Baboró International Arts Festival for Children & NUI Galway OÉ Gaillimh

‘Magic can Happen’

A Process Study Report of the Baboró BEAST! Project.

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The School of Political Science and Sociology at the National University of Ireland, Galway, undertakes research on a wide range of areas such as, education, the environment, work, crime and deviance, family care and welfare and public policy.

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Executive Summary

Baboró International Arts Festival for Children has operated for more than sixteen years and focuses on making art accessible to children of all ages including babies, toddlers and teenagers and their families. Baboró stages an Arts Festival for children in October each year and includes new and innovative works using the art forms of puppetry, theatre, visual arts and music amongst others. The organisation has developed strong links with schools, communities and educational institutions since its inception. This outreach work is a developing aspect of Baboró's role and this year the organisation established the BEAST! (Baboró: Environment, Arts, Science and Technology) project, to work with schools on achieving a higher profile for science/technology (STEM subjects)[1], by encouraging children and their teachers to explore these subjects through the arts.

Representatives from Baboró engaged with the Ryan Institute, National University of Ireland, Galway (NUI Galway) to develop a brief that would attract the interest of scientists, technologists, engineers and other researchers and academics from the university population to design and deliver science projects to primary school children in Galway City and County. The project brief invited researchers to devise a series of workshops that would explore the possibilities and realities of designing a 'low carbon' future and its impact on biodiversity and sustainability. Following on from the science workshops, a number of different arts practitioners, skilled at working with children, facilitated them to create their artistic interpretation of the science topics they had explored. The work resulting from these engagements with the scientists and artists will inspire an exhibition and installation at Baboró International Arts Festival for Children in October 2012.

During the development phase Baboró engaged with the School of Political Science and Sociology at NUI Galway to carry out a process study review. Researchers from the School worked with Baboró to refine the project objectives and design the research study. The research objectives are detailed in the methodology section (Chapter Two) and include the design of qualitative and quantitative tools to collect data, observation of science/technology and art workshops, description of the project model and compilation of the process study report offering analysis and recommendations on the future development of the BEAST! model.

The expected project outcomes included impacts for the children around engagement, behavioural change and social development; impacts for the teachers in how they view the use of art to teach science and technology subjects; the production of artworks for Baboró International Arts Festival for Children in October and the documenting of the project model and project outcomes in a process study report.

Eight schools in County Galway took part in BEAST! Four were located in Galway city and four in rural towns and villages. The schools served a spread of populations that included a school serving a wide multicultural population and a school serving a socially and economically disadvantaged population. The young participants were predominantly in the 7yrs to 9 yrs age group and numbered 215 children.

Baboró facilitated a briefing meeting for science, technology and arts practitioners to meet with Teachers in April. They discussed aspects of workshop delivery, timings and other organisational aspects. Social researchers from the School of Political Science and Sociology, NUI Galway were also present at the briefing in order to engage in the initial phase of the process study. The intervention comprised the delivery of workshops in the schools and these took place over the

[1] 'STEM' subjects include science, technology, engineering and mathematics

months of May to June. Each school received 4 ½ hours of science/technology workshops and 4 ½ hours of art workshops.

The research methodology for the process study included a literature review of research on science education methods in primary schools. The literature (Varley *et al.* 2008, Gilbert and Priest, 1997,) points to the benefits of field trips, working in groups and external practitioners visiting schools to teach. The long term UK study ('Creative Partnerships' 2002-2011) was a government funded educational initiative that was delivered in more than 2,700 schools and worked with more than one million young people. It examined the impact of using external, creative practitioners in the teaching of the science curriculum and demonstrated that there was a measurable improvement for the young participants in terms of improved attendance, behaviour and performance (Kendall et al, 2008) compared to the rest of the UK school going population. This improvement was more marked in those schools that had been participating for more than three years.

The research methodology used a mixed methods approach in order to capture the project outcomes. This included participant observation at workshops and field trips, focus groups, personal interviews and purpose built data collection instruments that were administered to children pre and post intervention. Two out of the eight schools were studied in detail and case studies were generated using this material (Chapter Four). Scientists, technologists, artists, teachers and parents in addition to Baboró staff were interviewed on their perceptions of BEAST! In addition science/art practitioners and teachers were interviewed at a third school from a disadvantaged city catchment in order to capture perceptions from respondents at a Galway City school (Chapter Five)

All stakeholders expressed positive comments about BEAST! and that they would like to repeat the experience. Social researchers noted a high level of engagement in the workshops by children and teachers. Children talked about changes in the ways that they perceive science since participating. Parents noted their children demonstrated an increasingly positive attitude towards science and that their thinking about the role of science had changed. The children showed a high level of collaboration and this was noted by teachers, arts/science practitioners and observers in the two case study schools and in the Galway City school. The project objective of raising the profile of science in the participating schools was thus achieved successfully as was the objective of increasing the level of team building and collaboration amongst the young people.

The objective of improving levels of confidence and self-esteem in the cohort of children was not observed when the findings from the data collection instrument were analysed. It is suggested that in order to achieve changes in these measures it would be necessary to deliver more workshops over a longer time period.

In addition to the widespread collaboration that took place with the young people, collaboration between science and arts practitioners and teachers was also very evident. This was a strong feature of BEAST! and stakeholders identified that they felt that the project could be further improved by increasing the opportunities to network and collaborate.

In relation to the teaching method adopted by the visiting practitioners, teachers were very positive about the benefits of the more open, creative and flexible approach adopted by science and arts practitioners and felt this could be a very useful addition to the teaching of the science curriculum. They appreciated that practitioners were 'passionate' about their subjects and this was seen as a key element of the effectiveness of the model. Teachers discussed that children had more ownership of the work when they had significant input into decisions about the work. They felt that it was a 'very worthwhile' project. There is thus evidence that this model of working has created

real synergy in the schools and amongst the practitioners delivering the workshops. This teaching methodology could be successfully transferred to other schools. The model is sufficiently robust to be replicated with the proviso that the key essential elements described in the discussion chapter (Chapter Six) are in place.

The recommendations which arise from the process study findings include:

- The science brief should be broad to attract optimum numbers of science and technology researchers.

- Collaboration should have a high priority at every level of the project and opportunities to collaborate should be built into project implementation.

- Increased numbers of arts workshops would provide children with more time to develop their artistic response to the science topics. Being involved in decision making increases the children's sense of ownership and their creativity but this requires time to explore freely.

- The initial project meeting (prior to project implementation) for practitioners should contain information regarding insurance, child protection issues, in addition to enabling participants to share details of their proposals and increase knowledge sharing. There should be a closing presentation of the work and of the learning for practitioners and Baboró to harness more of the project's benefits.

- When designing science workshops it is worth considering if it would be beneficial if the current science curriculum were consulted in order to build on the children's current understanding of key concepts.

- It would appear that children aged 9-12 are the most appropriate age group for this intervention in terms of level of comprehension for science concepts and motor skills for arts activities.

- The quantitative data collection instrument should be administered to all the children at all the schools that participate in future BEAST! projects. It would enable a comprehensive benchmarking process at the pre-intervention phase and at post intervention. This would support a more comprehensive capture of the project outcomes and of the impacts of the project for the young participants. If a future study also included a control cohort then this would add to the rigor of the findings.

- It would be beneficial to engage parents during the intervention possibly including exercises for children to do at home and with a final presentation of the children's work and learning to parents.

- Participants recommended that BEAST! should be repeated and that there should be strengthened links with Baboró and NUI Galway.

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Chapter One: BABORÓ – BEAST! Project
Introduction and Description of the Project Model

1.1 Introduction

This chapter introduces the BEAST! project in greater depth; it outlines the genesis of the BEAST! model, discusses some of the principal motivations of Baboró management for adopting this approach, the initial contact made with NUI Galway for recruiting scientists and the aims and objectives of the BEAST! model. Firstly, the chapter begins by discussing the role of Baboró as an organisation who advance the creative arts among children in the West of Ireland. Secondly, the chapter discusses the aims and objectives of BEAST! in greater depth, before moving on to some of the expected outcomes of the project, such as behavioural and attitudinal change among children towards science and the arts and more general impacts on the schools who took part in the BEAST! project.

Over the last sixteen years, Baboró International Arts Festival for Children has brought a wide variety of Irish and International shows to children and their families in Galway. These have included performances, workshops, exhibitions and literature events that have showcased the art forms of poetry, percussion, dance, theatre, puppetry, mime, music and visual arts. Baboró aims to introduce new works, highlight new approaches to the arts and provide new engagement opportunities to their young audience. The festival takes place during October, and this year takes place from 15th-21st October.

Baboró International Arts Festival for Children began as one element of the Galway Arts Festival in 1994 and developed into its own dedicated festival in 1997. In the sixteen years since its establishment it has focussed on making the arts accessible to all children including babies, toddlers and teenagers. In 2009 Baboró hosted a conference 'Natural Born Artists – Arts for Early Years in Ireland' which attracted delegates, speakers and artists from the international community.

1.1.1 The BEAST! Project

As part of its remit, Baboró engages with families and children in schools and in the wider community. The outreach work with schools has become an important focus of the work and as part of the schedule for 2012, Baboró determined to target a cohort of eight schools in county Galway with a new project entitled BEAST! (Baboró: Environment, Arts, Science and Technology) project, Baboró engaged in an outreach partnership with the Ryan Institute for Environmental, Marine and Energy research at NUI Galway to deliver the project. NUI Galway has access to key researchers in the fields of sustainability and development and the Ryan Institute facilitated the recruitment of academic staff and postgraduate and postdoctoral students to deliver the scientific elements of the project. They also facilitated the scientists[2] to refine their proposed workshops to make them appropriate for the young people.

1.1.2 Rationale

Baboró identified the rationale behind the establishment of BEAST!:

> '*Arts and creative activities are of enormous benefit for young children as they engender confidence, encourage critical reflection and creative thinking and provide a powerful base for team working, problem solving and future development'* (Project proposal).

[2] The term 'scientist' includes researchers and academic staff that came from biological and marine sciences, computer science and engineering disciplines.

The original idea for BEAST! was inspired by a project in the UK called 'The ARK Project' which worked with technologists, artists and children to create a life sized ARK art installation and in the process created an excitement and interest in the young participants. Discussion and reflection brought Baboró to question the relationship between science, art and how best to design a project that would use art to create new ways of learning science and technology for primary school children.

> *'We wanted to give the children an eye-opening experience, where the world opens up [to them] and they get the excitement that one gets from new learning and the sense of wonder. [We wanted them] to be able to take the new knowledge and explore and create the habit of a lifetime. And we wanted to bring knowledge in a supportive way, contextualise knowledge, so that practitioners would act as facilitators… would journey [with the children], learning and exploring [together].'* (Baboró Artistic Director)

The overall project goal was to raise the profile of science and technology in the cohort of primary schools, encouraging the children and teachers to engage with and explore these subjects through the arts and for the young people to present their interpretation of the science workshop topics at an exhibition and installation at the Baboró International Arts Festival for Children in October 2012. The project aims were refined with the NUIG social scientists and are defined as the following:

1.1.3 Project Aims

- To instil or improve levels of confidence, critical thinking, problem-solving, creative thinking and team working in primary school children
- To demonstrate in schools and to teachers the use of the Arts in teaching the school curriculum
- To create a project model that can be replicated easily and effectively and be used by others to teach and to evaluate

1.1.4 Project Objectives

- To marry Science, Technology (STEM)[3] and the Arts in exploring a 'Low Carbon Future' with primary school children though a series of workshops delivered by Scientists and Artists
- To create an artistic response using the children's understanding of the topic
- To design and/or source quantitative and qualitative tools to collect data
- To observe workshops and document behavioural and attitudinal changes to evaluate the impact of the project
- To write a process study report offering critical thoughts on the process and possible future developments for BEAST!

1.1.5 The Expected Outcomes

The expected outcomes were identified with Baboró and the researchers at the early stage of the process study. The initial expected project outcomes included:

a) Impacts on the children relating to engagement, behavioural change and social development both in and out of school
b) Impacts on the ways the children engage with learning
c) Impacts on how teachers view the use of the arts in teaching the science and technology curriculum
d) The tangible production of an interactive exhibition inspired by the children's art works

[3] 'STEM' refers to the initial goal of increasing interest in young children in Science, Technology, Engineering and Mathematics subjects.

e) The documenting of the project model that can be replicated by other educational organisations working with children. (Process Study Report)

f) The documenting of the learning created through the delivery of the project (Process Study Report)

1.1.6 BEAST! Process Study

The staff and management of Baboró were conscious of the need to compile social scientific data on the various impacts that the project might have on the children, as well as the other participants who were involved in the project, such as the teachers, artists and scientists. As a result, representatives from Baboró contacted researchers at the School of Political Science and Sociology, NUI Galway to conduct a process study of BEAST!. In particular, as Baboró were interested in documenting the engagement of individual children in the classroom with scientific and artistic topics and in monitoring any behavioural changes which might occur as a result of the project, the social researchers were interested in conducting a benchmark of children's sense of belonging, attitudes towards science and nature and their feelings about school. As well as this, in-depth data collected through interviews and Participant Observation (PO) enabled the researchers to reveal some complex patterns underpinning children's reactions to the different topics and their sense of engagement in the creative process.

