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# Is Technology, Including the Use of ICT, Utilised Effectively Within the Teaching of Science?

by

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**Abstract**

This research project investigates the use of technology, including the use of ICT, in a primary school. It looks at how technology is used in the teaching of science and the ways in which pupils feel the use of technology impacts their engagement. The study also looks at the benefits and constraints of using technology in both the opinions of teachers and students. The research draws from previous literature to gain an understanding of the conclusions that have previously been made relating to the impact of technology and ICT, particularly in the subject of science. The project makes use of questionnaires, observations and structured interviews to collect data. From these research instruments, multiple findings were made such as the large disparity between how teachers utilise technology and students' preferred use. Following this, recommendations were made including teachers being offered professional development in how to best use technology.

**Contents**

## Research Issue

The research project investigates whether technology is being used effectively within the teaching of science. There is a focus on ICT as well as other modern technologies such as mobile phones and tablets. The study does not look at the use of more 'traditional' scientific technologies, such as stopwatches or Bunsen burners, but these have been discussed where appropriate.

**Justification**

This work draws upon Ellison (2018).

Within my own teaching experience, I have noted an emphasis on using technology, particularly in mathematics. Literature suggests this is because the correct incorporation of technology within a lesson increases engagement and access to information (Falloon, 2014; Domingo, 2016). With this knowledge in mind, it continues to surprise me that modern technology is rarely seen within the teaching of science. Researching this topic has contributed to my professional development as I have demonstrated teacher standard 3b by showing a "critical understanding of developments in the subject" (Department for Education, 2011, p.11). The results of this study allow me to best utilise methods which enable the most effective teaching of pupils within my own practice; this follows standard 5a (DfE, 2011). From my experience in teaching, combined with research, I have developed a personal passion for technological integration in the classroom. To overcome this potential source of bias, I have ensured that my research instruments were piloted and peer reviewed in order to eliminate bias from the questions asked. Additionally, all quantitative data is purely objective and either given directly by teacher or students. Finally, qualitative data from both the focus group and observation has been reviewed by the class teacher where appropriate in order to ensure accuracy.

The National Curriculum (DfE, 2011, p.12) outlines the importance of "7c)…using approaches which are appropriate to pupils' needs" and agreed with the findings of BECTA (2002) that ICT would benefit children's learning. Following the work of BECTA, Warwick et al. (2006) also made the case for ICT to see more use specifically in science. In spite of this, there is no mention of more modern technologies, such as mobile or tablet, anywhere within government frameworks. In relation to this, the research project offers valuable insight and has been used to inform future practice.

There is a much larger emphasis placed on the use of technology by both the US and Australian governments (Hennesey et al., 2005). Internationally, many researchers have reached the same conclusion; technology can be a valuable addition to the range of resources at a teacher's disposal when integrated correctly (Furio et al., 2014; Falloon, 2014; Domingo, 2016). The international research points towards the use of technology within schools being

beneficial but studies have not yet considered how technology can be integrated into UK schools and none have looked specifically at its use within primary science lessons.

**Research Questions**

Creating precise research questions is a vital part of the research process as doing so guarantees the focus is narrowed and concentrates only on the key research issue. This means the research is more likely to be pertinent and meaningfully contribute to the topic in question (Denscombe, 2012).

1. **To what extent is ICT, mobile and tablet technology used within science lessons?**

This question aims to find the current use of technology and ICT within the classroom so this can be compared to the recommended use suggested by literature, as well as the opinions of students and teachers.

2. **What are the benefits and constraints of using technology within science lessons in the views of:**
    - **A) Teachers**
    - **B) Students**

The question looks to discover how both teachers and students view technology with a particular focus on its role in the classroom.

3. **What impact does using technology in a science lesson have on children's motivation and engagement?**

This question hopes to determine the effects of successful integration of technology on students within the science classroom.

