Heartsease 'Science Day' Project Report

Introduction

This report follows the journey and development of a 'science communication' based project at Heartsease Primary School in Norfolk with year six children aged between ten and eleven years old. The project brief was to create and develop a 'fun' cell based science activity which could be conducted at a 'science day' with two of the year six classes within the school. One of the overall aims of the project was to utilise different methods of communication and teaching to influence the way that children view science; to give them an opportunity to see that science that can be fun and interesting.

Models of science communication in the UK

The last century has seen the most fast paced growth of science and technology ever witnessed by mankind. As our understanding of these topics has increased so has our ability to utilise them and manipulate them to suit our needs. With our growing dependence on science based technology the Government in the UK has highlighted the importance of effective communication of scientific research and knowledge between scientists and the public. The word public is used here to describe all members of society who are non-specialist in the particular field under discussion; this can include scientists from other disciplines. Effective science communication in society has numerous democratic and ecological benefits which place it high on the Governments agenda.

The communication of science occurs at various levels within the public domain. There is a continual transmission of information between scientists, the government, the media and the public at various geographic levels. Within the UK there have been three main phases or approaches to science communication within the public arena. The first phase between the mid 1960's to mid 1980's was termed 'Scientific Literacy'. This considered science to be part of a stock of knowledge of which the public should be aware. It was primarily a deficit model, which suggested there was a knowledge deficit on the part of the insufficiently literate public. This prompted an increase in science education across the board to address and measure four fundamental elements of concern. These included educating the public so they were qualified with a basic knowledge of textbook facts about science, an understanding of scientific methods, an appreciation of the positive outcomes of science and the rejection of superstitious beliefs. This was designed to encourage an informed public to participate in science policy decisions.

The mid 1980's marked the beginning of a second phase of science communication called the 'Public Understanding of Science' (PUS). This was also a deficit model of communication but the focus shifted towards changing public attitudes towards science. The introduction of the PUS movement was marked by the release of the Bodmer Report in 1985, which suggested a good knowledge of scientific fact produces quality attitudes towards scientific technologies. The Bodmer report prompted the formation of the 'Committee on the Public Understanding of Science' (COPUS) by the Royal Society, the Royal Institution and the

British Association for the Advancement of Science. COPUS aimed to interpret scientific advances and make them more accessible to non-scientists. It played an important role in the development of the PUS model of communication utilised by the Government. However, the 1989 influential Durant report questioned public scientific literacy, raising concerns which are still prominent today. The report questioned members of the public in the UK and the USA on factual scientific knowledge, with devastating results. For instance, only 34% of the British public knew that the earth went around the sun once a year and only 23% of the British public recognised a link between the burning of fossil fuels and global warming (Durant *et al*, 1989). The findings of this report mocked efforts by the Government to improve the quality of the publics understanding of science.

In 2000 a House of Lords Report (House of Lords, 2000) and a Welcome Trust Report (Office of Science and Technology and the Welcome Trust, 2000) prompted a move to a third phase of science communication called 'Science and Society' which focuses on the deficit of the technical experts not the public. It marks the transition from a deficit model to an engagement model of communication, a two way dialogue between specialists and non-specialists. This model aims to build public trust in science and scientists and also to improve the quality of the decision making process and the production of socially robust science. This is the first time in the history of science communication in the UK that there has been recognition of a deficit on the part of scientists. Indeed, a 2006 Royal Society report indicated that scientists in the UK are not engaged with the public. They found that only 12% of scientists considered communication to be relevant; suggesting that scientists are not concerned with their isolation from the public domain (The Royal Society, 2006). Reasons for this included existing pressures to publish results, secure funding for their departments and conducting actual research.

The 'Science and Society' model of public engagement has been continually supported by the Government. In 2008 the DIUS (Department for Innovations, Universities and Skills) brought out the consultation document 'A Vision for Science and Society' which outlines the Governments stance on developing science and technology and comments on the major challenges in this goal (DIUS, 2008).

> 'Science improves the quality of everyday life; it underpins prosperity and increases our ability to face new challenges. We must exploit science and technology to become an innovative nation… a major part of the challenge is to build a more mature relationship between the public, policy makers, the media and scientists, where everyone understands each other better'.

As part of the Governments commitment for achieving this vision of science and society the report highlights the need for strengthening the level of quality engagement with the public on all major science issues and increasing the number of people who choose to study scientific subjects and work in research and scientific careers. This emphasis on the recruitment of members of the public to scientific employment is central to the development of this project. Projects such as the one undertaken at Heartsease are critical if such as vision is to be met as they offer an alternative means of engaging with young children and establishing an enthusiasm for science.

