupil that he had been captivated by the work. He was able to describe the greenhouse effect, the effect on leaves outside, global warming at the North Pole, how to look at leaf colour to check this, and the effect on leaves of warming and cooling. He was able to discuss the consequences of global warming on skiing. Other pupils could also discuss their work on the environment easily. Two pupils, for example, discussed how they had looked at a tree outside, how they had used a GPS to show the position of the tree, and how much they had enjoyed gardening and weeding. They talked about how to look at the colour of leaves, the matching of colour, and the reason why the world is getting hotter.

5.7   The Portal

The WMnet Climate Change in the Curriculum portal has been live for some time (and can be accessed at http://climatechange.wmnet.org.uk). Links to the Climate Change Pledge and the Ask the Expert events were added to the home page at a later date. Resources and web links were combined and organised into five categories: classroom materials; data; government sources; scientific sources; and interest groups. The home page currently provides a list of key features on the left-hand side (curriculum maps, resources and web links, activities, events calendar, acknowledgements, contact details, contributing, and asking a question). There is a search facility at the top of the page, and key activities are highlighted centrally and to the right (see Figure 2 following).

Figure 2: WMnet Climate Change in the Curriculum Portal, upper part of home page

Further down the home page, specific current activities are shown in the centre left, and latest items are listed on the right hand side (see Figure 3 following).
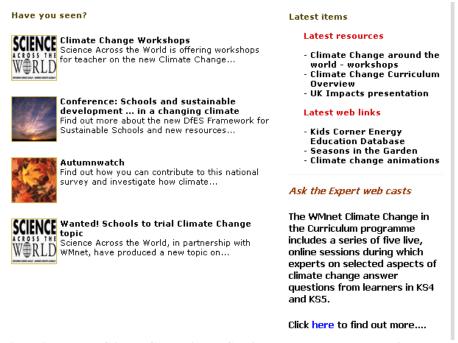
Figure 3: WMnet Climate Change in the Curriculum Portal, lower part of home page

On the curriculum maps page, links are provided to a variety of mapping approaches. These show the relationship between climate change activities, and key curriculum documents (see Figure 4 following).
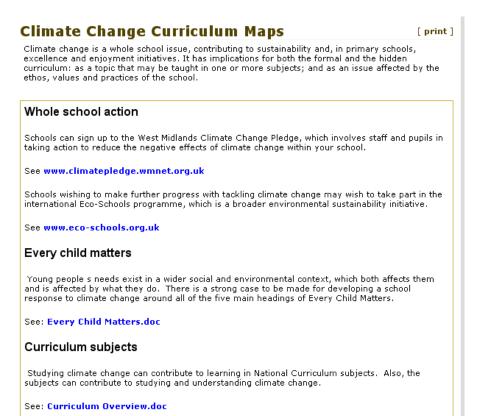

Figure 4: WMnet Climate Change in the Curriculum Portal, curriculum maps

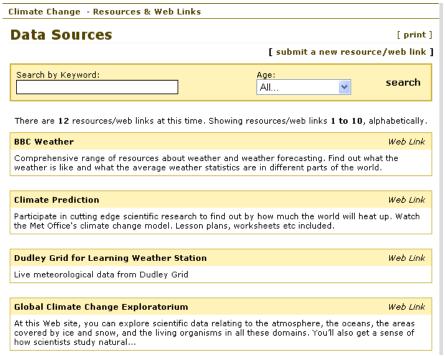On the data sources page, a list of data sources are listed, with links to each one (see Figure 5 following).

Figure 5: WMnet Climate Change in the Curriculum Portal, data sources

On the events calendar page, forthcoming and previous events are listed (see Figure 6 following).

Figure 6: WMnet Climate Change in the Curriculum Portal, events calendar

On the 'ask a question' page both the questions submitted and the answers provided by subject experts are shown (see Figure 7 following).

Figure 7: WMnet Climate Change in the Curriculum Portal, ask a question

While the WMnet portal provides a wide range of facilities, it is clear that the use of the portal is lower than had been anticipated. Portal statistics show that between September 2005 and April 2006, the numbers of views of the home page has increased substantially since BETT 2006 (when the programme was officially launched) (see Figure 8 following).