## Literature Review

*Is Technology, Including the Use of ICT, Utilised Effectively Within the Teaching of Science?*

ICT in Schools

ICT was the first real technology to be implemented on a national scale in classrooms and its presence is on the rise. BECTA (2002, pp.1-2) concluded that they saw a "potential of ICT to be used…in the school curriculum". In the same year, Baylor and Ritchie (2002) state that schools often have a dichotomous relationship with ICT; it can be the subject of the lesson or a tool used to facilitate learning across the curriculum. Although not frequently recommended, the National Curriculum does make mention of ICT and integration within core subjects (DfE, 2013). It is important to note that BECTA was commissioned by the DfE to evaluate "the progress of the ICT in Schools Programme" so it should be expected that their opinion would influence government policy. Additionally, the government's policy and view is largely influenced by international change such as technological emphasis in the US and Australia (Hennesey et al., 2005). Similarly, Hermans, van Braak and Vanderlinde (2009) concluded that child competency in ICT must stem from national policy. However, it is worth noting that not all international policy is generalisable to the UK. The Teachers' Standards (DfE, 2011, p.12) continue to emphasise the government's view: "7c)…using approaches which are appropriate to pupils' needs". This standard can easily be applied to the use of ICT to support learning. Hennesey et al. (2005, p.186) agree with the government's view that ICT is "helping pupils to reach higher levels of understanding". However, their research is limited to English secondary teachers so it is hard to extrapolate their findings to a wider primary level. Furthermore, all schools in the study were within Cambridgeshire; an area with 8% fewer children in low-income families than the average in England and ranked 10$^{th}$ for level 3 results (DfE, 2017). This furthers difficulties with generalising to the wider population as children in more affluent areas are likely to have access to higher levels of ICT than available in less affluent areas. The view of OfSTED (2011, p.7) somewhat aligns with the government's but does suggest the government "set out clearly the pivotal role of ICT in school improvement". While the statement highlights the importance of ICT, it is not dissimilar to the view of BECTA (2002), despite being nine years after their recommendation. Aligning with this view, Tondeur, Valcke and van Braak, J. (2007) conducted a questionnaire of over 300 primary teachers and concluded that the use of ICT as a tool for learning was limited.

## Technology in Schools

Technology is becoming more available to children both at home and in school. Falloon (2014) states that the impact of using mobile technology in schools is largely positive. Domingo (2016, p.21) has similar views and states passionately that the two main advantages of mobile technology are "facilitating access to information" as well as "increasing engagement to learning". However, Domingo (2016, p.23) over-emphasises the positives of mobile technology by compiling the views of eight "author's contributions to the topic" in a table only containing positive headings; this means any negative comments are omitted thus demonstrating bias. Although Dhir et al. (2013) acknowledge the use of technology in the classroom is prolific, they ask for technology to be better integrated into curricula in order to take advantage of technology in a manner that best suits its strengths. This mirrors the concerns raised by BECTA (2002) regarding ICT's integration within the curriculum. Miller (2005, p.57) argues vociferously against the use of technology in schools claiming it is harmful to child development and needs to be "examined and critiqued". Miller's interpretation does not lean on any particular research and the idea of harming development is challenged by Hutchby and Moran-Ellis (2013) as they claim educational games stimulate a child's imagination and that technology increases children's access to information. The latter claim is supported by the views of Domingo (2016) and Furio et al. (2014) who state that some children attain information more effectively from technology. However, Furio et al. (2014) do note that research in educational games is lacking thus it is hard to corroborate their findings. Furthermore, Cao et al. (2015) passionately argue for the integration of technology within the classroom as a means to encourage collaborative learning. There is a common belief that teachers do not have sufficient skills to support the use of technology within the classroom (Keengwe, Onchwari and Wachira, 2008). However, in a focus group of primary school teachers, Baartman et al. (2014) recorded that zero of the teachers felt they needed help with using technology. Of course, this method is limited and further research tools, such as an observation, would be necessary to reach more meaningful conclusions.