Non-Government Schemes for Public Engagement

There are numerous non-government lead ventures across the UK which aim to increase public engagement with science. One such initiative is the 'Beacons for Public Engagement' funded by the Wellcome Trust, the Higher Education Councils and Research Councils UK (RCUK). This initiative aims to "address the recognised need for change within institutions in order to further support public engagement across all subject areas and the full range of activity by higher education institutions". The initiative has resulted in the appointment of specially chosen higher education institutions, such as UEA, and partnership organisation to act as collaborative centres across the UK. These collaborative centres are then able to utilise available funding to encourage public engagement with university staff; who are often associated with large academic research laboratories and other influential scientists from a range of disciplines. This is challenging as it has long been the case that public engagement is not well regarded and is difficult to conduct in universities as it does not raise significant funding. The results from the 2006 Royal Society report support this notion. The Wellcome Trust is a major charitable organisation which plays a major role in supporting public science engagement. The work of such charitable organisations is critical for realising the 'vision of science and society' outlined in the Government DIUS 2008 report. Such charitable organisations are able to work independently of the Government to support and supplement existing Government schemes.

Communication theory

Communication theory is central to Government aims if it is to successfully engage the public in scientific debate. There are numerous definitions of communication.

- Weaver wrote in 1949 that communication is the procedures by which one mind can affect another.

- Miller wrote in 1951 that communication involves passing information from one place to another.

Communication was originally seen as a linear event, moving from the source to the receiver.

Source - message - channel - receiver

However, communication is not a one way process, it is interactive, and this linear model does not allow for feedback from the receiver. Recently, this has lead to the development of a transactional model of communication. This allows a feedback loop from the receiver to the communicator, thus allowing dialogue and interaction. This model can also consider the context in which communication occurs (Figure 1). With the development of our understanding of communication theory and what makes communication effective it is important to consider the project with these models in mind.

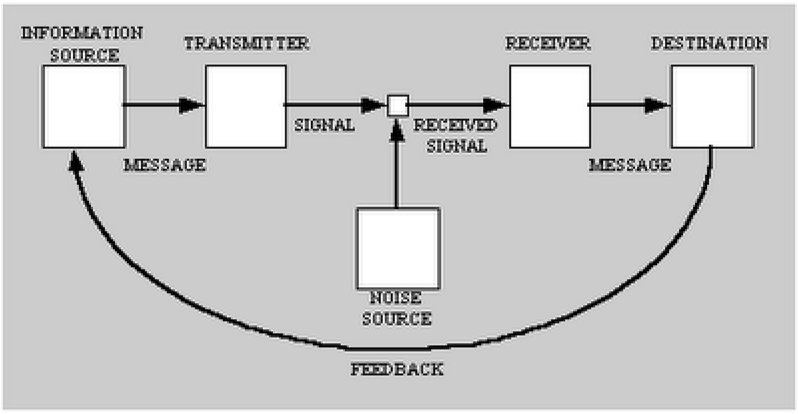


Figure 1. An illustration of a transactional model of communication. Notably, this involves the movement of information from the source to the receiver but also includes a feedback loop, allowing dialogue and interaction between the source and the receiver.

These models explain that successful communication is dependent upon effective interaction, based upon dialogue between the communicator and the receiver. There are numerous factors which can affect this interaction, which must be considered in the generation of scientific engagement schemes. One key factor that can influence the effectiveness of this interaction is audience (the receiver). If we consider just this factor alone it is clear how considerations such as this can add to the complexity of devising scientific engagement schemes. If we consider the UK as a whole, the audience is a western group with various socio-economic and cultural and religious backgrounds. It is both male and female with complexities of age, personality and experience. As a general whole, it has received a rudimentary science education is school, though it may not remember most of it. However, that is not to say that it is not increasingly aware of ethical, ecological and environmental issues.

The communication of science to a mass audience such as this is a complex process that must allow for the different learning styles and intelligences, previous experiences and culture of each individual within the audience. The construction of knowledge is a social activity, when scientific issues are communicated each individual person builds upon an existing knowledge framework which allows them to assess new ideas in the context of what is already known, resulting in a cumulative learning experience. Given that learning is such an active process the communicator must be overly conscious of their audience, not their message, and allow the development of dialogue by listening to their audience. It is essential that the communicators and the audience must have some understanding of each other.