1.2 Project Details

1.2.1 The BEAST! Project Staff

One member of Baboró staff was dedicated to manage the project during the implementation phase. Two further members of management staff were involved in the project design and implementation. One photographer was employed to record the workshops using still camera and video camera to form a pictorial record of the work done with the children. One person was employed to curate the children's artistic works for the BEAST! at Baboró exhibition.

1.2.2 Funding

Baboró received funding for BEAST! from NUI Galway 'Bright Ideas Innovation Fund', Dublin City of Science 2012 fund, and a number of other funders, whose support enabled the Second Phase of the project – BEAST! at Baboró..

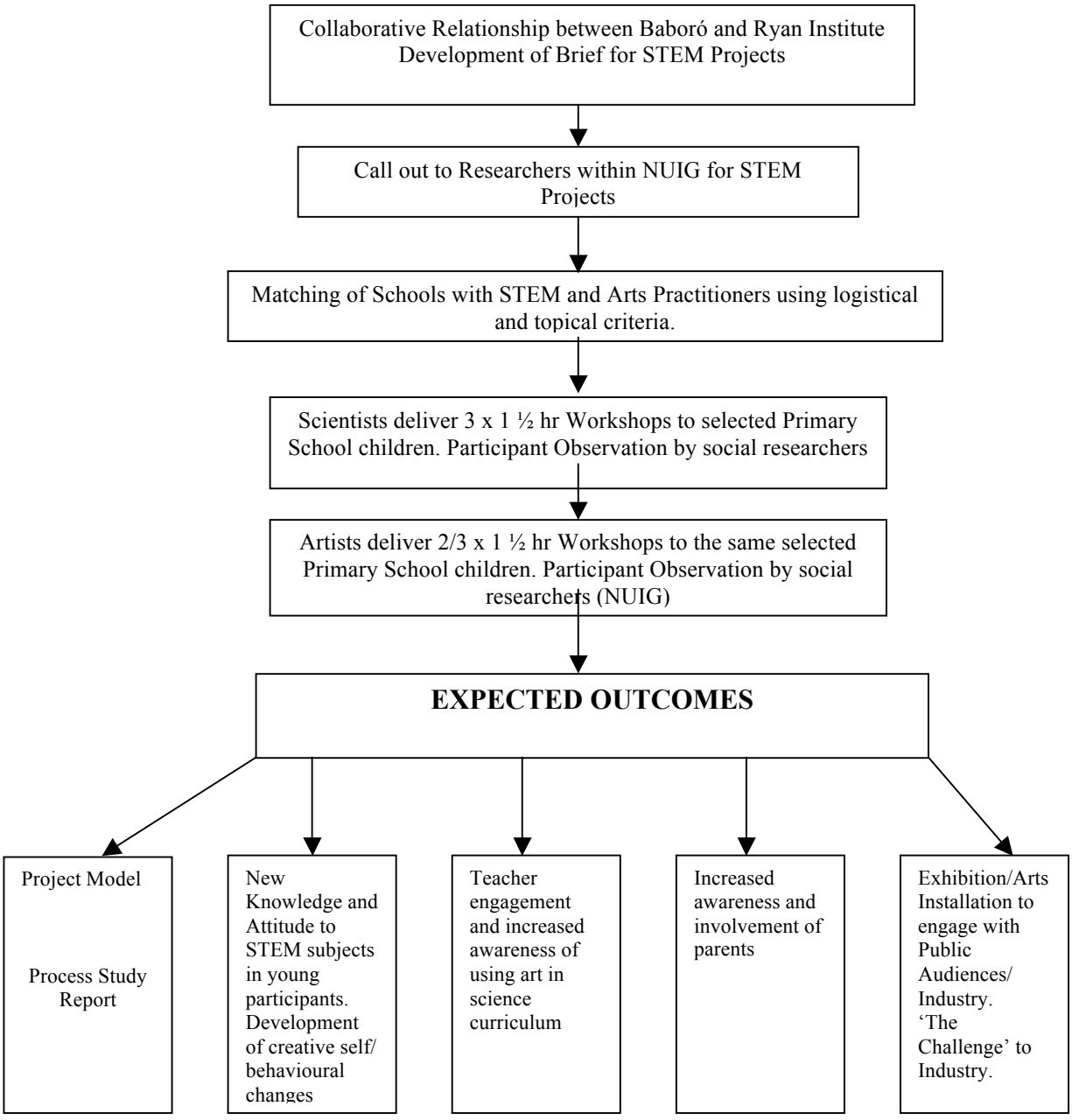
1.2.3 The School Cohort

Eight primary schools participated in the project and they were situated throughout County Galway. Schools were located in Gort, Attymon, Oughterard, Lettergesh and four schools in Galway city were situated in Newcastle, Shantalla, Renmore and Salthill. The schools served a range of populations with two schools serving disadvantaged populations, one school serving a wide multi-cultural population with increased needs for language support and two schools serving more isolated rural populations. The total cohort of children involved with the project comprised 215. They were primarily children from 2nd, 3rd or 4th Class and aged from seven years to nine years. In one small school the age ranged from 5 years to 12 years as the whole school of eighteen children participated.

1.3 The BEAST! Model

The discussion and planning for the project took place over more than a year and involved consultation with the Ryan Institute at NUI Galway, scientists and other arts practitioners in Ireland and in the UK. After the research phase a model of delivery was designed and took the following format (see Figure 1 below):

Figure 1. Baboró BEAST! Model



1.3.1 The Scientific Engagement

In early 2012 Baboró approached the Ryan Institute (NUI Galway) to collaborate in the delivery of the project. The Ryan Institute sent out a call to all university departments (see Appendix I), which detailed the brief for proposals to run 3 science (STEM) workshops (1½ to 2 hours each) with primary schools in Galway City and County. There was an enthusiastic response from the academic community and at this stage it became obvious that although many of the proposals were excellent, not all the proposals matched the element of the brief relating to the vision of a 'New Low Carbon Future'. Six of the proposals fully fulfilled the brief and two proposals although not fulfilling the brief fully were chosen on their merits. These two focused on 'Biodiversity, Food Production and Co-existence' and 'Environment and Disease (Viruses and Bacteria).' As with many innovative projects the initial project aims needed to be amended in the light of the prevailing circumstances on the ground and the initial objectives of providing new ways of interacting with science and technology subjects was fulfilled by these two proposals.

1.3.2. The Science Project Topics

The projects undertaken in each of the schools which took part in BEAST! are outlined in Figure 2 (below). It is interesting to note the wide range of projects proposed by scientists which were completed as part of BEAST!:

Figure 2: List of Schools and Projects Descriptions

School	Project Description
Scoíl Chaitríona, Renmore, Galway	Seaweed and Exploring Bio fuels. DNA Testing – The students identified varieties of seaweed and algae and 'planted' varieties to grow in order to explore how to produce bio fuel from these plants.
Lettergesh National School, County Galway	Biodiversity, Food Production and Co-existence. The students learned to identify varieties of local sea life, and create a model of co-existence to aid in the preservation of particular eco-systems that exist in the ocean off the coast of Ireland.
Attymon National School, Athenry, County Galway	Deep Sea habitats and food chains. Some external influences that can threaten habitats include pollution, over fishing and climate change. The students studied their own food web and explored how to reduce the threats that can damage coral reefs and the species that live on them.
Scoíl an Chlochair, Uachtar Árd, County Galway	Green and Sustainable Information Technology: Carbon usage, science as 'all around us' and children's representations of sustainable futures.
Scoíl Bhride, Shantalla, Galway	Environment and Disease – Proteins, Viruses and Bacteria.
Scoíl Inse Guaire, Gort, County Galway	Alternative Energy – Storing and converting energy and harvesting energy from people during motion.
Scoil Íde, Salthill, Galway	The Built Environment, sustainable building materials and renewable energy, eco houses.
Galway Educate Together NS	Ocean Acidification. The students were introduced to the scale of the universe, from atoms to galaxies, and how energy transfers in that system. Experiments producing carbon dioxide (CO_2) and explaining how CO_2 affects the pH of the ocean were conducted, and the consequence of ocean acidification was discussed.

1.3.3 Initial Project Briefing

Baboró brought together the scientists, artists and teachers at an initial briefing meeting in April to provide the background to BEAST! and to agree workshop scheduling and other organisational details. Each triad of practitioners for each of the eight schools met together and the scientists described the theme of the science topic. There was also some input from teachers who suggested ways to simplify the delivery of information, some help with lesson plan formats and similar. The social researchers from the Child and Family Research Centre were also present at this briefing.

1.3.4 The Artistic Engagement.

Baboró has developed relationships with arts practitioners who have experience of working with school children, and they selected some artists working with different art forms that schools may not have experienced before in order to give them additional arts skills. The brief for the artists was that they would work with the children's interpretation of the science topic allowing them the flexibility and freedom to develop their own approaches. The interpretation could be in the form of music, film, sculpture, games, visual art, architecture or any other artform that the children wished to use to express their ideas. Many of the artists attended the science workshops as observers.

1.3.5 The Schools Engagement

Schools provided considerable support to the project in terms of timetabling children to be free for workshops, providing educational and other facilities and in being adaptive and flexible support to the practitioners. One of the objectives of BEAST! is 'To demonstrate in schools and to teachers the use of the Arts in teaching the school curriculum' or in the words of the Baboró Artistic Director *'art practitioners demonstrate to teachers how art can be used to deepen the learning around science and technology'*. There was considerable interest in the project within the school communities and often there was more than one teacher present at workshops. Teachers were not there in an observational capacity but as a support to the practitioners, often contributing by making links with the children's existing learning. The teachers' insights on the teaching approaches used by the practitioners and of the possible impact on the school curriculum are detailed in the two case studies and in the discussion section of this study.

1.3.6 The Public Engagement

The culmination of the project work will be an interactive exhibition in a well chosen accessible site. There will be school and group tours and interactive elements in the exhibition with which audiences will be invited to engage. This element of the Model is not included in the process study as it has not taken place during the study timescale.

1.3.7 The Challenge!

It is planned that the schools choose a local business or industry and make a presentation to them on their learning from BEAST! They will challenge the business to engage with using less energy and contributing to a 'Low Carbon' future.

1.4 Report Structure Outline

The following outline summarises the layout and content of subsequent sections of this report:

(a) Literature Review: In this chapter, the literature surrounding important aspects of the BEAST model is reviewed, such as scientific education in Ireland and the benefits and challenges of using art as aid for teaching science.

(b) Research Methodology: This section outlines the methodological approach that was taken by the researchers who combined a range of qualitative and quantitative methods to gather data in the schools under study. Such methodological techniques include Participant Observation (PO), in-depth interviews, focus groups and a survey questionnaire.

(c) Two Case Studies: The two schools where the research took place are described in this part, Scoíl an Chlochair, Uachtar Árd and Lettergesh National School, both in County Galway. This part also describes the projects that were rolled out here.

(d) Research Findings: The main findings of the project are outlined in this section. In particular, this section focuses on issues to do with engagement and attitudes towards creativity of all stakeholders in the project.

(e) Discussion and Recommendations: This part focuses on the extent that the BEAST! project model managed to achieve its aims and makes recommendations on how the project might be enhanced in the future.

Chapter Two: Literature Review

2.1 Introduction

This section critically analyses social scientific literature on a number of topics that are relevant to the Baboró project. First of all, this section examines some of the different characteristics of the Baboró model and looks at where they fit in relation to theoretical approaches to child learning. Secondly, it focuses on literature relating to the primary school curriculum, and science and artistic education in Ireland. Specifically, it assesses the benefits and challenges of using collaboration and group work among children as effective teaching methods for scientific education. These topics were chosen for inclusion in this literature section as they are some of the most prevalent aspects of the BEAST! model.

While many theoretical approaches to child learning have been put forward by psychologists and sociologists, there appears to be little research on matters relating to scientific and artistic education among children in Ireland. Indeed, there seem to be few empirical studies of methods of science instruction in Irish primary schools. As well as this, there appears to be few research studies that focus on children's reactions to these methods of instruction or the attitudes of teachers and parents towards them. Such research would be important for understanding children's sense of engagement with scientific topics in Irish primary schools.

Much research has been carried out internationally on children's relationships with the environment and the factors which influence young people's attitudes towards their surroundings. In Ireland, however, there is sparse research on these topics. Social research on these topics would be significant for advancing a greater understanding of children's reactions to nature and how they conceptualise terms like 'climate change', 'the environment' and what constitutes a 'low carbon future'. Hence, this section contends that this small-scale process study makes an important contribution to the Irish literature on these topics. However, further research on these issues is also recommended.

