

A study into the influence that
Information Communication
Technology tools have on primary
pupils' attitudes towards science.

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Overview

Brief outline of research idea

This research explores the impact that the integration of Information Communication Technology [ICT] into primary science lessons had on pupils' attitudes towards the scientific skills of recording and communicating in a fifth class in a Dublin city suburb. It was carried out from the 1st of September 2009 until the 1st of May 2010. The twenty children were taught eighteen science lessons with the aid of a variety of ICT resources, over a period of two months. The topics covered were light, the respiratory system and temperature. The ICT resources included: an interactive whiteboard [IWB], digital cameras, spreadsheets, microphones, a digital thermometer and a class blog (<http://primaryscience.wordpress.com>). This report outlines the children's experiences during the lessons. It is based on questionnaires completed by the participants before and after the lessons, interviews with six of the participants before and after the lessons, and field notes from the lesson.

Summary of research aims

The purpose of this study was to investigate whether the integration of ICT tools (digital cameras, a class blog, classroom computers, microphones, data loggers, an IWB and spreadsheets) into primary science lessons will influence pupils' attitudes towards the scientific skill of recording and communicating. This study examines:

- Pupils' attitudes towards the use of ICT tools in primary school;
- Pupils' attitudes towards the use of ICT tools in primary school science;
- Pupils' attitudes towards the scientific skill of recording and communicating in primary school science;
- Pupils' attitudes towards the use of ICT tools to record and communicate during primary science activities.

Research Design

After carefully considering the quantitative and qualitative approaches used in educational research and taking into account that this study would be carried out in a fifth class primary classroom, the researcher decided to use a mixed method approach. After considering the complex social setting of a classroom, it was felt that the main method of data collection for this study would be a humanistic (qualitative) approach which would allow the researcher to recognise the multiple realities within the classroom (Lincoln & Guba, 1985). The quantitative data was used to provide a check on the ideas and themes that emerged from the qualitative data (Dey, 1996, p. 9). The multiple methods of data collection chosen for this study were questionnaires, interviews and observations.

Ethics

Prior to undertaking this classroom research, ethical procedures were considered. Permission for the research was obtained from the principal, the board of management of the school, the participants and their parents. This was done through the distribution of letters to each of the above. The letters contained an outline of the purpose of the research, the procedures involved and confidentiality assurances. All interviewees were informed that participation in the interviews was voluntary and that they could withdraw at any stage. Confidentiality and anonymity was ensured throughout this study.

Summary of background reading

Teacher and pupil attitudes towards primary science

Research has highlighted that how a teacher teaches primary science affects their pupils' attitudes towards science (Harlen & Holroyd, 1997; Jarvis & Pell, 2004; Johnson, 2007). Teachers that lack confidence in teaching science have been shown to have an adverse affect on pupils' attitudes towards science (Harlen & Holroyd, 1997; Jarvis & Pell, 2004). Contrary to this, there is evidence that effective science teaching has a positive impact on pupils' learning of science (Johnson, 2007). The literature indicates that there is a direct correlation between a teacher's confidence and how they approach the teaching of primary science and their pupils' attitudes towards science.

Recording and communicating in primary science

To develop the skill of recording and communicating the curriculum (DES, 1999) outlines a variety of methods to record and present findings and conclusions. These are:

- Oral and written account;
- Charts, graphs and diagram;
- Presentations using word processing or publishing tools.

(DES, 1999, p. 80)

In her study on the implementation of the primary science curriculum Coroon (2005) surveyed 86 teachers. The author suggested the pupils recording experiences were limited to worksheet style activities and that this may be unsuitable for pupils with literacy difficulties. In a recently commissioned report on the new Irish science curriculum, it was established that ten out of the fifteen classes observed in the study involved pupils recording their findings in written form (Varley, Murphy & Veale, 2008). There was no evidence of the use of charts or graphs in the science lessons that were observed by Varley et al. (2008). The authors suggested that pupils who participated in the study did not appear to be "experiencing a

varied range of possibilities for recording and communicating” (Varley et al., 2008, p. 8). It appears from these studies that primary pupils in Ireland are not being given appropriate opportunities to develop the scientific skill of recording and communicating as envisaged in the curriculum.