Learning Theory

The communication of specific knowledge, such as science, is guided by numerous learning theories. Many of which underpin the education system in place today. The three main theories are the behaviouristic, humanistic and cognitive learning theories. Behaviouristic learning is learning in response to a stimulus. It follows Pavlov’s basic principles of classical and operant conditioning. It is linked to the development of skills through practice by repetition. Humanistic learning is highly value driven. It emphasises the natural desire of everybody to learn. The learners are therefore empowered and have control over the learning experience which is guided by a facilitator (Schunk, 2008). Cognitive learning involves learning by experience. It focuses on how people understand material, how thoughts are processed and the development of insight. A common way of looking at this is through Kolbs learning cycle (Figure 2). Cognitive theory also focuses on the different basic learning styles; these are based upon the belief that all people learn most effectively differently (Pritchard, 2009). Many people show combinations of these four styles however, one style usually dominates.

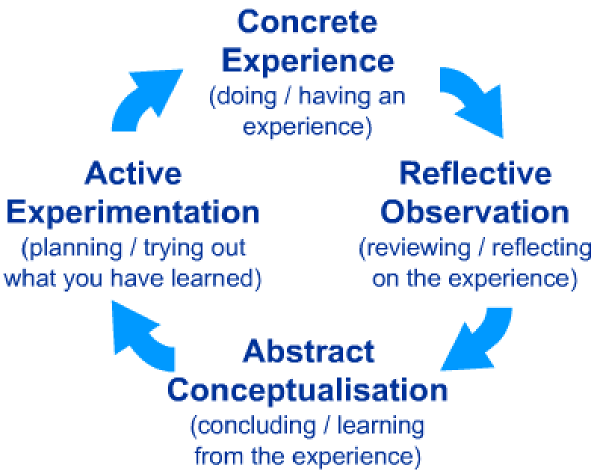


Figure 2. Diagramatic representation of Kolbs learning cycle

- **Activists**

  Activists learn by doing. They are open minded and enthusiastic about new ideas. They tackle problems by brainstorming but are bored by longer term implementation and considerations.

- **Reflectors**

  Reflectors collect information and consider it at length, searching through all available choices.

- **Theorists**

  Theorists like to analyse/adapt and integrate information into complex but logically sound theories. Tend to be detached and objective and keen on basic assumptions and theories.

- **Pragmatists**

  Pragmatists are keen on trying out ideas to see if they work in practice. They seek out new ideas and get on with things confidently and quickly. They are impatient with open ended discussions.

Howard Gardner also proposed that different people also have various levels of intelligence across a range of intellectual areas (Gardner, 1993). Originally Gardner only described seven basic intelligences, though he later described an eighth and ninth (Pritchard, 2009).

- **Linguistic**

  The mastery of language, use language to express and also to store information.

- **Spatial**

  The ability to create mental images.

- **Logical**

  The ability to detect patterns and to reason, often associated with scientific and mathematical thinking.

- **Musical**

  The ability to detect pitches and tones and rhythms.

- **Bodily-kinaesthetic**

  The ability to use ones mind to control bodily movement.

- **Interpersonal**

  The ability to understand the feelings and intentions of others.

- **Intrapersonal**

  The ability to understand ones own feelings and motivations.

- **Naturalistic**

  The enjoyment of and facility with the natural world, with ability in recognising patterns and classification

- **Existential**

  The enjoyment of and facility with asking and examining questions about life, death and ultimate realities.

The key to mass communication is to communicate the same message in as many different forms to cater for the different intelligences.

Science Engagement in Schools

It is commonly accepted that a key reason for public disinterest in science is the lack of relevance to their everyday lives. Science is a discipline which values the abstract and objective and litters itself with technical language that removes it from everyday communication. One way of overcoming this is the development of a science curriculum which can engage children at a young age and communicate the relevance of science and technology within their lives. The current science curriculum is designed to:

- Provide an appreciation and understanding of the impact of science and technology on everyday life.

- Give confidence to make informed personal decisions about things which involve science.

- Enable reading and understanding of the essential points in media reports about matters involving science.
- Allow critical reflection on the information included in such reports, or more often, the information omitted from such reports.
- Enable discussion with others about issues involving science.

With respect to the science curriculum at key stage two, students are expected to cover four areas of study. Student are then expected to be able apply their knowledge from these four areas of study to simple things such as everyday processes and their health and well-being and also think about the positive and negative effects of scientific phenomena on their lives and the environment.