2.2 Science Education and Children's Reactions to Different Methods of Instruction

As stated previously, the literature on scientific education in Ireland is sparse, although it should be stated that some important studies have emerged on this topic. In 2003, the Irish Primary Science Curriculum was implemented in Ireland and has served as an important impetus for the publication of reports and research articles on the theme of science education. For a number of years, concerns have been expressed internationally about the quality of scientific education in schools and recommendations have been made on ways that it can be improved. Some researchers in Britain and Ireland have also reacted to this and have focused on teaching methods in schools, although it seems that much more research is needed on this topic. In particular, this chapter contends that the literature would benefit from more case-study research of how science is taught in individual schools and the degree of pupil engagement that is accomplished using different instructional methods. Furthermore, it would also be significant for research to be conducted on what the science curriculum means to different stakeholders in education in Ireland (policy-makers on education, teachers, pupils and members of other teaching organisations). This could make a very important impact on the research literature.

2.2.1 Problems in Science Education in Ireland and internationally and Barriers to Effective Learning

Looking at how science is taught in schools, de Boo and Randall (2001) argued that scientific education in schools may be overly prescriptive as they observed a tendency for students to follow instructions in class. In turn, this leaves the children with few opportunities to develop their own questions about the modules or to collaborate with each other. Similarly, a report in Northern

Ireland by the Department of Education (DENI) concluded that children needed to be stimulated more in science class and that they should be given the chance to develop their own investigations (DENI 2002). As well as this, some of the literature suggests that children's interest in science declines with age and this trend continues into the post-primary years (cf. Murphy and Beggs 2002). Varley *et al.* (2008: 12) suggests that this decline in interest may result from the lack of opportunities that are given to children to develop their own scientific investigations in schools.

Numerous reports exist in other countries about the quality of scientific education in schools and ways that children's engagement with scientific areas can be enhanced. Many of these reports also come to similar conclusions as Murphy and Beggs (2002) for example. Goodrum *et al.* (2000) focused on the scientific curriculum in Australia and found that there are discrepancies between the curriculum as it is proposed in national education documents, and how science is taught in schools. Nevertheless, the Australian government seem to recognise the importance of enhancing creativity and hands-on scientific education in schools. Goodrum *et al.* (2000) state that the 'ideal science curriculum' in Australia should encompass student enquiry, and that children and young people should be continually encouraged to question the world around them. In addition, Goodrum *et al.* (2000) also argues that the learning environment should be characterised by 'ownership' and 'engagement' with learning materials. It would be interesting if more in-depth social research were conducted on children's engagement with different science topics in school.

2.2.2. Irish Research on Scientific Education and Child Learning

Focusing on scientific education in the Irish context, Varley *et al.* (2008) discusses the ways that science enhances the skill-set and improves creativity among children and young people. For example, they state that 'primary science offers the opportunity to harness young people's natural curiosity. Ideally, during science class, children should be provided with opportunities to manipulate and probe materials, ask questions, hypothesise, predict and test their predictors' (cf. Varley et al. 2008: 11). This seems to validate the significance of using a collaborative teaching approach when instructing children in science as it enables them to engage effectively with the materials under study.

Varley *et al.* (2008) also produced interesting findings on attitudes to science among primary school teachers and children and this also appears to have especial resonance for the Baboró study. In particular, the children who were surveyed were very enthusiastic about science and scientific education and they enjoy working collaboratively. At the same time however, Varley *et al.* (2008) found that there were very few opportunities for some pupils to play a more active role in designing activities in the classroom. Instead, many pupils seem to be experiencing a type of scientific education where the classroom demonstrations are teacher-led. As well as this, the pupils' experiences of science education in classrooms seem to revolve around reading, writing and completing exercises from workbooks. At the same time however, some pupils were unenthused about this method of education and felt that it did not allow them to be creative. Furthermore, the children were enthusiastic about going on field trips and in having visitors enter the classroom to teach scientific topics. In a similar vein, Gilbert and Priest (1997) focus on field trips to museums among primary school children, and they argue that children are more engaged in exhibits when they work in groups with friends, when they can walk around on their own and choose which exhibits to visit. This seems to suggest that aspects of the Baboró model may be conducive to science learning, as it aimed to provide ample opportunities to children to work collaboratively and to develop their own ideas.

2.3 Advantages and Challenges of Group Work as a Scientific Teaching Method

Within the literature, the advantages of group work and collaboration between students learning science have been widely discussed by educational theorists. However, there appears to be little research in Ireland on this topic once again. There is little research available on how group work

should be organised in different contexts, although some studies have looked at barriers to effective group work in schools, such as lack of confidence among teachers to effectively co-ordinate group work in class and lack of supports for teachers (Howe *et al.* 2003). Once again, it is argued here that further research should be completed in Ireland on the effects of group work on science education and teacher's opinions about this teaching method.

At the same time however, there is a significant amount of literature internationally which argues that group work can have very significant effects on learning (Osborne & Freyberg, 1985; Thorley & Treagust, 1987). Social constructivist theorists of education have argued that dialogue and social interaction are pivotal to successful learning and engagement with learning materials (MacDonald and Miell 2000). More recently, Howe *et al.* (2000) conducted an experiment on the effects of group work on science education among primary school children in the South of England. The researchers sought to determine whether the students who took part in the programme would show greater progression of learning on matters such as condensation and force, compared to a control group who did not participate. The study concluded that in this context, student learning was supported when students propose ideas and explain their reasoning and these are often key features of group work. In addition, this study also assessed if other processes such as disagreement, reference back and resolution (which are also part of working in groups) affected learning. From the results generated by Howe *et al.* (2000), it was difficult to determine if these processes had a significant effect on learning. However, they also make the point that such processes can indirectly support child learning (cf. Howe et al. 2000: 31).

Studies have also looked at the effects of collaboration among children on artistic and musical learning. For example, Miell (2000) argues that friendships between children can significantly affect how they learn music in groups, although this also depends on context. Studies such as Miell (2000) seem to corroborate that peer relationships can have very significant effects on learning among school children.

2.4 Marrying Science and Art and the Effects on Child Learning and Engagement with Science

As well as this, there appears to be little research in Ireland on the ways that science and art, married together can affect child learning of scientific topics. In particular, it seems interesting for more research to be completed on how children conceptualise 'creativity' and how the creative arts could impact on science learning in the context of Irish primary schools. In the UK, however, there appears to be much more research on the effects of the *Creative Partnerships* initiative on child learning. The *Creative Partnerships* scheme had some similarities with the BEAST! as it brought science and art together in efforts to help children engage better in the classroom. This is advertised as the UK's 'flagship creative learning programme'[4] and it ran from 2002 until September 2011 when funding was withdrawn from the UK Arts Council. The project brought people who were involved in different sectors of the creative industries into classrooms, such as architects, scientists and artists to work with teachers 'to inspire young people and help them learn'.[5] The programme was hugely successful. Overall, it worked with 2,700 schools, 90,000 teachers and over one million young people were involved in the project. The programme aimed to develop the skills necessary to help students excel academically and to prepare them for the workplace. Creativity was at the very heart of the *Creative Partnerships* initiative. It was defined as 'the wider ability to question, make connections, innovate, problem solve and reflect critically'. Fostering creativity among young people was seen as being important for helping them to reimagine what the world should be like and to enable them to make change happen.

[4] See http://www.creative-partnerships.com/

[5] See http://www.creative-partnerships.com

Since the conclusion of *Creative Partnerships*, a number of studies have emerged which evaluate the success of the project. In particular, these studies focus on the effects that creativity has on educational attainments and student retention rates which are mentioned frequently in the literature. Eames *et al.* (2006) found that there was a small association between attending *Creative Partnership* activities and levels of academic progress in young people. Kendall *et al.* (2008) also found that taking part in CP improved young people's attendance and behaviour in schools. Participating in *Creative Partnership* was also associated with a drop in the absence rates in primary schools and this drop in absence rates increased as CP became more established in these schools. This was particularly noticeable in schools which had run CP for three years or more. For example, in schools that had taken part in CP for five years or more, the total amount of absences was 0.41 days per year which is below the level considered to be statistically significant.

Significantly, Kendall *et al.* (2008) also looked at changes to children's self-confidence and self-esteem and attitudes to the learning process among pupils at CP primary schools. Much of their analysis focused on comparing outcomes for young people who took part in CP schools to national figures for primary school children. For children at Key Stage 2 (KS2) level,[6] Kendall *et al.* (2008) found that there were no statistically significant differences in progress between children who attended CP and national figures in attainment rates for English, Science and Maths. However, at Key Stage 3 (KS3) level,[7] Kendall *et al.* (2008) found that the progress of young people who took part in CP did increase compared to pupils at a similar age and stage nationally. This was also evident in the sample of children at Key Stage 4 (KS4);[8] progress of young people who took part in CP was statistically significantly greater than that of young people nationally.

2.5 Summary

This section reviewed literature under a number of different headings which relate to some of the most salient aspects of BEAST!. In particular, it reviewed literature on group work and child learning, the effects of creativity on scientific engagement and children's attitudes towards scientific learning in Ireland. It is recommended that much deeper research needs to be completed on science education in Ireland and what it means to different stakeholders in the education system. However, children and their attitudes towards science and current teaching models also need to be factored into this research. As a result, this chapter recommends that more in-depth research needs to be carried out on how science is taught in Ireland and the benefits and disadvantages of applying different teaching strategies in specific educational contexts.

[6] Children at Key Stage 2 level are defined in the Education Act 2000 as children between the ages of 8 and 11 years.

[7] The term 'KS3' generally covers the first three years of secondary school

[8] KS4 includes children from fifteen years up to the end of compulsory schooling in Britain.

Chapter Three:
Research Methodology of the BEAST Process Study

3.1 Designing and Implementing the Project Methodology

The researchers utilised a mixed-method approach when collecting, analysing and interpreting data for this study. Qualitative and quantitative methodological techniques were employed in order to access children's social worlds. The researchers felt that using qualitative and quantitative techniques would enable them to explore the children's viewpoints and the experiences of other participants in BEAST! (teachers, scientists and artists). A quantitative survey questionnaire provided insights on the children's sense of wellbeing and resilience and the qualitative and ethnographic methods revealed in-depth data about their reactions to science and art.

The objectives of the Process Study were as follows:

- To design the project methodology including to design and/or source quantitative and qualitative tools to collect data
- To describe, and critically analyse, different aspects of the project model
- Establish the perspectives of different actors involved in BEAST! (artists, scientists, teachers and children)
- To observe workshops and document behavioural and attitudinal changes to evaluate the impact of the project
- To write a process study report offering critical thoughts on the process and possible future developments for BEAST!

3.2.1 Description of Schools that took part in BEAST! Process Study

Representatives from Baboró chose the two schools where the data would be collected for the BEAST! process study. The schools that they chose to take part in the study were Lettergesh Primary School and Scoil an Chlochair, Uachtar Árd. The Baboró staff interviewed for the BEAST! process study acknowledged that all of the projects that were received from the scientists were interesting. All of them were unique in their own way and they related to the topics of 'sustainable futures' and 'low carbon futures' in highly diverse ways. However, they decided to include these schools as part of the process study as they felt it would be interesting to observe the engagement of children who live in country areas in Galway County and that this could be augmented at some stage with a larger-scale, comparative study of children's sense of engagement with science and art in urban and rural areas.

As part of the BEAST! process study however, the researchers also carried out interviews with the scientist, artist and teacher in Scoil Bhríde in Shantalla, Galway City which also participated in the BEAST! study. This school was chosen for inclusion in the study for two reasons; because it is situated in an area that is classified as 'socially disadvantaged' and it is located in the city. The researchers wanted to explore whether or not similarities and differences might be discernible in the data from a city school that is classed as socially disadvantaged, compared to Lettergesh and Uachtar Árd, which are located outside of the city limits. This is explored in greater depth in this report in chapters five and six (findings and discussion).

3.2.2 Overview of Research Aims, Questions and Methods

The following table (Figure 3) provides a summation of the main aims of the BEAST! process study, the research questions which related to these aims, and the methodological approaches that were adopted throughout the project.