Information Communication Technology [ICT] in primary science

A study by the British Educational Communications and Technology Agency [BECTA] (2009) found that eleven year old pupils that participated in the study made greater progress in science when given more exposure to an interactive whiteboard [IWB], “with low attaining boys making as much as 7.7 months additional progress” (p. 15). Another BECTA (2003) report on the use of ICT in the teaching and learning of science in the United Kingdom [UK] maintains that there are three key benefits of using ICT in science:

- ICT can make science more interesting;
- ICT allows for more time for observation, discussion and analysis;
- ICT increases opportunities for communication and collaboration.

(BECTA, 2003, p. 1)

Despite the apparent benefits of ICT in primary science and the expectation which exists to integrate ICT tools into lessons, Murphy, Beggs, Russell and Melton (2005, p. 6) suggest that teachers are not confident in using ICT tools in primary science. A review of the implementation of the Primary Science Curriculum (DES, 1999) by the National Council for Curriculum and Assessment [NCCA] (2008) found that teachers used ICT to plan for science lessons rather than for pedagogical purposes. Varley et al. (2008) summarised that the use of ICT did not appear to be common in Irish primary science classrooms, despite pupils being positively disposed to the notion of using ICT in science.

Pupils' attitudes towards ICT and learning

International research shows that children have positive attitudes towards using ICT for learning (BECTA, 2009; BECTA, 2009a; Hayward, Alty, Pearson & Martin, 2003; Selwyn, Potter & Cranmer, 2009). Hayward et al. (2003) conducted 1,804 paired interviews with both parents and children (aged five to eighteen) to evaluate attitudes towards ICT in school and at home in England. The report showed that 76% of the surveyed children aged between five and eleven stated that “using ICT made schoolwork more fun” (Hayward et al., 2003, p. 3). Despite the importance given to the use of ICT within all curricular subjects (DES, 1999, 1999a; NCCA, 2004) there is a paucity of research into Irish children’s attitudes to using ICT in primary science.

Blogging in education

Despite the hype around the teaching and learning benefits of Web 2.0 tools such as blogs, wikis and podcasts there is a lack of international empirical evidence to support these claims (Crook & Harrison, 2008, p. 3; Ramaswami, 2008). There are many commentators who have given anecdotal evidence of the learning benefits of blogging in a classroom (Downes, 2004; Duffy & Bruns 2006; MacBride & Luehmann, 2008; Owen, Grant, Sayers & Facer, 2006; Richardson, 2009). Examples include the following:

- Promotes reflective thinking;
- Nurtures collaboration and relationship-building;
- Increases perceived accountability and therefore quality of student work;
- Encourages peer support for one another;
- Increases opportunities for students to receive feedback;
- Extends learning outside classroom walls;
- Allows and encourages interactions with experts outside of the classroom.

(MacBride & Luehmann, 2008, n.a)

Classroom blogs in science

There is little international research into the use of blogs in secondary school science classrooms and the researcher found no international or Irish research into the use of blogs in primary science. One study which was found in relation to science was a study by Luehmann and Frink (2009) into how eight American and one Canadian secondary school teachers used a classroom blog to support the teaching and learning of science in their classrooms. The authors list five potential learning affordances for science classroom blogs. These are shown in the Table 1 *Learning affordances for science classroom blogs*.

Table 1: Learning affordances for science classroom blogs

<i>Science learning Goal</i>	<i>Description</i>
Long-term scientific engagement.	Pupils would be able to use the archival nature of blogs to aid them in completing long-term investigations.
Support scientific explanations that bring multiple voices or resources together.	The blog would allow pupils to use multiple resources to present scientific explanations.
Extending scientific understanding through engagement with multimodal format.	The blog allows pupils to exchange scientific ideas with the aid of multiple presentation formats (picture galleries, personal narratives, essays) easily with their peers and others.
Use of peer feedback in developing scientific explanations.	A blog allows for easy access to pupils' reports for viewing and critiquing, which allows for scientific discussion, collaboration and ongoing revision of ideas.
Engagement with and within the scientific community	By a blog being public, work and ideas are impacted by both the local and distributed participants, in reality or in potential. Even if the external audience does not interact through comments, the potential for this interaction affects the pupils' blog posts.