1. Scientific enquiry
2. Life processes and living things
3. Materials and their properties
4. Physical processes

<u>Project Development</u>

Heartsease Primary School

Heartsease primary school was opened at the end of 2007, created by the reorganisation of two first schools and a middle school. Consequently, the school is larger than average. Most pupils are from white British backgrounds, only a small number are from minority ethnic backgrounds. The proportion of children entitled to free school meals is above average, which can indicate a high incidence of pupils with potential problems. The proportion of pupils with learning disabilities or learning difficulties is well above average as is the proportion that have statements of special educational needs. Children's attainment upon entry to the school is typically well below average, especially in communication, language and literacy. Ofsted reports from 2008 indicate that pupils joining the school from years one to six were well below national standards, both with respect to attainment and personal development and well being. However, as a result of good teaching the pupils progress is accelerating rapidly. As a general whole the curriculum was reported as developing satisfactorily, supporting the needs of all pupils including those who find learning difficult (Ofsted, 2008).

The 2009 achievement and attainment tables by the Department for Children, Schools and Families indicated that the number of children achieving the expected level four attainment or above in all three core subjects was below the national average of 247 at 228 and also the Norfolk average of 241. However, despite results that are below average, the number of children achieving or exceeding expectations has increased from 176 in this last year since its opening in late 2007 (Department for Children, Schools and Families, 2009). This is in keeping with Ofsted results which suggested that the School is rapidly establishing a good standard of education which is resulting in the rapid progress of underachieving pupils. With respect to science, the Department for Children, Schools and Families report 88% of pupils achieved level 4 or above in science and 24% of pupils achieved level five in science. The national curriculum recommends that children in key stage two should be working within levels 2 and 5, with a majority achieving a level 4 by the end of the key stage.

Assessment of Project Brief

In order to establish a suitable focus for this project it was first necessary to confirm the nature of the activities being performed by the other members of the group participating in the science day at Heartsease primary school (Appendix 1). From this it was apparent that the theme of cell types would compliment the subject matter of the other projects taking place. It also highlighted the need for a project that did not include the design or making of cells or their parts from any type of clay. Two of the other project designs included such activities and one of the aims of the science day was to stimulate pupils in numerous ways to make the greatest impact on their experience. However, without an understanding of what previous teaching on the subject of cells that children in year six had experiences it was difficult to produce ideas for an activity based upon different cell types.

An examination of the key stage two science curriculum, focusing specifically within the topic of life processes and living things revealed that the pupils are taught about the composition of the human body, focusing on some of the different organ systems such as the heart and circulation specifically and also about growth and reproduction. The subject of cells is not mentioned specifically in the curriculum until key stage three. So, although it was still not apparent what introduction the pupils would have had to cells or cell types, the subject of cells does fit within the ‘life processes and living things’ unit of study. Therefore, if nothing else, it was assumed that the project could act as an extension to work previously under this unit of study and also as a ‘taster’ of work to be covered in the following year upon entry to secondary school.

Action Learning Set Questions

The action learning set acted as an opportunity to pose the dilemma of designing a suitable activity around the subject of different cell types to peers at University. This allowed them an opportunity to pose questions about different aspects of the project idea that may have not been considered (Appendix 2). Following the action learning set each of the questions proposed was briefly considered (Appendix 3). It was already clear at this point that there was a need to design an activity which focused on a topic within the theme of cells that was not already being covered. So the only suitable idea from the action learning set was getting the children to stain and view their own cells under the microscope.

Further examination of the projects and activities conducted in science centres and museums to engage children in scientific learning resulted in the discovery of a game of cell Top-Trumps, designed and hosted by the ‘Centre of the Cell’ organisation. The cards contained pictures of each of the cell types and information on each of the cell types, including number of cells in the body, turnover, length, functions, the number of scientists researching using that particular cell type and ‘fun facts’ about the cell. This conveyed basic information about the fundamental characteristics of the different cells on a level that is appropriate for children and in a manner which makes it ‘fun’. Indeed, Top-Trumps is a popular children’s game often associated with other themes such as cars or television shows. Following consideration of the time constraints of the activity session it seemed more suitable to base an activity around the Top-Trumps cards from the ‘Centre of the Cell’ organisation, rather than attempt to stain and view the children’s own cells which is a far more lengthy activity. Consequently, the Top-Trumps cards formed the basis of this project activity.

Activity Design

The activity was designed to focus predominately on the construction of Top-Trumps cards. Eight card designs were created based upon different cell types (Appendix 4).