Figure 3: Summary of BEAST! process study aims, research questions and methodological approaches utilised

Aim	Research questions	Methods
Describe and Analyse the Baboró BEAST! Project Model	● What does the BEAST! Project Model consist of? ● What are its aims and objectives and desired outcomes? ● Why was it established? ● What are the structures and practices of the programme? ● How many schools/young people involved? ● What is the key research evidence on using arts in the science/technology curriculum?	● Review of programme reports & other relevant documents ● Interviews with Baboró Artistic Director/ Project Co-ordinator Focus group with Baboró Management Staff ● Documentary review ● Literature review
Establish the perspective of participants/key stakeholders regarding the programme	● Why did stakeholders choose to engage with the programme? ● What outcomes are perceived to result from the programme for young people, teachers, practitioners, parents? ● What are the views of stakeholders regarding the programme implementation?	● Interviews and Focus Group with Baboró Artistic Director/Administrator/ BEAST! Co-ordinator ● Administration of Quantitative data collection instrument to children in two participating schools ● Observation of 3 workshops in each of the case study schools and at field trip to marine laboratory. ● Interviews with 3 Teachers, 3 Scientists/Technologists, 3 Artists ● Focus Group with 7 young people in one school ● Interviews with four parents
Document Attitudinal and Behavioural Changes towards Science and Art	● What are the opinions of key stakeholders in BEAST! towards science and art at the commencement of project? ● What can be concluded at end of project about behavioural change as a result of BEAST?	● Quantitative Survey questionnaire (Baseline study) ● Interviews and participant observation ● Quantitative survey questionnaire (repeat of baseline study conducted in Week 1) ● Interviews and Participant Observation
Reach a series of conclusions regarding the BEAST! pilot project	● What is the core purpose of the project? ● What outcomes are perceived to result from the programme for children, teachers and practitioners? ● What are the views of stakeholders regarding programme implementation? ●What recommendations can be made to guide the future development of BEAST!?	● Interviews with Baboró Artistic Director/ Project Co-ordinator ● Focus group with Baboró Management Staff ● Analysis of findings from Quantitative data collection instrument ● Review of all primary and secondary data ● Process study review

3.2.3 Designing a quantitative Survey questionnaire

The social researchers who completed the BEAST! process study developed an instrument aimed at 'measuring' children's attitudes to BEAST!, science and art, their feelings about school, their friends and sense of wellbeing. The quantitative instrument was partly developed from research that was previously completed by the Child and Family Research Centre, NUI Galway (CFRC). This tool has been tested and validated for measuring children's wellbeing, their feelings of resiliency, their social networks and social supports. In the BEAST! survey, such items were incorporated to 'measure' children's sense of 'belonging' at school and at home in order to chart attitudinal and behavioural change throughout the project.

As well as this, Larsson *et al.* (2009) items on eco-affinity and eco-awareness were also incorporated into the instrument. As the scientific projects implemented in schools were focused on children's interpretations of a 'sustainable future', the researchers decided to extract data on how the young people reacted to the environment around them. It was also envisaged that at the end of the project, we would be able to make suggestions, albeit tentative ones, about children's environmental behaviours and whether or not we could observe any behavioural change.

The questionnaire was divided into five discrete sections (see Appendix II). In section one, the children were asked to indicate their feelings about taking part in activities with the scientist and artist. In section two, they were asked about their experiences in school; if they felt like they belonged in school and if they felt 'connected' to their teachers and/or other pupils. The third section also focused on how the children felt at school and included items such as 'I feel good about myself', 'I feel worried' and 'I feel valuable'. The fourth section asked about the children's feelings towards their friends, while section five focused on their attitudes towards nature. The researchers administered the survey with the children during the first workshop with the scientist and repeated it again during the final session in order to chart any changes that might have taken place in behaviours and attitudes during the project. The number of children who took part in the survey questionnaire in both schools is summarised in the table below (Fig. 4).

Figure 4: Number of participants in Pre and Post Questionnaires (BEAST Process Study)

	Lettergesh	**Uachtar Árd**
Pre-questionnaire (number of participants)	17	20
Post questionnaire (number of participants)	17	18

3.2.4 Using Focus Groups, Interviews and Ethnography to tap into children's social worlds

Participant Observation

Phase III of the study focused on the qualitative part of the project. The researchers completed ethnographic research (Participant Observation) at three workshops in each of the two schools. The observation schedule was adapted from Ballantyne (2005[9]). In addition, one of the researchers also attended a field trip to the Ryan Institute's Carna Research Station by the Lettergesh group. During the workshops and the field trip, the researchers recorded extensive field notes on the children's reactions to the scientist and artist. Participant Observation was advantageous as the researchers were able to observe the children, scientists, artists and teachers directly and ask them about their feelings towards different parts of BEAST!

[9] Ballantyne, R; J. Packer and M. Everett (2005) 'Measuring Environmental Education Program Impacts and Learning in the Field: Using an Action Research Cycle to Develop a Tool for Use with Young Students' *Australian Journal of Environmental Education,* vol. 21: 23-37

Qualitative Interviews and Focus Groups

This ethnographic research was also completed in tandem with of qualitative interviews and focus groups, which yields exceptionally rich data on how people (re)-construct social meanings (see for example, Waterton and Wynne 1999; Macnaghten 2004). The artists, scientists and teachers in the two schools were interviewed.

In Lettergesh, a focus group took place with seven of the children who participated in the BEAST! project. Telephone interviews were also held with four of the parents of the Lettergesh children after BEAST! concluded. This was done in order to probe parents about whether or not they had noticed changes in their children's attitudes or behaviours since their participation in the project. In Uachtar Árd, telephone interviews were arranged with parents of some children who participated in BEAST! Interviews were also conducted with the scientist, artist and teacher in both Lettergesh and Uachtar Árd. The Outreach Officer at the Ryan Institute was contacted for interview and the researchers were able to tap into some of her opinions about the project about. The table which follows summarises the number of interviews which took place in Lettergesh, Uachtar Árd and Shantalla and the participants who took part in these interviews (see Fig. 5 below).

Figure 5: Participants interviewed as part of BEAST process study;

Participant's role in BEAST!	**Number of participants interviewed (Lettergesh, Shantalla and Uachtar Árd)**
Artists	3
Scientists	3
NUIG Ryan Institute Representatives	1
Baboró representatives	3
Parents	4
Teachers	3

3.3 Data Analysis

The interviews and ethnographic research was analysed using Discourse Analysis (DA). This is a highly versatile method of analysis as it can be used to analyse texts and photographs as well as talk (see Bryman 2012: 528). The researchers completed a close reading of the field notes and interview transcripts and extracted themes from these texts. They also linked the data gathered in the schools with studies from the literature review and compared themes and ideas which were emerging from the data gathered in Lettergesh and Uachtar Árd with other studies. Utilising Discourse Analysis (DA) was useful as it enabled the researchers to appreciate how different stakeholders in the project negotiated different understandings about science, art and creativity. Authors such as Alldred and Burman (2005) also state that the DA approach is important for researching children. They advocate an approach to research where precedence is given to the voice of the child and where they are listened to.

3.4 Ethical Issues

Ethical issues were also given the highest primacy during the project. A literature search on ethical issues that impact on research with children was conducted and during the BEAST! study, the researchers adopted a 'child-centred' approach to the process of data collection. A consent document was prepared which the children signed before taking part in the interviews and this contained pictures which the children could relate to. The teachers contacted parents to ask permission for their child's involvement in the study prior to its commencement. Both of the researchers were vetted by Gardaí before completing the study.

3.5 Conclusions and Recommendations

This chapter outlined the mixed-method approach that was utilised by the researchers during this study. Mixed-methods helped the researchers to compile an in-depth view of the children and the ways that other actors (teachers, scientists and artists) experienced the project. The qualitative and ethnographic research strategies yielded in-depth data on reactions to the project and the children's behaviours. However, the quantitative survey questionnaire enabled the researchers to tap into different aspects of children's resilience, wellbeing, social supports and, their reactions to nature.

Mixed-methods could be advantageous for other evaluations of BEAST! that might be completed in the future. It would be useful to complete another study to follow up on this process study in the future. Utilising qualitative and quantitative methods may also be important for such a study, as it could capture changes to the children's attitudes and behaviours. However, if a larger project took place in future, over a longer time scale with higher numbers of children, schools, practitioners and teachers, it could be more appropriate for capturing behavioural and attitudinal changes in children which may be (in)-directly attributable to BEAST!. Completing the project over such a 'compressed' time-scale meant that the project was limited in the extent that it could capture such changes. Hence, should a similar project be implemented in the future, it would be advisable to ensure that it runs for a much longer period of time, in order to capture behavioural and attitudinal change.

Chapter Four: Two Case Studies of Participating Schools

4.1 Introduction

This chapter provides important detail on the two schools which were studied as part of the BEAST! process study. Significantly, it also provides essential data on how the projects were implemented in both schools; the content of the individual workshops that were delivered by the scientists and artists, what they wanted to achieve through BEAST! and the learning of various participants who took part in the project (for example, teachers, artists, scientists).

The first case-study which is outlined here relates to Lettergesh Primary School which is situated on the west coast of Connemara. The second case study documents the BEAST! model as it was implemented in Uachtar Árd. While data was collected in Shantalla as part of the process study, the researchers decided to focus on the schools chosen by Baboró for the purposes of this chapter. However, some relevant detail on the perspectives of artists, scientists and teachers from the Shantalla School are also included in chapter five.

Case Study 1, Lettergesh National School: The 'Interconnectedness' of Marine Life and Concepts of 'Biodiversity' in a Seaside School[i]

Background

Lettergesh National School is a two teacher school with 18 students aged from four years to twelve years. The scientist found that the children were comfortable within their setting, had a good knowledge of sea species and good awareness of sounds and textures because of their on-going interaction with the sea and local environment. The school was an obvious match for the science project which focused on the marine environment and biodiversity.

What the Scientist wanted to achieve

The scientist described his objectives for the workshops:

> *'I wanted to get across to children that research can improve our way of living and the importance of food webs and the interconnectedness of nature, the interaction of [fish] species with each other and the importance of biodiversity for our future'* (Scientist Number One).

The scientist delivered two workshops of two hours each and also hosted a field trip at the Ryan Institute marine station and laboratory at Carna for the group of 7 older children. He adopted an informal style of delivery and used games to deliver concepts in an interesting format. The goal of making information accessible included the challenge of filtering complex language into less technical words. The scientist used challenging and probing questioning to engage the children in querying their own views on their food sources and the interdependence of species. The scientist also used different sensorial approaches in order to enhance the learning through touch, sound and odours of species.

The children (and teachers) found the field trip to the marine laboratory very exiting and a highlight for the group. *'This was in more detail. It was a new angle on science when they visited the marine laboratory. It was more technical'* (Parent Number One). The laboratory visit included observing how fish use camouflage and how to dissect fish to identify age, species and other data. Children were fascinated to see the scientist within his work context and talked about him being *'Cool'* (Child Number One) and not like their image of a *'crazy scientist'* (Child Number Two).

In the focus group discussion, the children were keen to talk about their experience of the science workshops and also of the teaching style adopted by the scientist:

'He was very friendly and knew the stuff we like. He didn't just go straight in he got to know us first; got to know our names and what we liked. He was chatty and he didn't write any of our questions off as too complicated. He would try to tell us to help us to understand.' 'He never gave up on something – he was persistent' 'He always seems to have enough time he wasn't always rushing away ... he'd give enough time to every person' (Child Number Three).

What the Artist wanted to achieve

The artist, following the project brief, had the aim of drawing forth the children's artistic response to the science workshops and delivered two workshops of 2 ½ hours each. The goal was the creation of an artwork for the exhibition at Baboró International Arts Festival for Children in October. The artist saw the project as *'A collaborative effort to showcase that science [and technology] isn't just in the higher realm but everyday'* (Artist Number One).

The artist took a flexible approach to the workshops but identified that because of time constraints they adopted a more prescriptive approach in terms of deciding the craft skill that would be used (felting with wool) and the artwork to be produced (a wall hanging). The artist was surprised at the learning displayed by the children. *I was surprised that they knew so much about the subject material and that they had memorised stuff and retained it and were able to explain it to me'* (Artist Number One). The children's attention span was retained over the workshop time. The artist thought that they *'could collaborate with the children more if I had more time and I could get ideas from them. They had good colour awareness and brought their own colour ideas. They were talking about the science as they were working together'* (Artist Number One).

The children said they enjoyed the arts workshops and were surprised at the artwork they had produced and the skills they had acquired. They were keen to repeat the experience. *'I didn't think we could make something as complex as we did with the felt. It was easier than I thought'* (Child Number Four).

Benefits to the children of participation in the Baboró BEAST! project

Engagement and extended attention span

All those interviewed (Teacher/Scientist/Artist/Social Researchers) observed that the children were very engaged with the science workshops and also with the follow up arts workshops. The sessions were much longer than children were used to but teachers noted that they maintained their attention span because they were engaged. Parents noted that children were keen to attend school on workshop days and that they '*absolutely loved'* the project (parent number one). Some of the children repeated back facts they had learned to their parents at home. Teachers noted that the children had good retention of the information and were able to explain this competently using their own terms.

Changes in attitude and thinking about science – Making new connections

Teachers and parents and the children themselves noted that the children's thinking about science had changed:

'We learned that science isn't just dinosaurs and experiment or creating Frankenstein or figuring out stuff. Science is about everything' (Child Number Five).

'Very positive, children talked about it a lot and were very engaged ... they have explained it in their own language and have more interest in science now' (Teacher Number One).

One parent thought that it had changed their children's way of thinking about science:

'It benefited them- opened up their thinking. They are well used to the sea and fish..but this was in more detail it was a new angle on science when they visited the marine laboratory. It was more technical. Before that they took nature for granted; they have a new connection now' (Parent Number Two).