(Luehmann & Frink, 2009, p. 278)

The authors found that the success of the blogs was determined by: how the teacher designed and introduced the blog to the pupils, how pupils interacted with the blog and how teachers responded to pupils participation (Luehman & Frink, 2009).

Findings

This study found that the ICT tools used during the intervention lessons had a positive impact on pupils' attitudes towards the scientific skills of recording and communicating, but that some of the participants had concerns about how some of the ICT tools were used. This study sought to examine the following research questions:

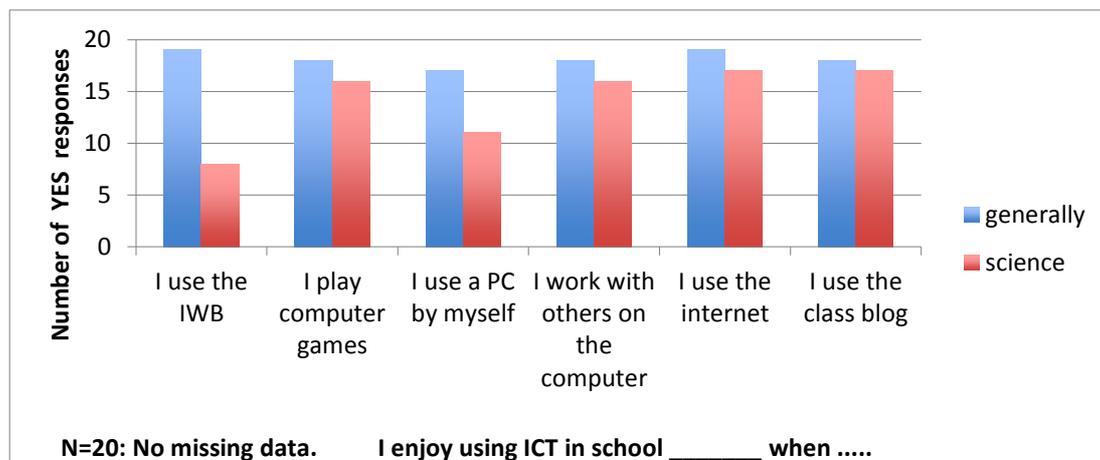
- What attitudes do pupils have to using ICT tools in school?
- What attitudes do pupils have to using ICT tools in school science?
- What attitudes do pupils have to recording and communicating in school science?
- What attitudes do pupils have to using ICT tools to record and communicate in school science?

Conclusions

The first question aimed to establish what pupils' general attitudes towards ICT in school were in this study. It emerged from the findings that after the intervention lessons most of the pupils had positive attitudes towards the use of ICT tools in school, but that some of the pupils had reservations about using some ICT tools. Pupils did not like when the activities which included ICT tools were too easy or too hard.

The second question was concerned with pupils' attitudes towards the use of ICT tools during school science. The post-intervention data showed that although pupils had positive attitudes towards using ICT tools in science, they were not as positive as pupils' attitudes towards the use of ICT tools in school in general (Figure 1). Pupils' attitudes towards the different ICT tools used during the science intervention lessons are outlined in detail when the fourth research question is discussed.

Figure 1: Post-Intervention comparison of pupils' attitudes to ICT in general in school and pupils' attitudes to ICT in school science.



The third question related to pupils' attitudes towards the scientific skill of recording and communicating during school science. The first method recommended in the primary science curriculum (DES, 1999a) to develop the skills of recording and communicating is oral and written accounts. The post-intervention data showed that over sixteen of the twenty participants enjoyed discussing their science investigations with their peers and their teacher (Table 2). Although, the data shows that the participants were quite positive towards writing during science, two of the six participants interviewed after the intervention lessons indicated that they disliked writing during science. Participants' attitudes towards drawing graphs during science were also positive. Charts and graphs are discussed further in the analysis of the next research question.