- Red blood cells
- White blood cells (Neutrophils)
- Fat cells (Adipocytes)
- Egg cells
- Sperm cells
- Skin cells (Keratinocytes)
- Nerve Cells (Neurons)
- Stem Cells

On the basis of the top-trumps cards taken from ‘The Centre of the Cell’ organisation the following categories were included on each card:

- Number in the body
- Number an adult makes each minute
- Length
- Number of functions
- ‘Fun facts’

Each card outline was printed with the cell name, the categories and the fun fact on the card and the picture of the cell type was printed separately onto stickers. It was planned that during the activity the children would be given information about the different cell types which would enable them to match the correct pictures to the correct cards. At the end of the activity, the children would then have eight cards to play a game of Top-Trumps with. In addition to making Top-Trumps cards. The children would also be provided with dissection microscopes so that they could examine slides of different cell types.

After establishing a cell based activity for the science day the next step was to draft a rough activity schedule (Appendix 5). This roughly assigned time slots to different steps of the activity throughout the 45 minute designated time period. However, following this, there was a change to the organisation of the science day. This meant that instead of teaching four 45 minute classes of twelve children, it would now mean teaching eight 30 minute classes of six children. Consequently, there were changes made to the timing of the final activity schedule (Appendix 6). This final activity schedule provided an opportunity to construct a more in-depth plan of how the activity would be run and the topics that could be included during the discussion about the different cell types.

Key Considerations

When designing the activity it was crucial to consider a number of different factors to maximise the experience for the pupils.

The Audience

As previously discussed, a key consideration of any scientific engagement scheme is the audience. Obviously, it was clear from the initial brief that this project was aimed at year six children aged between 10 and 11. However, this does not provide information on the composition of the students present in the classes, or about their abilities and attitudes to science. As previously discussed, Ofsted reports indicated the class would be composed of a majority of white British students who are below national standards with respect to attainment, personal development and well being. An above average number of children with learning disabilities or difficulties and children entitled to free school meals. Factors such as this may be interpreted to suggest that the pupils participating in the activity day were unlikely to show a great enthusiasm for learning or for science in general. For the activity to be successful it therefore needed to engage the pupils imaginations and make science fun. The higher than average proportion of children with learning difficulties emphasised the need to design the activity in such as way that it was easily accessible and understandable to all children, especially those with learning difficulties. At the same time the achievement and attainment tables issued by the Department for Children, Schools and Families indicated that in 2009 88% of pupils achieved a level four or above in science and 25% of pupils achieved a level five. This is at the top end of the attainment targets for children in key stage two. This highlighted the need to design the activity in such as way that it could also be extended to challenge and engage those children to a higher attainment level. The discussion of the different characteristics of each cell type and other related topics provided an opportunity to develop and challenge these students. For instance, it allowed the discussion of transfusions and blood cell types when talking about red blood cells, or a discussion of the issues of cloning when talking about stem cells.

Models of Communication

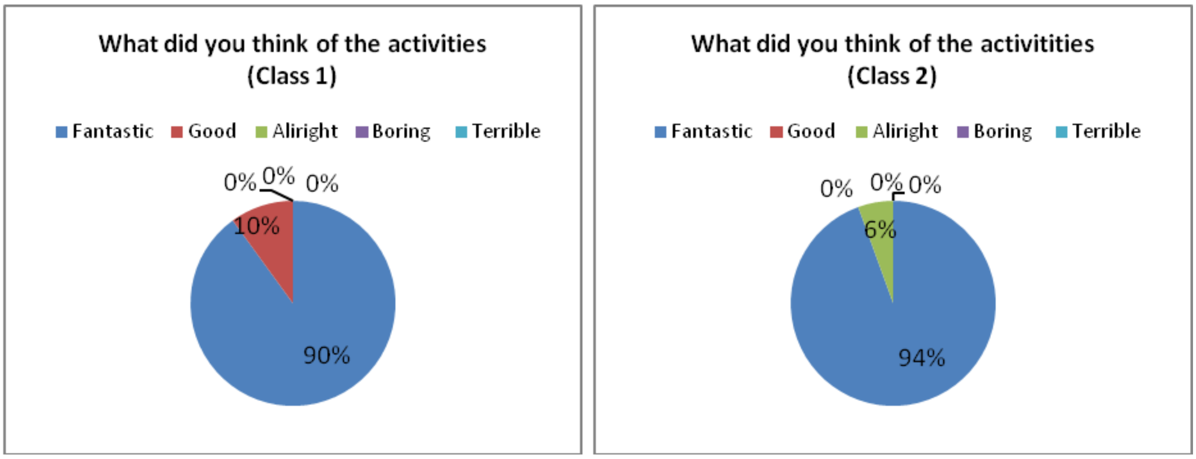
In order to maximise the effectiveness of the communication throughout the activity it was also essential to consider the activity within the context of the models of communication. The activity was developed with respect to the 'science and society' model of communication. It aimed to present information to pupils in such a way as to engage dialogue and discussion. A large part of this involved the use of questions to gain insight into pupil's opinions and interests. The use of questions can also act as hooks to draw pupils into the discussion. This then also allows the leader to respond appropriately to the needs of different pupils.