Two parents and one teacher observed children had expressed an interest in science as a career:

> *'I couldn't say I see differences [in child's behaviour] but I know my son talked a lot about going to college and he is really curious about how to get to be like [scientist] and how to get to be a scientist. He has been asking a lot of questions'* (Parent Number Three).

More collaboration and more ownership of the work
Teachers were surprised at the level of impromptu collaboration between children of different ages and different classes. This was especially evident in the arts workshops where older children helped younger children without prompting and children collaborated freely.

Teaching method
Views on the teaching method were expressed by children, practitioners and teachers.
The children said that the atmosphere in the science workshops was different, *'It wasn't like a school atmosphere. It was very relaxed'* (Child Number Six). During the art workshops, some of the children started to sing as they worked. The teaching style enabled the children to relax and engage more fully with the practitioners and the subject matter. This increased their enjoyment, retention and collaboration. Teachers and social researchers noted that the children collaborated very well and creatively together. The level of collaboration surprised the teacher.

Learning from the project experience
The learning from the project experience is the following:

- The scientist/artists need to display enthusiasm and passionate involvement in their subject in order to create interest with the young people. They need to use challenging questioning to enable the children to challenge their own views on the subject. The young people responded positively to this.
- Children were left with an interested and positive view towards science and their environment.
- The relaxed teaching style enabled the children to relax and engage more fully with the practitioners and the subject matter. This increased their enjoyment, retention and collaboration.
- The teachers saw the benefit of using this teaching style and also the benefit of using art to teach the curriculum and the benefit of involvement of outside practitioners. Teachers enjoyed the experience, adapted to and linked well with practitioners, and enjoyed seeing their students collaborate together positively.
- The children gained valuable arts skills and produced an attractive artwork of high quality
- Parents were intrigued about the project and would like to have been involved at some stage either at the preliminary planning stage or at the end where they could have had a presentation of the children's learning and work.

Case study 2, Scoil an Chlochair, Uachtar Árd: Discovering Children's Ideas about 'Smart Devices', Carbon Usage and 'Sustainable Futures'

Background

The second case study which is documented here is Scoil an Chlochair, which is located in the heart of the town of Uachtar Árd, near the shores of Lough Corrib in County Galway. It is a mixed school with boys and girls, ranging in age from four to twelve years. The BEAST! engagement took place with pupils from second class, aged between seven and nine years old. Approximately twenty pupils took part in the project. Both the artist and scientist were impressed with the level of engagement of the children and the amount of interest that they displayed in the topics that were covered at each session. The science project focused on carbon usage and the scientist brought electrical appliances such as light bulbs and electric kettles to the individual sessions, appliances which the children would be familiar with from seeing in everyday life. The science sessions were very interactive as 'You Tube' videos were also shown to the children about electricity usage. However, these cartoons were aimed very much at children and the pupils demonstrated a high level of engagement with these videos. Some children remarked that they had accessed these videos and other e-resources on electricity after the sessions concluded.

What the Scientist wanted to achieve

The scientist who was involved in the session stated that he wanted to make science 'real' for the children. He wanted them to move them towards the idea that 'science is everywhere' and that scientific research is valuable. He also talked about the need to inspire children in primary schools who would become 'the scientists of the future'.

The scientist delivered three workshops in total. The first lasted 90 minutes, the second 60 minutes and the third was 50 minutes. The scientist talked about where he worked and his links with NUIG and showed them pictures of the DERI Building (Digital Enterprise Research Institute) on the University Campus. He talked to them about what electricity was all about, how it is made and why it is important in everyday life. The scientist also used other strategies such as lighting a bulb in class to show children that the amount of carbon that they use in everyday life has an effect on the planet. The sessions were very interactive with children talking to each other and eagerly watching the different aspects of the sessions. They were interested in the scientist's lap-top and the sound effects and cartoons that he used in class. All of this seemed to be highly engaging for the children.

When the children talked about the sessions with the scientist, they frequently made comments such as *'I wish that school was like this all the time'* and *'the scientist is cool'.* Other children commented *'we will miss him a lot. I wish he was here every day. He was really nice and friendly'.* Another child said *'I used to think that scientists blew up things and I was a bit afraid but I really like doing this'.*

What the Artist wanted to achieve

As was the case in Lettergesh, the artist's workshops focused on extrapolating the children's responses to the content that was delivered by the scientist and how they conceptualised a 'low carbon future' and the ways that they expressed it through art. The artist adopted a very informal approach with the children and talked to them freely about if they liked art and if they enjoyed drawing. In one of the first sessions, she showed them examples of public art that she had completed in various towns across Ireland in efforts to challenge '*what they think of as art and what they mean by art'.*

In one of the first sessions, the children were encouraged to think about the science sessions and what they were learning in these sessions. They were asked to think about what a 'smart device' would look like as this was a particular topic that was covered by the scientist. The children were able to produce highly interesting artwork of 'smart washing machines', 'smart phones' and other technologies that they would like to develop in the future. When asked why

they thought of these devices as 'smart', one of the children said*; 'it's smart because it does things for you and it makes life easier'.* There was some evidence that some of the children did not fully grasp the concept that electricity usage affects the environment as many of the pictures also included plugs and plug-holes. At the same time however, the pictures that were produced were highly creative and showed that they had internalised many of the messages about technology and 'smart devices' that were being conveyed by the scientist.

The artist had many ideas about projects that could be pursued with the class but she eventually settled on making a film about pollution, carbon usage and sustainability which would combine the insights gained from the science sessions and ideas from the children's everyday 'lived realities'. In the second last session, she talked to the children about this and asked them to give her ideas which she would adopt in order to make a story board. The children showed very high levels of engagement in this task as they talked readily about the names of the different characters ('the good guys') who would take on 'The Pollutionators' (or 'the bad guys') in efforts to save the world from waste. The children were encouraged to think about the different parts of the story and how it would develop and what could happen in the individual scenes. The story was contextualised to the children's own social worlds. For example, the children chose to conduct the battle scene to save the planet at a castle that they had visited the week before. They also deliberated as a group about what the final scene should consist of. They agreed that it should be a party for the 'good guys' which would happen at Supermac's.

The degree of engagement of the children in these tasks was clear as they made figurines of themselves which would appear in the film and they gave interesting reasons why they chose to make these figures in the ways that they did. One child said*; 'Pink is my favourite colour so I'm putting a lot of pink in this'.*

Benefits to the children of participation in the Baboro BEAST! project

Engagement and extended attention span

The children were very engaged at the science workshops and at the arts workshops. This was the opinion of all who were involved in the project (scientists, teachers, artists, social scientists). At some times during the sessions, the attention of some of the children seemed to dip, if only for a while. However, they seemed to be fully engaged in the process whereby they made the figurines, as they drew and painted the story boards and backgrounds, and with the interactive resources that were used by the scientist (including a windmill which seemed to come to life from the computer screen). The teacher also stated that the children 'are a great group' but that they were even more enthusiastic about school since the project commenced. Indeed, she told the researcher that the children talked about the scientist and artist after they left the classroom every week. The children also made cards for the artist, scientist and social scientist to say 'thank you' after the project concluded.

Changes in attitude towards science and other benefits of BEAST!

The teacher who was interviewed for the project said that some of the children had new found confidence in themselves and that it gave some children the confidence to express themselves more openly. This was especially important for children who do not always attain the highest grades academically but it gave them the chance to express their other talents in areas like singing and dancing. The teacher also stated that it made science seem more real to the children and that it may inspire some of the children that they can become scientists in the future.

Teaching method

As in the case of Lettergesh, views on the teaching method were expressed by children, practitioners and teachers.

The children commented that they loved attending the art and science workshops because it was different to a normal class atmosphere. The fact that the teacher allowed the artist and scientist to take the lead meant that the children did not feel under pressure as they might during other lessons. Instead, they were encouraged to discuss the topics with each other and to make contributions to the class about the subject matter. In this situation also, the teachers and social researchers observed that the children collaborated very well and creatively together. However, the teacher noted that the class were excellent on topics like artwork. Indeed, one of the first things that was noticeable to the researchers on entering the classroom was the large volume of

art completed by the children which was everywhere in the classroom. This included for example, coloured jars, religious paintings, projects about other countries, charcoal drawings and flags that had been coloured in.

Learning from the project experience

The learning from the experience of those involved in this school is the following:

- The scientist/technologist/artists need to be enthusiastic about their subject in order to sustain the children's interests.
- The children seemed to engage well with the topic as they were relaxed in the classroom. This is partly attributable to the teaching method and they saw it as different from a 'normal' day at school.
- The teacher allowed the artist and scientist to take the lead when they were in the classroom which allowed for greater engagement.
- The children gained valuable arts skills and were able to contextualise some of their own knowledge of their everyday 'lived realities' to the film that was being produced.
- The children were engaged in every aspect of the film's production and in creating the backgrounds and the story that is being conveyed in the movie.

Chapter Five: Findings

5.1 Introduction

This section presents the results of the qualitative, quantitative and ethnographic data which was collected by the researchers in the schools in Uachtar Árd and Lettergesh, along with interviews that took place with teachers, artists, scientists and members of the Baboró staff. While the project yielded findings about a variety of issues such as the level of knowledge of children about environmental issues, their sense of belonging and resilience, the findings that are given here relate to some of the main issues which were being investigated as part of the project and some of the core themes which emerged through the qualitative and ethnographic inquiries. The interview questions (see Appendix III) contained questions about the participant's feelings towards the BEAST! model and the method of teaching, the factors that motivated people's decisions to take part and their feelings about collaboration and creativity that emerged during the study. As these matters are also being elaborated on in the 'Discussion' section of this report, it seems pertinent to discuss them in some degree of depth in this part.

5.2 Perceptions of Scientists about Baboró BEAST!

As part of the interviews, the scientists, who participated in BEAST! were asked about their experiences with the project and their feelings about working with Baboró. In particular, the interview schedule focused on why they were interested in taking part in BEAST! at the beginning but it also asked them to reflect upon the things that they had learned since the project concluded. Overall, the scientists felt that the project had been very worthwhile and their responses reveal that they learned much about themselves as well as things about their subject area during the project.

Firstly, all of the scientists who were interviewed expressed very positive feelings about Baboró and about the possibility of working with the organisation in future. They all commented that they had a positive experience working with Baboró this time around and all three of them felt that there was considerable scope for extending the project or repeating it again.

5.2.1 Feelings of Scientists about the BEAST! Model and Child Learning

The three scientists who were interviewed commented on the children's sense of engagement in different aspects of the project and that the model is important for teaching children about science. One of the scientists commented for example, on the artist who was working in his school and said that bringing the two together was a great idea because the children were able to experience science *'in a very fun way'* (Scientist No. 1).

Significantly, the scientists who took part in the project also stated that they felt that they had learned a lot from taking part in BEAST! One scientist said that working with the children had helped him to appreciate his topic more and another implied that the project had affected him in a 'deeper' way. One of the main reasons that he volunteered for BEAST! at the start was to advance his career and it would enable him to work with children, a group he had never worked with before. However, he commented that working with the children had affected him in other ways and that it gave him a lot of confidence to work with children in future (Scientist No. 2). As well as this, another scientist who took part said that it gave him insights into the everyday lives of children and what they experience when they are at school.

All three of the scientists and artists who took part mentioned that they felt a strong connection to the project and that they were committed to advancing the learning of the children. As one scientist put it, *'if you put the right people together, then anything can happen. Magic can happen'* (Scientist No. 2).

Interestingly, one of the scientists who took part commented that projects like BEAST! may have other beneficial effects on children. He said that some of the children in the school felt that the university and higher learning were removed from their lives because many of them came from lower-income households. On one of the trips that they took as part of the project, he said that the sense of excitement was palpable among the children and he believes that some of them felt that *'their opinions were somehow worth something to people in the institution'* because of this visit (Scientist No. 3).

5.2.2 Scientists' Reasons for Participating in BEAST!

The scientists also mentioned some of the reasons why they had chosen to take part in BEAST! For example, two of the scientists mentioned that they had become involved as a call for interested proposals had been made by the Ryan Institute Outreach Officer to scientists at NUI Galway. Because they had dealt with the Outreach Officer in the past and they felt that the work that they do is to a very high standard, they felt that they would like to be involved in the project (Scientist No. 1 and Scientist No. 2).

The reputation of Baboró also seemed to affect the decisions of the artists to take part. For example, one artist said that she had worked with Baboró on projects in the past and this would have influenced her decision to take part in the project (Artist No. 1). One of the scientists also mentioned that he wanted the experience as he felt that it could help to advance his career in the future (Scientist No. 1).