Figure 2: "Why is this so hilarious?" Pupils using a microphone (Post-intervention)

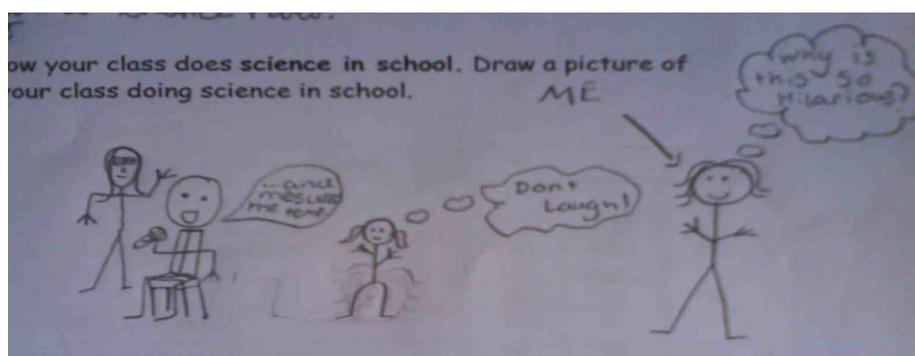


Table 2: Pupils' attitudes to recording and communicating during science
(Figures expressed as number of responses)

I like school science when...	Pre-Intervention			Post-Intervention		
	Yes	Not sure	No	Yes	Not sure	No
<i>I copy from the board</i>	9	7	4	13	5	2
<i>I fill in my workbook/worksheet</i>	10	7	3	16	4	0
<i>I write about something I have done in science class</i>	12	6	2	12	7	1
<i>I draw graphs</i>	7	9	4	12	5	3
<i>I talk about science investigations with my friends</i>	14	4	2	16	2	2
<i>We discuss science investigations with the teacher</i>	17	3	0	18	2	0
<i>N = 20; There were no missing responses.</i>						

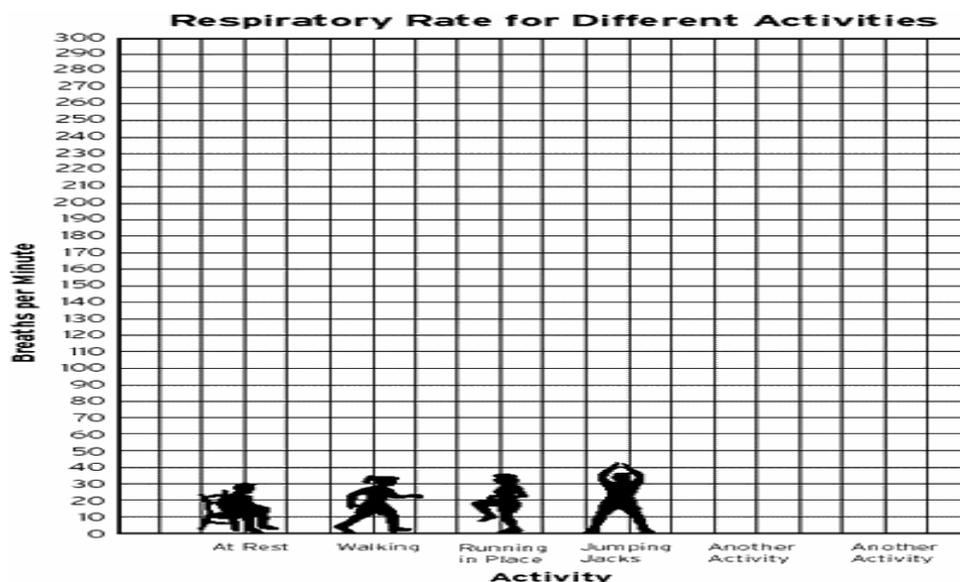
The fourth question established what pupils' attitudes were towards using ICT tools to record and communicate during school science. Coroon (2005) highlighted in her study that pupils with literacy difficulties should use alternative methods to record and communicate during science. Podcasting and typing are two ICT tools that may be considered as alternatives. The findings showed that pupils had very positive attitudes towards the use of the microphone during science because they worked with friends and had fun. On the other hand the data indicates that podcasts took time to create, with pupils re-recording podcasts if they were unhappy with the finished recording. Pupils appeared to be preoccupied with how the podcasts sounded and they had genuine concerns about how their voices sounded when they were played on the blog (Kelly, 2010).