Learning Theory

Another key consideration in the design of this project was to facilitate the different learning styles of the pupils. As previously discussed there are four main learners: activists, reflectors, theorists and pragmatists. The most effective project is obviously one which can facilitate all of these different learning styles and communicate one message in the most possible ways. Different parts of the Top-Trumps activity were designed to appeal to these different learning styles. The construction of the cards by matching the correct cell photograph to the cell type on the basis of the information provided on the card was designed to facilitate the learning of activists, who are known for their enthusiasm and desire to learn by action, and pragmatists, who are keen on trying out new ideas and get on with activities quickly and confidently. In addition to this there was verbal information presented about each of the cells to help the pupils decide upon the correct picture. Depending upon the interest expressed by the students, this could then lead to the discussion of other factors about the cell types. This discussion of each cell type was designed to facilitate the learning of reflectors, who like to collect information and consider it at length, and theorists, who like to analyse, adapt and integrate information so that it fits a logical pattern. Obviously, parts of the activity are more suitable to particular learning styles than others. The open ended discussion of the cell types does not lend itself to activist and pragmatist learning, but the combination of discussion and action in the construction of the cards was really essential, in catering for the different needs of all of the types of learners. An important aspect of this activity was that the pupils would then have the Top-Trumps cards to take home with them. This was designed to help reinforce the activity and promote further discussion of the information covered during the activity at home. As an additional activity at the end of the session, the pupils were also given the opportunity to view real cells under dissection microscopes. This active process was designed to further consolidate the information presented during the Top-Trumps activity and also act as an extension to challenge more enthusiastic students.

Final Preparation

In addition to the above, it was essential to construct a check list (Appendix 7) and a risk assessment (Appendix 8) prior to the activity day. The check list aided the organisation of the



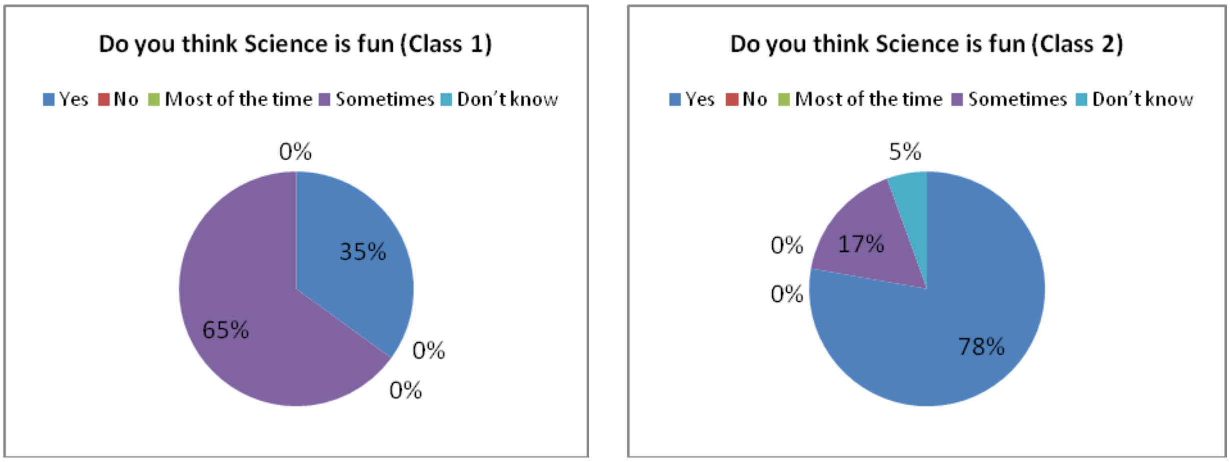
activity day and ensures that apparatus needed was not forgotten, whilst the risk assessment was a legal recruitment of the School. This highlighted all of the associated risks with the project and the steps that would be taken to ensure that the children were protected against them. Dr Kay Yeoman also completed a separate risk assessment for the day that covered all of the projects conducted (Appendix 9).