5.2.3 Challenges encountered by scientists during BEAST!

The researchers also asked the scientists and artists about any of the challenges that they might have experienced when planning the activities for the class and how they sourced ideas about what to prepare for the Baboró show. In particular, the researcher was very interested in how the scientists 'contextualised' topics such as climate change, carbon usage, biodiversity and viruses for the children, or how they brought it down to 'the child's level'. The scientists who were interviewed did see this as a specific challenge; how to make a relatively 'technical' subject area seem engaging and intelligible to children. One scientist remarked that seeing the textbooks that the children were using beforehand was important as it enabled him to gauge the extent that the children were aware of certain topics. He also remarked that he had talked to the teacher beforehand, and she had told him some of the techniques that she used to explain scientific topics in class to the children. For example, she regularly used the term 'CSI' as it was akin to the television series, when they were investigating a problem in class (scientist No. 1). For this particular scientist, this was an important strategy as he felt that it was important to draw on the children's 'lived realities' which would 'contextualise' the knowledge for them.

Another scientist who took part in BEAST! stated that his project was only loosely related to the idea of a 'low carbon future' and as a result, he found it difficult to link his subject matter to the project brief that was given by Baboró, which focused specifically on how children interpret 'low carbon future'. He found this to be a particular challenge but he also stated that he felt that he achieved his aims with the children. He wanted them to see that *'science was not inaccessible to them'* and that *'they could aim to do great things with their lives'.* He also stated that he felt that there were important learning gains for the children from his subject matter (Scientist No. 3).

5.2.3 Scientists' Ideas about Collaboration between Stakeholders in BEAST!

The theme of collaboration was frequently mentioned by the scientists who were involved in BEAST! While the fieldwork suggested that the project inspired a great deal of collaboration among children who took part, the data collected also suggested that other stakeholders in the process (for example, scientists) favoured more collaboration prior to the commencement of the project and while the project was ongoing.

Collaboration was important for one scientist who mentioned that he had talked with the teacher in the school before taking part in the project as he wanted to know more about the level of knowledge that the children had about science and art before the project commenced. He stated that this was an important factor for him to consider when he was planning the different activities that were part of BEAST! (Scientist No. 2).

However, both he and the artist in the school said that they would favour a higher degree of collaboration with each other before BEAST! commenced as it may have been easier for them to follow through on one another's ideas that they were mentioning in class (Scientist No. 2 and Artist No. 2).

In addition, this was a point that was raised by the artist and scientist who were involved in the project in Shantalla. Their case was slightly unusual as they are blood relatives and spend a lot of time together. However, the scientist who was interviewed made the point that he would have liked more collaboration to have happened between the physical scientists on the project and the social scientists as he felt that he would have had a much greater overview of what BEAST! was trying to achieve (Scientist No. 3).

One of the scientists that was involved in the project also felt that the meeting that was organised at the beginning of the process and which was attended by the social scientists, physical scientists, Baboró staff and teachers was a *'missed opportunity'* to some degree, and he would have liked if there was greater engagement between the different stakeholders at this stage (Scientist No. 2). Another scientist stated that it would have been more interesting if different people had introduced themselves at the meeting and announced what their role would be in BEAST! (Scientist No. 3).

When asked what recommendations that they would like to make to Baboró if a similar project were to be implemented in future, two of the scientists commented that they would like to see more collaboration between different stakeholders (such as artists and scientists) and increases in the amount of knowledge-sharing between scientists and artists who were taking part in various projects. As well as this, one scientist also made the point that he would like if some amount of engagement happened now that the project has concluded between the various stakeholders about what has been learned by the various actors involved (Scientist No. 3).

5.3 Feelings about the BEAST! Teaching Method: Opinions of Teachers in Participating Schools

There was widespread support among teachers for the BEAST! teaching method. The three teachers who were interviewed made very positive comments about engaging children through art and science and to the possibility of running the programme in schools in the future. For example, the teachers stated that the project is very engaging for the children and that it helps them to see that 'science is real' and 'that it is all around us' (Teacher No. 1). In the interviews, the teachers also said that they felt the children's excitement about doing the BEAST! activities and that the children talked about the artist and scientist throughout the week (Teacher No. 2).

One of the teachers that were involved in the study stated that she believed that this teaching method can also enhance motor functions in children, such as hand and eye co-ordination and it can also facilitate the building of muscles in a child's hands and arms (Teacher No. 2).

Importantly, one of the teachers also stated that the project could help to enhance the children's confidence. In the past, she has noticed that a number of children in the classroom have low self-esteem about themselves and their abilities. She stated that one boy who under performs in areas like literacy and mathematics has great talent in areas like art and dancing. She believed that

taking part in the project was helping this boy to overcome his fears about working with others and was helping to improve his confidence (Teacher No. 2).

Similarly, the teachers also made very positive remarks about the scientists and artists who visited their schools. All of the teachers praised them for their positive attitude towards the children and their willingness to interact with the children (Teacher No. 1, 2 and 3).

5.4 Attitudes of children towards BEAST! and their Learning

The findings were generally very positive on children's engagement with the BEAST! model. In Uachtar Árd, the children were constantly asking questions about what the scientist and the artist were doing and about the equipment that they brought into the classroom (author's fieldnote, May 2012). In the final workshop, when the artist brought in a camera to shoot the film based on the children's work, they each took turns to look through the lens of the camera and asked the artist about its purpose and what the finished product was going to turn out like (author's fieldnote, June 2012). The children were also asked about their feelings towards BEAST! and they expressed very positive endorsements towards it. In Lettergesh, children regularly made comments like *'it's fun'* and '*it's wicked'* when asked what they thought about the project (child No. 1 and child No. 2). Only two children in Uachtar Árd expressed more negative comments about the process saying 'it's okay' and 'I don't feel like I'm learning that much' (child No. 3 and child No. 4).

The children were also asked if they felt that they were learning a lot from their experiences in BEAST! Again, in Uachtar Árd, two children said that they felt that they were unsure about how much they were learning from the sessions (child No. 3 and child No. 4).

Despite this however, other children who took part talked about some of the interesting facts that they had learned about carbon usage and switching off electrical appliances during the sessions with the scientist. For example, one girl from Uachtar Árd said that she learned 'about things that are bad for the environment' and that she had started to switch off the lights at home in case it 'damages the planet and hurts animals' (child No. 5). Such findings might be seen as indicators of behavioural change and knowledge change among the children regarding environmental matters. However, it should be stated that it was difficult (if not impossible) to compile in-depth data on behavioural change in the time-period over which the project took place. The survey instrument revealed some interesting data about children's feelings towards the natural world and their attitudes towards school. However, the changes that were observed were minimal to say the least, and it cannot be proven that any such changes in attitude or behaviour were (in)-directly related to the project.[10]

5.4.1 Evidence of Collaboration and Team-Building among Children in Participating Schools

The data gathered through Participant Observation (PO) at both schools also revealed that a high degree of collaboration took place between the children when completing the activities. In Uachtar Árd for example, this was evident in the conversations that were ongoing in the classroom as they prepared the figurines from play-do (author's fieldnote, May 2012). There was also evidence which suggested that the model helped the children to engage and work together as a team. For example, one female child went around the classroom helping two or three other male children as she worked on her figurine, and as they worked, the children were showing each other how to affix pictures of fish and other wildlife to their own scene (author's fieldnote, May 2012).

There was also evidence of similar levels of collaboration in Lettergesh. For example, when the children visited the Ryan Institute's Research Station at Carna, groups seemed to form between the children at the different exhibits and they talked among themselves about what was contained

[10] This issue is discussed in greater depth in chapters six and seven of this report.

in the specimen jars (author's fieldnote, May 2012). The conversations between the children on this occasion also imply that they made reference to their own social worlds and 'lived realities' when making sense of the different exhibits and what they meant. This was evident in a conversation which took place between children at a particular jar where they talked about the contents of the jar which, when magnified, might look something like 'Spongebob Squarepants', a character from a children's television show that they watched regularly (author's fieldnote, May 2012). As well as this, the children seemed to work well together at the individual exhibits. For example, they took it in turns to touch the fish and talked excitedly about the marine life on show. After the trip to Carna, the group also visited a beach near the Research Station where they helped each other to collect sea glass and seashells (author's fieldnote, May 2012).

During the interviews, the scientists, artists and teachers were also asked their feelings about the extent that BEAST! encouraged participation and team-building among the children. Significantly, all of those who were interviewed said that they felt that the project did achieve its aims in this way and that they had observed this in the classroom. One participant also commented that children who sometimes feel left out of games and activities in class seemed to be more included in the activities than they were in other situations (Teacher No. 2). As a result, this participant said that BEAST! was a very valuable exercise and all of the teachers surveyed said that they would recommend it to other schools in their area who might want to be involved in the future (Teacher No. 1, 2 and 3).

5.5 Summary

This section presented some of the main findings of BEAST! and in particular, it focused on the opinions of stakeholders such as teachers, artists and scientists towards the project. Some of the most interesting findings were that there was widespread support for the project among all of the people who were involved and many of them pointed out some of the benefits of the model for teaching and learning. In particular, some of the empirical evidence provided here suggests that people felt that the children were engaged in the various activities and the participants such as the artists and scientists felt that they were learning a great deal from the process.

Some questions were raised by the interviewees regarding the degree of collaboration and interaction that should occur between the artists and scientists prior to the implementation of the model. Many of the participants felt that greater interaction between the different stakeholders could be beneficial for the project if it were repeated in the future, and some of them suggested that their learning could be enhanced if the model was reformulated to include more dialogue between different stakeholders. This issue of collaboration was a core theme that was mentioned in the interviews and it is included in chapter six as a key recommendation of this report.

Chapter Six: Discussion and Recommendations

6.1 Baboró BEAST! Process Study: Core Purpose

The purpose of this study is to describe the project model, its modus of operation and the views of stakeholder groups on its impact. Previous chapters have identified the views of the individual stakeholder groups involved and have been presented in order to provide clarity on the sources of differing perspectives. In this chapter these views are collated in order to answer the initial research questions and to arrive at the conclusions and recommendations.

The following analysis is based on the interviews, focus groups, observation studies and quantitative survey with stakeholders in three out of the eight schools that participated in the research. There is thus a caveat that although a significant amount of data has been generated, it is still a relatively small study from which to generalise the findings and readers should bear this in mind.

The research questions to be addressed in this chapter are the following:

- What is the core purpose of the Baboró BEAST! project?
- What outcomes are ascribed to the project as perceived by the young people, teachers, parents, science and art practitioners and Baboró management staff?
- What are the perspectives of stakeholders regarding project delivery including its strengths, challenges and areas for improvement?
- Is the project model sufficiently robust that it can be replicated in other primary schools for teaching STEM subjects?

BEAST! is a pilot project developed by Baboró to raise the profile of science and technology in the cohort of eight primary schools. Its main goal was to encourage the children and teachers to engage with and explore these subjects through the arts and for the young people to present their interpretation of the science and technology workshops at an exhibition at the Baboró International Arts Festival for Children in October 2012.

6.1.2 BEAST! project aims and objectives

BEAST! aims and objectives were as follows:

BEAST! Aims

- To instil or improve levels of confidence, critical thinking, problem-solving, creative thinking and team working in primary school children
- To demonstrate in schools and to teachers the use of the Arts in teaching the school curriculum
- To create a project model that can be replicated easily and effectively and be used by others to teach and to evaluate

BEAST! Objectives

- To marry Science, Technology and the Arts in exploring a 'Low Carbon Future' with primary school children though a series of workshops delivered by Scientists and Artists
- To create an artistic response using the children's understanding of the topic
- To design and/or source quantitative and qualitative tools to collect data
- To observe workshops and document behavioural and attitudinal changes to evaluate the impact of the project
- To write a process study report offering critical thoughts on the process and possible future developments for BEAST!

These aims and objectives will be the reviewed in this chapter under the research questions already highlighted at the start of this section.

6.2 Outcomes ascribed to BEAST! By Stakeholders

6.2.1 Outcomes for the children: Behavioural Changes, Sense of Belonging and Resilience

One of the main objectives of the study was to make suggestions on whether or not there were any behavioural changes for the children, such as their sense of belonging at home or at school, their resilience and their attitudes towards the environment. While the qualitative part of the study implied that there may be some changes in attitudes of the children towards science, the quantitative instrument did not pick up on any real changes in their sense of belonging and resilience. Most likely, this is due to the time-scale of the project. It would be probably take a much longer time period to instil any such changes in children. However, it may be the case that if the instrument were to be repeated in the future, some degree of change may be discernible. However, it is probably the case that the project would need to run for a much longer time period in order to effect such changes.

6.2.2 Teaching method

Practitioners, Teachers and Children observed that there were benefits to the more open and flexible approach that enabled the children to learn and retain information and to collaborate well together. Teachers noted that the children appeared to be 'happy'. Teachers and children became very engaged and enthused with the workshops and teachers facilitated and supported the scientists. Teachers saw the benefits of inviting outside practitioners into the classroom who were passionate about their subject and appreciated that scientists were able to translate ideas and concepts to make them accessible to the children. They felt that it was a '*very worthwhile'* project and enjoyed seeing the enthusiasm that children displayed. They also noted that children had more ownership of the work where they had a significant input on decisions about the work. There were indications that this approach is successful in engaging children who may usually feel left out of activities.