Participants of this study were also very positive about typing during science. Despite the pupils being very positive towards typing, the field notes showed that typing was also a time consuming process. It should be noted that pupils usually worked in pairs on a computer during the intervention lessons and that they had no previous keyboard skills training. Pupils

did attest that typing kept their work tidy, with Joanne saying that she preferred typing to writing because writing made her hand sore (Kelly, 2010). Valentine, Marsh and Pattie (2005) found that a large proportion of the 111 pupils in their study into the educational benefits of ICT, preferred to type than to write. In their study into the use of blogging by eighteen Canadian third graders (eight to nine years of age), Drexler, Dawson and Ferdig (2007) found that the pupils typing skills were marginal and that the typing was a time consuming process during the study.

The science curriculum (DES, 1999a) also recommends that pupils use charts and graphs while developing their recording and communication skills. During this study pupils created column charts using a template (Figure 3) and also used Microsoft [MS] Excel to create charts.

Figure 3: Example of a pupil's respiratory rate chart



The field notes showed that there were benefits in using the pupils' own charts and the charts created using MS Excel (Kelly, 2010). Murphy (2003) maintained that the main benefit of creating charts using spreadsheets was that it was quicker than pupils creating their own charts. In this study pupils created their own charts quickly, because they were given a

template to use and it allowed pupils analyse and discuss their findings quickly. The MS Excel charts were created using the class computer and displayed on the Interactive Whiteboard [IWB]. This enabled pupils to analyse data taken from all pupils within the class. It allowed pupils to easily compare their own data with that of others on the same chart and it allowed for different chart types to be used if required.

After the intervention lessons were taught, the digital thermometer (data logger) was the most commonly cited ICT tool in the pupils' descriptions of their favourite ICT tool to use during science. It should be remembered that this was the first time that the pupils had used any type of data logging equipment during school science, which may have influenced pupils' views. The field notes show that pupils found the digital thermometer easy to use (Kelly, 2010), which is in contrast to the views of Murphy (2003) who maintained that data loggers were not robust enough for use in primary classrooms. This study did not use any other data loggers during the intervention lessons. Harlen (2000) proposed that the use of data loggers allowed for the easy correlation of data and thus allows pupils to focus on interpreting and analysing the data. During this study, the pupils used the digital thermometer connected to a laptop and the pupils recorded temperatures inside and outside of the school building (Kelly, 2010). While pupils were outside the classroom gathering data using the digital thermometer it was difficult for some of the pupils to see the temperature graphs displayed on the laptop and it is questionable whether these pupils' analytical skills improved due to the use of the digital thermometer (Kelly, 2010). When the pupils returned to the class room, the laptop was connected to the IWB and the graphs were displayed for all pupils to see, which allowed all pupils to analyse the data (Kelly, 2010). The researcher would propose that while pupils are gathering the temperatures that there should be one digital thermometer/laptop between every four pupils to allow all pupils to see and analyse the data as it is being collected and not just when they return to the classroom. The participants'

attitudes towards the class blog were very positive, with over sixteen pupils stating that they enjoyed using the class blog in school and during science lessons (Figure 3). Some pupils worried that they may be mocked by others because their picture was displayed on the class blog, while others did complain about the complexity of the school digital camera.

Recommendations

In Harlen's (1997) opinion, it is only when pupils start to analyse and discuss their science investigations that a science lesson really begins and that pupils are given opportunities to develop their higher order thinking skills. Therefore, it is important that teachers choose the right methods for pupils to record and communicate their findings so that pupils are focused on their scientific findings and not just on how the presentation of their findings look or sound. Teachers should be provided with professional development to increase their science content knowledge and also on different strategies on how to develop pupils' scientific skills. The NCCA (2004) points out that ICT should only be used if it contributes to supporting the learning goals of the students.

Some of the participants in this study were conscious of how they looked and sounded on the class blog. Before setting up a class blog, Luehman and Frink (2009) state that teachers must take into consideration that the audience for pupils' work will now include others besides their peers and teacher. Pupils may be motivated to create high standards of work because of this new audience that may access their work, but it may also be a source of anxiety for some pupils.