Evaluation

Following completion of the activities the pupils from the two classes were asked to fill in a simple standard questionnaire (Appendices 10 and 11). This questioned their views on the activities, the subject of science and whether their views of science had changed as a result of the day's activities.

The responses from both classes were somewhat varied. The majority of class two (78%) thought that science was fun, whereas only 35% of class one thought that science was fun. The majority of class one (65%) thought that science was only fun sometimes (Figure 3).

Figure 3. Pie chart representation of the responses of the pupils in classes one and two to the question 'Do you think science is fun?'



The majority of both classes thought that the activities were fantastic (figure 4.)

Figure 4. Pie chart representation of the responses of the pupils in classes one and two to the question ‘What did you think of the activities?’

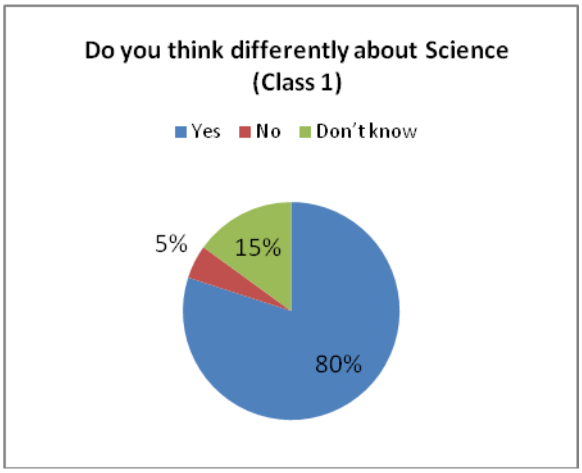
Lastly, the majority of both classes thought differently about science following the activity (Figure 5).

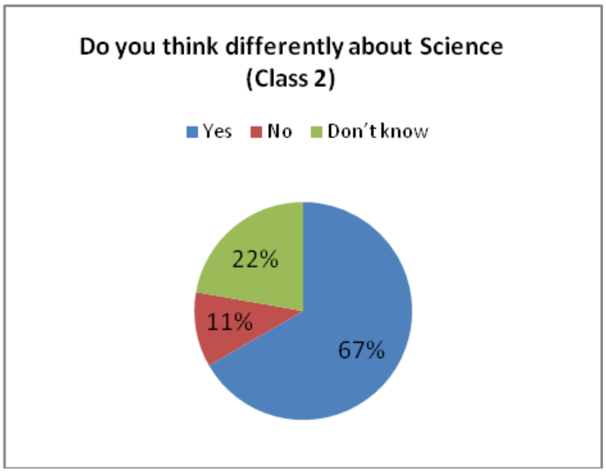
Figure 5. Pie chart representation of the responses of the pupils in classes one and two to the question ‘Do you think differently about science?’

Both classes commented extensively on the different things that they had learnt. For example ‘how big a fat cell is’ and ‘how many blood cells there are in the body’. And many also included thank you comments. For example ‘Thank you for coming to do your science day. I really enjoyed it and I learnt loads about what is in your body’ and ‘It was absolutely brilliant, I wish it could come again’.

One of the participating teachers, Ms Roberts, who also acts as the Heartsease Primary School Science Co-ordinator, also commented on the activity.

> ‘The science day was fantastic, the children engaged with all of the activities and the information provided really enhanced their understanding. Your students delivered the day with enthusiasm and professionalism, and we wee all really impressed with the quality of their teaching. The children can’t wait for you all to come back again’.





Self Reflection

This project has been unlike any other that I have encountered during my time at University. It has pushed me to consider theory and models of communication so unlike my other units of study and into situations of which I have no previous experience.

During the initial planning stages of the project I encountered numerous theories and models of communication and learning which were incorporated into my activity design. This theoretical application of models to an activity came relatively easily, as it is similar to skills which are built throughout our time at University. I was also forced to consider literature outside of my ‘normal’ references, including national curriculum outlines, school Ofsted reports and achievement and attainment reports by governing bodies, the manipulation and use of this information within the project was also something with which I didn’t struggle. However, one of my biggest challenges throughout the entire project was the development of an activity for an audience of which I had no knowledge, around a curriculum which I didn’t really understand. Despite much research into the curriculum and lesson plans and activities suitable for children that age, I found it highly difficult relating to the pupils and presenting the knowledge that I had in a way that was accessible to them. This was also apparent during the actual project.