Artists adapted their teaching to the science workshops and to the children. They noted that if they had more time with the children to enable the children more time to develop their responses to the topic and that this would be beneficial. They suggest 3-5 workshops instead of two. (I.e. 4.5 - 8 hours of contact time). Scientists and artists noted that they learned a lot from the experience in terms of gaining experience of working with children and in terms of learning how to make difficult concepts more accessible for the children. The widespread support for this teaching method demonstrates that it can be a very effective approach for the teaching of STEM subjects in primary schools. Teachers noted that if the science/technology practitioner could build their workshops around some aspect of the children's current curriculum it could achieve higher benefits for the young participants.

6.2.3 Change in attitude towards science and technology

It appears that this teaching approach has real benefits in that it was able to achieve the main project goal of changing children's perception of science/technology subjects and creating an interest and enthusiasm for the learning. It *'opened up their thinking'* (Parent No. 1). Children felt that their opinions had worth and this contributed towards their levels of engagement and ownership. The process of children seeing scientists within their work environment created a new awareness of the scientist's role and prompted some of the children to express an interest in science as a career. Children felt valued when their questions and opinions were welcomed by the practitioners on their visit to the institution. Some children saw that science was a part of everyday life and a creative activity just as much as art. These findings indicate that the objective of raising the profile of science subjects with the children was very successfully achieved and also had the impact of changing the way that children engage with science.

6.2.4 Skills acquisition

In both case study schools the children learned real art and craft skills around creating animation films in one school and in felting wool to create a wall hanging and mobiles of sea creatures showing the different habitats within the shoreline and diversity within the marine environment. These are skills that teachers also learned and plan to utilise in their own teaching approaches. Teachers noted that the method enhanced children's motor skills and hand - eye co-ordination.

6.2.5 Strengthening of existing links and building of new links with Baboró and NUI Galway

Teachers expressed enthusiasm for engaging in the project again with Baboró. Those teachers that went on field trips to NUI Galway felt this to be a very worthwhile aspect of the project and would like to repeat this experience and extend their relationship with NUI Galway.

6.3 Key Perspectives of Stakeholders regarding project delivery

There was general widespread support for the project throughout the stakeholder group. Overall the project worked well and created an excitement and enthusiasm for the science/technology topics with children and teachers alike. The process study identified some key elements of project delivery and the following section highlights these.

6.3.1 Collaboration and Team working

There was strong evidence for the impact of collaboration with this project. There was collaboration at every level; between Baboró and NUI Galway at the project design phase; between teachers and the science, technology and arts practitioners, and free flowing collaboration and team working with the children in the classrooms. Parents expressed the desire to be involved with the project at stages in its delivery. This evidence for collaboration would highlight the findings of studies on the 'Creative Partnerships' programme which identified one of the key characteristics of creative people to be the ability to collaborate with others. Increasing children's ability to work in teams was also one of the BEAST! objectives and it was successfully demonstrated at each of the case study schools.

Participants suggest that more could be garnered from this project if at the initial briefing stage science and arts practitioners and teachers spent more time discussing their proposed topics to the whole group and if they actively conferred with each other during the implementation phase. Additionally a meeting of all participants at the end of the implementation phase to present the work and discuss learning would enhance the project benefits. '*If you put the right people together, then anything can happen. Magic can happen'*

6.3.2 Age Cohort

Respondents identified the optimal age group for this project as optimally in the 9-12 age groups. It was felt that this age cohort would be the best both for understanding the concepts but also in being able to conceptualise the responses to the science/technology topics.

6.4 Is the Project Model sufficiently robust that it can be replicated for teaching purposes?

One benefit of the BEAST! Model is that it worked well in operation. Baboró provided the inspiration for the project and the driving force to move the project forward and to source the funding. Baboró provided sufficient flexibility to support arts and science practitioners and schools to work with their own schedules around the programming of workshops. They also had a project manager who co-ordinated the challenging logistical and timing elements of the project and the many other issues associated in delivering a project of this complexity. Practitioners felt that the matching of their project with the school and arts practitioner was carefully and well chosen.

There was widespread support for the model with all respondents and this is supported by the fact that all those interviewed would like to participate again. Overall respondents felt that the implementation of the model worked well.

6.4.1 Project brief of BEAST!

The project brief was sufficiently inspiring to attract the attention of potential researchers and also potential schools. However the brief of a 'low carbon future' was not fulfilled fully in all proposals so possibly it would be more advantageous to broaden the brief to attract a wider population of researchers. The learning from this process study is that the following factors are needed in order for this type of project to be effective:

- An organisation with good links to a population of arts practitioners experienced in working with children. Additionally there needs to be a history of linking with schools and the community. There is also a requirement for good project management skills and good knowledge of catchments and audiences for this type of project.
- An organising body with good links to a population of STEM researchers /practitioners (for example a university) and with good community outreach processes.
- A clear, inspiring brief that will gain both the attention of scientists to submit proposals to deliver a series of workshops and the attention of schools eager to participate.
- A sufficient number of enthusiastic practitioners to respond to the brief.
- A positive and supportive attitude towards collaboration and knowledge sharing at all levels of the project with scheduled opportunities for practitioners to meet together to share ideas and learning. Indeed, it might be beneficial for the various participants (social scientists, scientists, artists, teachers etc) to meet at different stages of the project.
- Good briefing details at the initial stages of the project.

There is evidence that the model is robust if the above requirements are fulfilled. Baboró achieved the project goal and most of the project objectives and would be in a good position to repeat the project and extend it to a wider number of schools.

6.4.2 Children's Confidence, Resilience and their Attitudes towards Nature

There was no evidence of widespread improved levels of confidence, self esteem, resilience or attitude towards nature within the case study schools that took part in the quantitative survey and that could be ascribed to the intervention. The data collection instrument is sensitive, reliable and has been validated to measure these values but the time scale of the project delivery was over a 5

week period. These measures respond to a dose effect in the sense that we suggest that 5 weeks was too short a time period and 5 workshops too few for these behavioural changes to take place. If this objective is to be included in further projects then it is suggested that more workshops over a longer time-period were built into the programme. In addition it would be beneficial if the quantitative instrument were administered to all children at the start and end of the intervention to give a larger study cohort. In relation to the measure 'attitude towards nature' children in both of the case study schools expressed very positive attitudes towards nature which did not change over the intervention time period. The other research methodologies of participant observation, personal interview and focus group have identified some beneficial behavioural impacts that have already been described.

6.5 Project Recommendations

The recommendations arise from the process study findings and from the previous analysis and are detailed below:

- Collaboration should have a high priority at every level of the project and opportunities to collaborate should be built into project implementation.

- Increased numbers of arts workshops would provide children with more time to develop their artistic response to the science topics. Being involved in decision making increases the children's sense of ownership and increases their creativity but this requires time to explore freely.

- The initial project meeting (prior to project implementation) for practitioners should contain information regarding insurance, contact details as well as enabling participants to share details of their proposals and increase knowledge sharing. There should be a closing presentation of the work and of the learning for practitioners and Baboró to harness more of the project's benefits.

- The science brief should be broad to attract optimum numbers of science researchers.

- When designing science workshops it is worth considering if it would be beneficial if the current science curriculum were consulted in order to build on the children's current understanding of key concepts.

- It would appear that children aged 9-12 are the most appropriate age group for this intervention in terms of level of comprehension for science concepts and motor skills for arts activities.

- It would be beneficial to engage parents during the intervention possibly including exercises for children to do at home and a final presentation of the children's work and learning to parents.

- The quantitative data collection instrument should be administered all the children at all the schools that participate in future projects. It would enable a comprehensive benchmarking process at the pre-intervention phase and post intervention. This would support a more comprehensive capture of the project outcomes and of the impacts of the project for the young participants.

- Participants would like to continue and strengthen their links with Baboró and National University of Ireland, Galway.

[i] The data for this case study was derived from interviews, focus groups, observation of workshops and data collection instruments.

References

Alldred, P. and Burman, E. (2005) 'Analysing Children's Accounts Using Discourse Analysis', in S. M. Greene and D. M. Hogan (eds.) *Researching Children's Experience: Approaches and Methods*, London: Sage.

Ballantyne, R; J. Packer and M. Everett (2005) 'Measuring Environmental Education Program Impacts and Learning in the Field: Using an Action Research Cycle to Develop a Tool for Use with Young Students' *Australian Journal of Environmental Education,* vol. 21: 23-37.

Bryman, A. (2012) *Social Research Methods* (4th edition) Oxford and New York: Oxford University Press.

De Boo, M. and Randall, A. (2001). *Celebrating a century of primary science* Hatfield: ASE.

Department of Education for Northern Ireland (2002). *A survey of the science and technology area of study in a sample of Northern Ireland primary schools, 2000- 2001*. Bangor, Co. Down: DENI.

Eames, A., Benton, T., Sharp, C. and Kendall, L. (2006). *The Impact of Creative Partnerships on the Attainment of Young People: Final Report*. Slough: NFER (report downloaded via http://www.nfer.ac.uk/nfer/publications/CPS03/CPS03_home.cfm?publicationID=18&title=impact%20of%20Creative%20Partnerships%20on%20the%20attainment%20of%20young%20people26/09/2012).

Galway City Partnership (2011) *Local Community Development Plan* 2011-2013 (Report downloaded via http://www.gcp.ie/pdf/GCP%20LCDP%20Strategic%20Plan%2020112013%20Revised%2031st%20August%20201-WITHOUT%20FINANCIAL.pdf, 26/09/2012).

Gilbert, John & Priest, M. (1997). Models and discourse: A primary school science class visit to a museum *Science Education*, 81, 749-762.

Goodrum, D., Hackling, M., and Rennie, L. (2000). *The status and quality of teaching and learning of science in Australian schools: A research report.* Canberra, ACT: DETYA.

Howe, C; A. Tolmie; A Thurston; K. Topping; D. Christie; K. Livingston; E. Jessiman and C. Donaldson (n.d.) *Group work in elementary science: principals for classroom teaching* (report downloaded via https://dspace.stir.ac.uk/bitstream/1893/961/2/SCOTSPRinG%20Paper%20Rev.pdf, 26/09/2012).

Kendall, L.; J. Morrison; C. Sharp and T. Yeshanew (2008) *The Impact of Creative Partnerships on Pupil Behaviour Final Report* NFER (Report downloaded via http://www.nfer.ac.uk/nfer/publications/CPW01/CPW01.pdf, 26/09/2012).

Larson, L.; G. Green and S. Castleberry (2000) 'Construction and Validation of an Instrument to Measure Environmental Orientations in a Diverse Group of Children' *Environment & Behaviour* 42(1): 72-89.

MacDonald R.A.R and Miell, D. (2000) 'Creativity and Music Education: The Impact of Social Variables' , *International Journal of Music Education* 36: 58-68.

Murphy, C. and Beggs, J. (2002). Ten years of National Curriculum primary science in Northern Ireland: A study of children's attitudes. *Irish Educational Studies*, 21(2), 13-24.

Osborne,R. & Freyberg,P.(1985) Learning in Science: The implications of children's science. Heinemann Publishers Auckland, N.Z.

Thorley, N. R. and Treasgust D. F. (1987). 'Conflict within dyadic interactions as a stimulant for conceptual change in physics', *International Journal of Science Education* **9**, 2, 203-16.

Varley, J.; C. Murphy and O. Veale (2008) *Science in Primary Schools Phase I, Final Report* Dublin: National Council for Curriculum and Assessment (NCCA).

Appendix I

Call made to NUIG Researchers for BEAST! Participation

BEAST! Baboró: Environment, Arts, Science and Technology Project

What is BEAST!

Baboró in 2012 is partnering with the Ryan Institute at NUI Galway to launch a major project marrying science, technology and the arts: exploring a Low Carbon Future.

The project aims to give a higher profile to science and technology in primary schools, encouraging children and teachers to engage with, and explore, the these areas through the arts, and for tomorrow's adults to present their interpretation of the world around them to the adults of today, and to their peers.

Beginning with a simple proposition:
Imagine a Portal into an exciting new Low Carbon world opens up and you are invited to enter and explore this new world.
What would you expect to find there?
How do people live, move around, and have fun?
What would you bring with you, and what would you leave behind?

Pairing STEAM (Science, Technology, Engineering, Arts, and Maths) Researchers and Artists with a number of primary school classes and community groups, we will lead a project encouraging students and communities to explore the realities and possibilities inherent in designing our living in the 21st Century.

The participants work with the Researchers and Artists to interpret their understanding of these topics, and ultimately the selected schools and community groups will create a major exhibition – with their projects as the exhibitions. They may make films, write songs, model buildings, create artworks, or any other artistic interpretations of this new world.

How does it work?

Step 1 – Researchers propose, prepare and deliver workshops to explore the technical/research element
Step 2 – Artists work with the children/ groups to interpret their understanding of the knowledge gained from the Researchers
Step 3 – Baboró mounts a major exhibition/interactive experience of the work created by the participants

Call Details

THE CALL IS NOW OPEN TO INVITE SUSTAINABILITY RESEARCHERS (Scientists, Engineers, Social Scientists) TO SUBMIT THEIR PROPOSALS TO BE A PART OF THIS INITIATIVE.