## ICT in Science

Although research on the topic of technological use in science is lacking, study into the use of ICT in science does exist. Gujral (2005, p.1) agrees with the findings of BECTA (2002) that "a significant number of teachers" make "little or no use" of ICT in their teaching of science. The

implication being that ICT is a tool not utilised correctly, despite its positive effect. However, Gujral (2005, p.3) strongly contrasts this view by suggesting a "first-hand practical, demonstration, visit or investigation" may be more beneficial than forced use of ICT. Williams and Easingwood (2003, p.2) agree with this view, avidly asserting that ICT should be used to supplement "what must in the first place be good science". Collier et al. (2014) support the use of ICT in science from a young age and state that appropriate use of ICT and technology can add to the wealth of experiences we should be offering to young children. However, mirroring some of the views of Gujral (2005), they call upon theory (Fry and Kolb, 1974) to suggest that technology and ICT do not offer concrete experiences and thus must first be preceded by alternative resources. Warwick et al. (2006, p.19) add that ICT has many uses within a lesson: "as a tool, as a reference source, as a means of communication and as a means of exploration". They suggest that ICT is only beneficial if used appropriately.

This review's purpose was to view how technology has been implemented into the teaching of science and its role continues to grow. Much of the research found suggested the use of ICT is prevalent throughout primary teaching and that technology, such as mobile or tablet devices, is on the rise. Much of the government's recommendations were made over ten years ago and without more recent large-scale studies, it is hard to conclude that there has been dramatic improvement. Technology, particularly mobile and tablet, is a tool increasingly used in a primary setting but more research examining its use in the teaching of science is required. Smaller studies seem to suggest that, when balanced with other experiences and resources, technology is a useful asset to the science classroom.

## Methodology

Lambert (2012) states that methodology is the range of processes used to investigate the research questions.

| Research Instrument | Respondents | Research Question/s | Sample Size |
|---|---|---|---|
| Questionnaire | Teachers | 1 + 2a | 5 |
| Observation | A Y5/6 class | 1, 2a + 3 | 26 |
| Focus Group | Selection of KS2 students | 1 + 2b | 12 |

***Figure 1.*** *A table giving information for each research instrument.*

According to Denscombe (2007), a questionnaire is an instrument with written questions and is designed to collect information by asking the target audience directly about the topic. A questionnaire was given to a small sample group of teachers in order to discover the extent of technological use within their teaching. The collected responses are both quantitative and qualitative. When used correctly, questionnaires are an extremely effective instrument for collecting a considerable amount of data in a short time frame (Denscombe, 2010). However, a questionnaire can often be heavily influenced by a variety of factors such as wording, bias or even the respondent's mood (Lambert, 2012). If not taken into account, these factors can limit the validity of the data. To further ensure validity and reliability, a pilot questionnaire was carried out. The questionnaire was given to peers in order to assess the quality and specificity of questions. From this pilot, it was clear that some questions were unnecessary. For example, question 3 (figure 2) often resulted in a short list of answers and thus could be joined with question 4. Likewise, the pilot group's responses to questions relating to frequency were short and lacking detail. Therefore, giving the respondent a short question with multiple options increased accuracy and decreased time to complete the questionnaire. This correlates with Denscombe's (2010) characterisation of questionnaires and follows the advice of Cohen, Manion and Morrison, 2011). The final addition that arose from the pilot study was to include a question looking at whether teachers would use technology more frequently if given the choice and, in their opinion, what current barriers existed.

1. How often is a form of ICT or technology used as resource within science?

2. What ICT and technology resources are available for pupils and teachers to use?

3. Which of these are most commonly used within science lessons?

4. How are these used within science lessons?

5. Would you like to use technology in your lessons more often? If so, what factors currently make this difficult?

1. What ICT and technology resources are available for pupils and teachers to use?

2. Which of these are most commonly used within science lessons and how?

3. How often do **you** use ICT or technology within science lessons in your classroom? **Please circle one.**

Every lesson Most lessons Occasionally Never

4. How often do **pupils** use ICT or technology within science lessons in your classroom? **Please circle one.**

Every lesson Most lessons Occasionally Never

5. Would you like to use technology in your lessons more often? If so, what factors currently make this difficult?

***Figure 2.*** *Questionnaire before and after piloting.*

Response rate is another common drawback of questionnaires. A low response rate means themes cannot be identified in the data and thus cannot be generalised reliably. One way in which this can be mitigated is to avoid complicated, ambiguous or lengthy questions (Cohen, Manion and Morrison, 2011).