Home page 15.cfm

Figure 8: Portal home page views recorded between September 2005 and April 2006-08-27

However, portal statistics also show that access to links through the portal has not increased substantially over that time (see Figure 9 following). Indeed, the portal statistics show that although the number of curriculum links has exceeded the number of international links, the difference has been in the order of 25% of the level of curriculum links overall.

Curriculum and International Links

Figure 9: Portal statistics showing numbers of links viewed between September 2005 and April 2006

6. Summary of Outcomes and Conclusions

6.1 Summary of Outcomes

Evidence from evaluation findings and from project reports indicates those elements of the Climate Change in the Curriculum Programme that have been completed and used for teaching and learning purposes. In Table 8 following, the specific objective elements are considered separately, in terms of outcomes arising.

Specific aims, objectives and criteria to consider	Identified outcomes
Targets will be set early in the project and progress assessed independently towards them	Project plans were developed by the project manager early in the programme. Reports have been produced and presented by the project manager, showing the extent of progress against the project elements at regular intervals.
KS3 science and geography QCA model schemes of work review	A mapping exercise was set up early in the programme by TIDE~. Some curriculum mapping information on the portal was downloaded (293 items by March 2006).
Web-cast and broadcast debates	Five web-casts were set up, successfully recorded, and made accessible on the portal. A broadcast debate was run (150 pupils from 12 schools took part), and this has was also made accessible on the portal. Use of these resources has been at a surprisingly low level.
Links to meteorological web-cams	The categorisation of resources and web links on the portal enables users to find sites offering weather data. Some links offer live data and web-cam access. A pilot with Dudley LA enables data from their digital weather station to be viewed via the portal.
Support for international collaboration	Discussions were held with European SchoolNet and Science Across the World. An international links information sheet has been downloaded 188 times. A school in Siberia was put in contact with a school in Herefordshire.
An inter-school collaboration project	Although this aspect was considered, no known actions or outcomes relating to it are known.
Topical activities	This aspect was discussed early in the programme. A project to extend Science Across the World's topic area on climate change and increase opportunities for sharing opinions worldwide using multi-media was agreed. Making the News was piloted for this purpose. An environmental resource centre and LA teacher advisor agreed to develop activities with digital video on the topic of floods. Different GLOBE activities, pertinent to particular seasons, such as Springwatch and Autumnwatch, have been promoted on the portal.
New pedagogical models	This aspect was discussed early in the programme, and activities of this from were to be produced by TIDE~.
Live, video-conference, on-line 'ask the expert' sessions	Five web-casts were set up, successfully recorded, and made accessible on the portal.
Email forums	Email forums have been established, but have not been used.
Climate change portal	A portal was established, and now offers access to a wide range of related resource. Visits to the portal, and use of the portal, have been surprisingly low.
Climate modelling tools and animations	Discussions were held with ASE and Nuffield Science representatives about development of modelling software to support the study of climate change. A proposal was made by Science Across the World.
Geographical Information Systems	No evidence on this aspect has been identified.
Teacher and adviser panel	A project board was set up to support the programme. An advisory core group and teacher working group was set up to support the development of curriculum materials by TIDE~.
Feedback forum	An 'ask the question' facility was established on the portal. Although key scientists have supported this facility, there have been surprisingly low numbers of questions raised.