There were numerous factors which I had not considered prior to the activity day, which became apparent whilst I was there. These were mainly the actions that I could take in the running and control of the activity. For instance, it quickly became apparent that the most effective way of holding the pupils attention was to hand out the Top-Trumps cards one by one as we moved on to the activity. It was also beneficial to work through the cards in a particular order, working through the more common and easily recognisable cell types first. This helped the pupils to understand the cell types and meant that there were fewer cell pictures to choose from as we moved on the less well-recognised cell types. I was also originally unsure how to conduct the game of Top-Trumps after making the cards and how to conduct the microscope activity. Trial and error showed that it was more effective conducting both of these activities as one large group as opposed to in smaller groups. Although with the microscopes this meant that only two children at a time could be viewing the cell slides, I found it easier to control the group and respond to the group as a whole than trying to monitor and respond to two or more groups at a time.

During the activity day we were faced with two very different classes in the morning and the afternoon. The class in the morning were well behaved and listened and responded well to instruction. Most of the children responded well to the activity design; they were inquisitive and engaged. In fact, I was surprised by the level of intellect demonstrated by some members of the class. Pupils were able to correctly identify the majority of cell types with little aid and often gave very insightful responses to questions. By comparison, the class in the afternoon were not behaved and did not seem to engage with the material taught in the same way. They were harder to control and although they interacted and were very excited by the activity, they generally showed little interest in discussing the actual science or information for each cell type. At the time this lead me to believe that the activity design was better suited to a class that was more intellectual or engaged. And had I been asked to repeat the activity with the second class again I would have altered the format to create a more active and involved activity whilst minimising any discussion. However, having looked at the commentary and evaluation from the second class, I feel that although they may have not taken away as much of the information as the first class, they still had a positive experience, which influenced the way that they viewed science. This was one of the main aims of the project, so in hindsight I think that it was just as successful, just perhaps in a different way.

I also struggled with individual pupils who would not respond or engage as part of a group regardless of how you interacted with them. For instance, one girl would not even choose a category in the Top-Trumps game. Even after much consideration I can not think of how I could have approached the activity in such a way to engage pupils such as this. Instead, I realised that you have to accept that some pupils will not be comfortable interacting with strangers in groups, and so there is very little that can be done during activity sessions such as this one to accommodate for them. I did notice however, that children who were particularly shy during the group activity seemed to engage more during the microscope activity. I think that this allowed more one to one interaction and instruction with some children. In future, I would try to incorporate activities which allowed this interaction into any session as it felt beneficial.

Overall, this project has been a truly rewarding experience. I gained a tremendous amount of pleasure from the entire experience, both in the design of the project and also during the activity session. It was particularly rewarding feeling that I had connected with some children and had provided them with a positive experience of science. I think overall it was successful in highlighting the need and importance of such outreach programmes in the community to engage children in science.

References

Department for Children, Schools and Families. (2009). Achievement and attainment tables for 2009; Heartsease primary school. Department for Children, Schools and Families.

DIUS. (2008). A Vision for Science and Society: A consultation for developing a new strategy in the UK. DIUS.

Durant J, Evans G and Thomas G. (1989). Public Understanding of Science. *Nature*. 340; 11-14.

Gardner H. (1993). Multiple intelligences: The theory in practice. New York: Basic Books

House of Lords. (2000). Science and Society. Her Majesty's Stationary Office.

Jackson R, Barbagallo F and Haste H. (2005). Strengths of public dialogue on science related issues. *Critical Review of International Social and Political Philosophy*. **6**; 349-358.

Office of Science and Technology and the Welcome Trust. (2000). Science and the public: A review of science communication and public attitudes towards science in Britain. Office of Science and Technology and the Welcome Trust.

Ofsted. (2008). Heartsease primary school; Inspection report. Ofsted; Raising standards, improving lives.

Parliamentary Office of Science and Technology. (2006). Debating Science. Parliamentary Office of Science and Technology.

Parry V. (2002). Scientists as communicators: how to win friends and influence people. *Journal of Molecular Biology*. **319**; 973-978.

Pritchard A. (2009). Ways of learning: Learning theories and learning styles in the classroom. Routledge.

Schunk D. (2008). Learning theories: An educational perspective. Pearson/Merrill Prentice Hall.

The Royal Society. Factors affecting science communication. The Royal Society.