The questionnaire aimed to answer research questions 1 and 2a making use of both qualitative and quantitative questions. Questionnaires were given to teachers at a school that had an existing relationship with the researcher with the aim of improving response rate. Questionnaires were distributed at a staff meeting and initial response rate was good but, despite questions being specifically targeted at teachers, a variety of staff responded. Using these results would have significantly reduced validity as questions regarding frequency would have been heavily impacted by the number of staff within one classroom. To combat this, a second group of questionnaires were handed out exclusively to teachers but returned with a lower response rate of only 5. This limits how generalisable the data is. Additionally, the answers to one questionnaire indicate an EYFS teacher was the respondent. Although this increases the range of the year groups to respond, it is problematic in that both EYFS teachers and students have a different relationship with technology to the rest of the school. This one

questionnaire is particularly limited in response to question 5 and this must be taken into account when discussing the findings.

Questions 1 and 2 are open in design and did not include preassigned categories so as to not place limits on the respondent's answer. However, in order to objectively analyse and compare the answers to these questions, items of technology were tallied to find the mode. On the other hand, questions 3 and 4 were closed questions with given categories of frequency. In order to analyse this data, a number was assigned to each category in order to find the mode and median answers. Question 5 consisted of two parts; one closed and one open. The data for this question was therefore placed in a tally of "yes" or "no" for the closed question and a separate tally of various reasons given for the open question.

Gray (2014) defines an observation as both being able to record facts that are being witnessed as well as the processes of perception and interpretation. All three of these processes must be integrated correctly to successfully carry out an observation. An observation of a Key Stage 2 class will be used to further answer the first and third research questions. The observation will also serve to triangulate the results of the questionnaires. According to Robson (2011, p.316), the main reason to use observation is that it gives "real life" data taken from the environment in question. One of the main drawbacks with observation is the possibility of the Hawthorne Effect impacting on validity (Coombs et al., 2012). Another limitation of an observation is that the notes taken can become what is perceived instead of what is seen (Bell, 2005). In order to remain objective and avoid possible bias, the class teacher reviewed the notes in order to confirm their accuracy. The unstructured nature of the observation meant that piloting the instrument in a meaningful manner was not possible.

The observation took place in a mixed year 5/6 class of 26 in a school with, what the researcher judged to be, good technology and ICT resources. In order to reduce the impact of the Hawthorne Effect (Thomas, 2013), a class that the researcher had previous experience with was chosen. Although steps were taken to diminish the Hawthorne Effect, for the observation to successfully take place, it was necessary for the research venue to be aware of the research topic. The exact impact of this is hard to measure but it is possible that technology and ICT were integrated to a higher level than is typical for this class. Another limitation of the observation, as noted by Bell (2005), is that the qualitative data is ultimately

what is perceived by the researcher. This was combatted by ensuring the notes were as objective as possible.

There were two main outcomes from the observation. First, quantitative data was collected on the use of lesson time as well as how much of the lesson had students interacting with technology. Secondly, qualitative data was recorded in the form of running notes which focussed on the tasks students were set, the technological resources made available to them and the instruction of how to use the technology to complete the task.

Denscombe (2007) states that an interview is a conversation with a set of assumptions such as consent and agenda. An interview took place, in the form of a focus group, with two separate groups of students in order to answer the third research question. Asking the same questions of two separate focus groups and comparing their answers means the findings could be triangulated. The main benefits of interviews, and the reason they were used in this study, are that they allow the researcher access and insight to "people's opinions, feelings, emotions and experiences" (Denscombe, 2007, p.173). A common constraint of interviews, particularly with young or vulnerable participants, is a feeling of pressure and unfamiliarity leading to lower quality answers (Elliot et al., 2011). In order to address this issue, particularly because the interviewees were children, the study made use of a focus group. A focus group is more suitable for students as it is a less intimidating environment and the interviewees are likely to give more detailed answers (Blaxter, Hughes and Tight, 2010).