To gain the full benefit of using ICT tools, primary pupils should be taught basic ICT skills such as typing. The NCCA ICT Framework policy (2007) provides guidance for teachers as to what ICT skills pupils should have at three levels: lower primary, upper primary and up to the completion of the Junior Cycle in secondary school, but it does not

give guidance on how teachers should teach any of these ICT skills to pupils. Internet safety should be taught in all schools as part of the Social Personal and Health Education [SPHE] curriculum.

In October 2010, the government invested a further €20.7m in grants for schools to buy ICT equipment, on top of the €23.3m they invested in hardware in schools in November 2009 (www.siliconrepublic.com). Despite these vast sums of investment in infrastructure there is no plan to train teachers in how to effectively use any of the ICT tools purchased. European research has shown that huge investment in ICT infrastructure in other European countries has not translated into the effective use of ICT tools in classrooms and that inadequate teacher professional development was a major reason for this (Balanskat, Blamire & Kefala, 2006, p. 51). The NCCA (2007a, p. 53) also reported that a lack of training in how to teach using ICT in different subjects prevented teachers using ICT in their teaching and one of the recommendations of the report was that there should be a greater focus on a pedagogical model of teaching and learning with ICT. Training must be given to teachers on how to integrate ICT tools successfully into their teaching so that it can benefit pupils' learning. Ensuring that the ICT tools are easy for teachers and pupils to use is something that must be taken into consideration. A list of ICT tools which have been tried and tested in Irish classrooms should be provided by the NCTE or the Primary Professional Development Service [PPDS]. It would be beneficial also if the PPDS created new exemplars for the science curriculum which integrated different ICT tools. It would also be useful if Discover Science and Engineering [DSE] created new exemplar lessons which integrate ICT tools.

The crucial component in the use of ICT in learning and teaching is the teacher and their pedagogical approaches.
(Webb, 2005, p. 705)

How the research has contributed to my professional development

I believe that this research has informed and improved the teaching and learning within my own classroom and the classrooms of others. While completing my research, I gave a presentation on blogging in education at the Computer Education Society of Ireland [CESI] annual conference in February 2010 to over thirty teachers and lecturers from primary, secondary and third level education sectors. Since completing the research I contribute bi-monthly to the teachernet.ie educational blog on the use of ICT in the classroom.

How the research will benefit the teaching profession and the wider education community

There is evidence that there is a dearth of research into effective teaching methodologies that will enable teachers to successfully integrate ICT into primary science lessons (Hennessy, 2006; Murphy, 2003). It is my opinion that some ICT tools can enrich the teaching and learning of the scientific skills of recording and communicating, but teachers must be given guidance on which ICT tools to use and how to use them. This research provides classroom based evidence of the successful integration of a range of ICT tools into primary science lessons.

There is also a lack of empirical research into the use of Web 2.0 tools, such as podcasts, wikis and blogs in education. I hope that this research will inform other teachers of the advantages and disadvantages of using a classroom blog in primary science, and that it will be a starting point for other researchers to initiate further study.

In September 2010 I started two new blogs which I hope will be an example for fellow educators in how ICT tools can be used in a primary school. The first one is a Discover Primary Science [DPS] blog (www.projectblogger.ie/stclaresps) through which

pupils and teachers in my school report about their science activities. During the school year I have trained all classroom teachers within my own school on how to submit blog posts. Instead of submitting a folder with written reports and photographs our school will be submitting our blog as our DPS log book. This blog is being used as a pilot by DPS on the projectblogger site and it is hoped that many more primary schools will follow it's example in the coming years. It also featured on the DPS Face book page (<http://www.facebook.com/DiscoverPrimaryScienceAndMaths>). The second blog is <http://teachnet.eu/stclaresradio>. This blog was setup as a teachnet project and it showcases pupils use of ICT tools across all curricular areas. Within my own school, three fellow teachers set up classroom blogs after seeing how effective my classroom blog (<http://primarysciecne.wordpress.com>) was at developing the teaching and learning within a primary classroom.

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