We are looking for NUI Galway researchers to develop and deliver 2-3 short (1 to 1 ½ hour) workshops to primary school classrooms on a subject related to the *Low Carbon Proposition*. These workshops would take place in April/May 2012.

You would be supported throughout the creative and delivery process by the teachers and the Baboró/Ryan Institute team. In addition to financial support available for the acquisition of teaching aids and to cover travel costs & related expenses, there will be some monies available to compensate researchers for their time.

This call is open to any NUI Galway researcher (postgraduate, postdoctoral, or academic level) from all disciplines related to the *Low Carbon Proposition*.

Call Deadline is 5 pm on February 24th
Queries and completed applications to sarah.knight@nuigalway.ie

Appendix II

Data Collection Instrument used in BEAST! Process Study

THE BEAST! Project

Index for Children

ID Number of Child _____	**T1/T2**
Date _____ 2012	**M/F**

My Involvement in these Activities

I want you to think about the activities that you have been involved in with _____ *(name Artist &/or Scientist)*. I will read out five statements and there are four ways you can answer (explain these) about what you think about being involved.

Items	Options			
1. I feel comfortable at the programme/activity	**1. NO!**	**2. no**	**3. yes**	**4. YES!**
2. I am a part of the programme/activity	**1. NO!**	**2. no**	**3. yes**	**4. YES!**
3. I am committed to the programme/activity	**1. NO!**	**2. no**	**3. yes**	**4. YES!**
4. I am supported at the programme/activity	**1. NO!**	**2. no**	**3. yes**	**4. YES!**
5. I am accepted at the programme/activity	**1. NO!**	**2. no**	**3. yes**	**4. YES!**

My Experiences in School

I would now like you to think about this school. I am going to ask you some questions about school and the friends you have here. For the next six statements, you can tell me how much you agree or disagree with things about your school.

6.I feel like I belong at this school	**1. Strongly disagree**	**2.Disagree**	**3. Neither agree nor disagree**	**4. Agree**	**5. Strongly agree**
7. This school fits me well	**1. Strongly disagree**	**2.Disagree**	**3. Neither agree nor disagree**	**4. Agree**	**5. Strongly agree**
8. I feel connected to this school	**1. Strongly disagree**	**2.Disagree**	**3. Neither agree nor disagree**	**4. Agree**	**5. Strongly agree**
9. I feel welcome at this school	**1. Strongly disagree**	**2.Disagree**	**3. Neither agree nor disagree**	**4. Agree**	**5. Strongly agree**
10. This school makes me feel like I belong	**1. Strongly disagree**	**2.Disagree**	**3. Neither agree nor disagree**	**4. Agree**	**5. Strongly agree**
11. This is definitely my school	**1. Strongly disagree**	**2.Disagree**	**3. Neither agree nor disagree**	**4. Agree**	**5. Strongly agree**

How I feel about myself in School

Read the statements and **tick the one** that is true for you. 

Remember, this is how you feel about yourself when you are <u>in school.</u>

		Not often	Sometimes	Often
(1)	I feel good about myself	☐	☐	☐
(2)	I feel healthy	☐	☐	☐
(3)	I feel I am doing well	☐	☐	☐
(4)	I feel miserable	☐	☐	☐
(5)	I feel I have lots of energy	☐	☐	☐
(6)	I feel cared for	☐	☐	☐
(7)	I feel valuable	☐	☐	☐
(8)	I feel worried	☐	☐	☐
(9)	I feel I can deal with problems	☐	☐	☐
(10)	I feel bored	☐	☐	☐

Read the statements and **tick the one** that is true for you 

Remember, this is how you feel about yourself when you are <u>in school.</u>

		Not often	Sometimes	Often
(11)	I feel noticed	☐	☐	☐
(12)	I feel people are friendly	☐	☐	☐
(13)	I feel there is lots to look forward to	☐	☐	☐
(14)	I feel safe	☐	☐	☐
(15)	I feel confident	☐	☐	☐
(16)	I feel a lot of things are a real effort	☐	☐	☐
(17)	I feel I enjoy things	☐	☐	☐
(18)	I feel lonely	☐	☐	☐
(19)	I feel excited by lots of things	☐	☐	☐
(20)	I feel happy	☐	☐	☐
(21)	I feel I'm treated fairly	☐	☐	☐

My Friends

Can you think about the friends you have and probably see most days? How would you say you get on with them? I'll ask you four questions and you can answer by saying '*not at all'* up to '*very much'*.

1. I am good at making friends	**1. Not at all**	**2. A little**	**3. Some**	**4. A lot**	**5. Very much**
2. I help other people	**1. Not at all**	**2. A little**	**3. Some**	**4. A lot**	**5. Very much**
3. I ask others if I can be of help	**1. Not at all**	**2. A little**	**3. Some**	**4. A lot**	**5. Very much**
4. I get along well with others	**1. Not at all**	**2. A little**	**3. Some**	**4. A lot**	**5. Very much**

How I feel about Nature?

The next set of questions I will ask you will look at how you think and feel about nature and the world around you. For the next 16 statements, you can tell me how much you agree or disagree with them?

5. I like to learn about nature.	**1. Strongly disagree**	**2.Disagree**	**3. Neither agree nor disagree**	**4. Agree**	**5. Strongly agree**
6. I like to read about plants and animals.	**1. Strongly disagree**	**2.Disagree**	**3. Neither agree nor disagree**	**4. Agree**	**5. Strongly agree**
7. I would spend time after school working to fix problems in nature.	**1. Strongly disagree**	**2.Disagree**	**3. Neither agree nor disagree**	**4. Agree**	**5. Strongly agree**
8. I like to learn about plants and animals.	**1. Strongly disagree**	**2.Disagree**	**3. Neither agree nor disagree**	**4. Agree**	**5. Strongly agree**
9. I am interested in learning new ways to help protect plants and animals.	**1. Strongly disagree**	**2.Disagree**	**3. Neither agree nor disagree**	**4. Agree**	**5. Strongly agree**
10. I would give some of my own money to help save wild plants and animals.	**1. Strongly disagree**	**2.Disagree**	**3. Neither agree nor disagree**	**4. Agree**	**5. Strongly agree**
11. I like to spend time in places that have plants and animals.	**1. Strongly disagree**	**2.Disagree**	**3. Neither agree nor disagree**	**4. Agree**	**5. Strongly agree**
12. I would help to clean up green areas in my neighborhood.	**1. Strongly disagree**	**2.Disagree**	**3. Neither agree nor disagree**	**4. Agree**	**5. Strongly agree**
13. My life would change if there were no plants and animals.	**1. Strongly disagree**	**2.Disagree**	**3. Neither agree nor disagree**	**4. Agree**	**5. Strongly agree**
14. My life would change if there were no trees.	**1. Strongly disagree**	**2.Disagree**	**3. Neither agree nor disagree**	**4. Agree**	**5. Strongly agree**
15. Plants and animals are important to people.	**1. Strongly disagree**	**2.Disagree**	**3. Neither agree nor disagree**	**4. Agree**	**5. Strongly agree**
16. It makes me sad to see homes built where plants and animals used to be.	**1. Strongly disagree**	**2.Disagree**	**3. Neither agree nor disagree**	**4. Agree**	**5. Strongly agree**
17. People need plants to live.	**1. Strongly disagree**	**2.Disagree**	**3. Neither agree nor disagree**	**4. Agree**	**5. Strongly agree**

18. Nature is easily harmed or hurt by people.	**1. Strongly disagree**	**2.Disagree**	**3. Neither agree nor disagree**	**4. Agree**	**5. Strongly agree**
19. Plants and animals are easily harmed or hurt by people.	**1. Strongly disagree**	**2.Disagree**	**3. Neither agree nor disagree**	**4. Agree**	**5. Strongly agree**
20. We need to take better care of plants and animals.	**1. Strongly disagree**	**2.Disagree**	**3. Neither agree nor disagree**	**4. Agree**	**5. Strongly agree**

Appendix III

Interview Guidelines used in BEAST! Process Study

Initial interview with Teacher

1. What was the initial contact that you received regarding the Baboró project?
2. How did you become involved with the project? What did you feel when you were approached about the school becoming involved?

3. What was the brief that you were given for this project?
4. What is the intended project impact?
5. How have you collaborated with the Scientist (……name)?
6. How have you collaborated with the Artist (……name)?
7. Were you involved in developing the idea for the project? If so how?
8. How do you think the is project operating so far?

FOCUS

- ***What creative initiatives are used in this school?***
- ***How is the pedagogy associated with creative initiatives translated into other areas of the curriculum?***

1. How is creativity built into the curriculum? Are some subjects more creative than others? Why? Is there a whole curriculum approach to creativity and if so how does this manifest itself?

2. How is teaching and learning organised that allows for creativity to flourish?

3. Are there skills that have been particularly been developed through working with the creative practitioners? Skills for teachers? Skills for pupils? Are these being translated across all subjects?

4. What is the impact of working in a more creative way on pupils and teachers?

5. Are there challenges to developing a creative curriculum? If so what are they and how can they be overcome?

6. Teacher role and professional development – does working in a more creative way change your role in the classroom? How? has it had an impact on the relationships in the classroom? What forms of professional development do you find the most effective in relation to developing a more creative approach?

7. How is the school trying to raise levels of student wellbeing (levels of motivation, engagement, participation, self esteem, resilience) in school and in lessons?

Draft Interview Guidelines Questions for Scientists

Tell me about how you became involved in this project?
What did you know about the project before you started?
What type of information did Baboró give you about the project? (what format did the information come in?)
What were your first reactions to the project?
How did you devise the experiments to use in the classroom?
How closely did you work with teachers and Baboró before you started in the classroom?
What have the children's reactions to you been like in general?
Do the children ask questions about the experiment when you are in the classroom? (if so, what kinds of questions?)
What do the children talk about to you and to each other while the demonstration is going on?
What kind of relationship do you have with the teachers in this school?
How do the children react to this class? Examples.

Have you noticed any changes in the children's behaviours since you first came here on day 1?
Have you noticed any changes in how the children react to you since you came here on day 1?
Have the teachers commented that there have been any changes in the children's behaviours?
In your opinion, have the children's team-working abilities changed since day 1?
Do the children work well as a group? Examples.
Do you feel that the class affects the children in any other way?
How do the children talk about nature?
How do the children talk about the environment? (has this changed over time?)
What do you think of the work of Baboró overall?
Would you be interested in becoming involved in a project like this again?
Have you encountered any problems since you first started the class?
How do you feel about doing the class?
Do you think that this is a worthwhile teaching method overall? If not, why not?
Do you think that other schools should become involved in this? If not, why not?

Questions for Teachers

How did this school get involved in this project?
What type of information did you receive from Baboró before the project started?
Are you aware of other, similar projects that operate in Ireland or elsewhere?
What was your first reaction to this project? Explain.
Were you ever employed in a school that took part in a project similar to this?
Why did you decide to implement the project here?
How did you approach the parents about the project?
What kinds of information did you give to parents before the project started?
How did the parents react to the project? (Why?)
How have the children reacted to the project? (Why?)
How do the children react to the artist? (Why?)
How do the children react to the scientists? (Why?)
At the start of the project, were any of the parents sceptical about the project?
Have the reactions of any of the parents changed in your opinion?
Do you think that this is an effective teaching method? (Why or why not?)
What kinds of skills do you think that it helps children to learn?
Have your opinions changed in any way about this project?
Do you think that other schools should become involved?
Have you encountered any difficulties implementing the project here?
Would you be interested in becoming involved in a project like this again?
What advantages do you think that this project has for the school?
Does it have any disadvantages for the school?
What advantages do you think that this project has for the community?
Does it have any disadvantages for the community?
Does it affect children in other ways, do you think?
How do the children talk about nature?
Has this changed since the project was implemented?
What types of nature projects have the children been involved in in the school up to now?
Why is Baboró different to these projects?
Have you noticed any changes to the children's (a) self-esteem, (b) confidence, (c) willingness to become involved in class since the Baboró project started?
What do you think of the work of Baboró overall on this topic?
Describe the atmosphere in the classroom. Has this changed in any way since the project started?
How do the children react to the end of each session?
Are there any recommendations that you would make on how the project could be improved?

Do you think that the children's enthusiasm for learning about the environment has changed in any way since the start of the project?
Do you think that the children's enthusiasm for attending school has changed in any way since the start of the project?

Initial interview with Artist

1. What was the initial contact that you received regarding the Baboró project?
2. How did you become involved with the project?
3. What was the brief that you were given for this project?
4. How did you develop the idea for the project?
5. What is the intended project impact?
6. What skills, attitudes or behaviours do you hope to change or develop?
7. How have you collaborated with the Teacher (……name)?
8. How have you collaborated with the Scientist (……name)?
   eg have you integrated ideas into your aspect of the project after discussion with the Scientist etc
9. What resources will you use /been offered?
10. What do you expect to personally gain from taking part in this project?