Specific aims, objectives and criteria to consider	Identified outcomes
To effect a change in learners' perception of the curriculum such that the curriculum is seen to be more relevant	A Climate Change Pledge was launched at BETT 2006. Take up by schools has been slow (4 by March 2006, with one outside the region, and 7 by May 2006, with one outside the region). Where schools have undertaken climate change activities, learners have benefited, and it has affected the attitude to learning for some young pupils. A range of older pupils have taken action to address climate change issues, resulting from their involvement in a debate and conference.
To provide a stimulus for collaboration and partnership between schools in the region and beyond	A great deal of effort has been put into the creation of links to foster collaboration. A marketing company has been involved, demonstrations and exhibitions have been run, and email and mail contacts have been made with chief education officers, local authority officers and schools directly. Links have been forged with the ASE and the Geographical Association.
To create and sustain links between working scientists, particularly those in the region and learners in schools	Although links with working scientists were established through the web-casts, and although the scientists were willing to maintain links, there has been surprisingly limited use of these facilities by pupils and teachers.
To promote e-learning both in and out of school	The activities undertaken have promoted e-learning both in and out of school. However, use of resources and activities has been low. Some older pupils have accessed the portal independently, but there is no evidence available to indicate the levels of independent pupil and teacher access.
To exploit the potential of emerging technologies that make use of broadband connectivity	The web-cast facilities, sharing of data and access through web-cams have all exploited the use of broadband technologies. However, some of the ways in which resources have been presented have not enhanced ease of access by learners or teachers.
To develop curricular resources and learning objects of national relevance and utility	The resources available are a useful collection of materials, which cannot be found elsewhere. However, access to resources needs to be considered more carefully, to ensure that learners and teachers can identify easily materials of value to meet their specific needs.
All sciences including ecology and environmental science – data capture and interpretation	GLOBE data capture and sharing facilities have been used within the programme. GLOBE has trained a number of teachers, and a small number of schools have captured and recorded data on the GLOBE web-site.
Geography - weather	Links to the GLOBE site, and to the Dudley weather station data, have supported this focus.
Citizenship – personal and collective responsibility	The debate raised issues of this nature, but otherwise these forms of issue are not obvious.
RE – ethical issues	No evidence on this aspect has been identified.
ICT – use of a range of applications and skills	Other than the need for learners and teachers to use various web-based facilities, no evidence on this aspect has been identified.
International partnership and twinning – pairing with schools abroad, with video-conferencing to compare and discuss	No evidence on this aspect has been identified.
Media literacy – judging the reliability of evidence, spotting bias	No evidence on this aspect has been identified
Sustainable development – discussions of solutions	The debate raised issues of this nature, but otherwise these forms of issue are not obvious.
MFL – debates with peers in other countries	No evidence on this aspect has been identified

Table 8: Outcomes arising shown against individual aims and objectives of the programme

6.2   Conclusions

A number of conclusions can be drawn from the findings:

- Climate change is a complex area of learning, which requires understanding at a variety of levels, including emotional, scientific, political, and cultural levels.
- There is a real question as to whether this is an area of learning that is too complex for young learners, and if so, how this should be tackled. However, many aspects have been undertaken in primary schools, and benefits for specific learners and groups of learners (including the gifted and talented) have been identified.
- Climate change is a unique area of learning, where 'real' science can be tackled by young people (on the GLOBE web-site). It is an area that allows science to be tackled from the point of view of questioning, rather than of providing facts. The involvement with GLOBE has led to at least two schools becoming active at a data collection level.
- Web-casts have been able to inform at an expert level, but the use of these resources has been low.
- The debate and discussion event was welcomed by pupils who reported on it, it was reported to have informed them, and to have led to a number of specific actions being taken at individual, group, school and home levels.
- So far WMnet have recorded 52 schools involved across the programme. Although involvement by schools has been variable, a number of schools and pupils have been involved in events that have informed them, have led them to act on issues of climate change, and have provided a stimulus to encourage scientific data collection or a changed attitude to learning.
- The ways in which teachers and learners can access resources and facilities on the portal needs to be carefully considered. Access through questions rather than statements might enable users to find appropriate resources more easily. The recorded web-casts might be better presented in the form of selected elements in question and answer form, for example.

7. Recommendations for Future Action

7.1 Recommendations

Based on the evidence available, recommendations for future action are:

- Although the rate of access and use by learners and teachers has been low, there is a useful bank of resources available. This bank should be maintained, and access should be reviewed and enhanced where possible.
- Change the form of some resources to make them more accessible. For example, the web-casts could be split into elements that address specific questions. Questions to be used as titles, so the web-cast element then provides an answer to that question. An example of this form of access is shown in Figure 10 following.

Figure 10: Questions used to provide access to video clips (Source: CSALT, Lancaster University)

- From the experiences with the web-casts it was clear that when technology goes wrong it appears to put presenters off. There needs to be some discussion with presenters about these possibilities, and the sorts of things to do when this happens. Similarly, pupils need to be prepared so that their time is not wasted.
- It is important that the visual nature available during web-casts is used adequately. Otherwise, an audio-cast would suffice.

- More work with senior teachers in schools on climate change should be undertaken. In the past the shape of ICT in the curriculum has been supported through the work of ICT co-ordinators and availability of courses at senior teacher level (such as NCSL SLICT courses). Similar approaches for climate change should be considered if this is an important aspect to shape for the future curriculum.

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