The researcher interviewed 12 students ranging across a variety of classes from Key Stage 2. In order to make the data more generalisable, the children were taken from a random sample left to the discretion of the school. In order to achieve a relatively random sample, the student council was chosen as a suitable selection of children. As a result of this, all children were able to clearly express themselves and put across their thoughts which greatly aided the research process. However, in the view of the researcher, it is likely that there is a correlation between being a member of the student council and academic performance. Therefore, the sample is not truly random and this limits the reliability of the data. To improve the interview process, it would have been preferable to interview the two groups of students on separate occasions but, due to time constraints, this was not possible. Instead, the groups were randomly separated onto different tables and given the prompts for discussion simultaneously. This process did not completely eliminate triangulation between the groups as, following an initial

conversation within their table, all students were then given the opportunity to discuss ideas. From this it became apparent which ideas were agreed upon by all students and which were more individualised. This was then reflected in the notes.

Questions 1-5 resulted in answers relating to the current use of technology in the classroom whereas questions 6 and 7 resulted in students giving answers pertaining to their preferred use of technology. Therefore, answers from these two sets of questions were grouped and analysed for the number of times each item of technology was cited. This data demonstrates how the current use of technology differs from the preferred use of the students. However, as 5 different questions' answers were accumulated and then compared to the answers from only 2, the two sets of data are not directly comparable. To account for this, the second smaller set of data was multiplied by 2.5 so it is of equal scale to the first set. Each method of interpreting the data creates its own limitations but making use of both aims to reduce the impact.

Blaxter, Hughes and Tight (2010, p.85) define triangulation as "Where two or more methods are used…to try to verify the validity of the information being collected." This is crucial within research as it ensures instruments are being used effectively and means the findings are more generalisable.

**Reliability, Validity and Ethics**

Reliability can be defined as to what extent author researchers would reach the same conclusion; how generalisable the results of the study are (Borg, W., Gall, J. and Gall, M., 2007). To address reliability, piloting will be used for each of the research instruments to highlight any potential issues such as leading or ambiguous questions (Lambert, 2012). This should lead to a greater ability to generalise the results. Bell (2005) notes that questions in both questionnaires and interviews asking for opinions are susceptible to inconsistencies as each participant will be influenced by a variety of factors. Despite this, when used correctly, these questions have a place.

According to Lambert (2012), validity is the extent to which the research instrument measures what it is designed to measure. Validity is important to ensure the results of the study answer the research questions effectively. Thomas (2013) states that the Hawthorne Effect describes a visible change in people's behaviour because they are being studied. This is relevant to research question one as this uses an observation. The Hawthorne Effect must be considered and steps will be taken to diminish such a risk. This will be done by the researcher becoming known to the students in advance in order to reduce the stimulus. Triangulation is the primary method of validating results as comparing between multiple research instruments, or between different sample groups, and arriving at the same findings, means the instrument is measuring the intended outcome (Basit, 2010). The final limitation the researcher must remain vigilant of is bias; not projecting the researcher's views onto the facts the instrument is collecting.

In the view of Alderson and Morrow (2011), ethics concerns the protection and respect of research respondents. Lambert (2012) adds that the researcher must also protect themselves from harm. This study will need to be cognisant of ethics in regards to confidentiality and anonymity as well as in regards to data protection. The study will be explained to all participants and it will be made clear their involvement is voluntary. This means all participants are able to give informed consent (Denscombe, 2007). Additionally, all respondents will be made aware of the ability to opt-out at any point. Confidentiality is the promise that it will not be possible to identify participants from the study whereas anonymity means even the researcher will not be able to identify responses (Bell, 2010). Once collected, all results will be recorded in a table where names will be omitted; eliminating the possibility of referring to names later in the study. This process serves to make the research both

confidential and anonymous. In order to abide by the correct data protection guidelines, the researcher must: use the data for the purpose originally specified; only collect data relevant to the study; guarantee the data's security and keep the data no longer than it is required (Denscombe, 2007). This will be achieved by ensuring that all data is kept in a locked environment, digital copies are password protected and the data is only kept for as long as it is necessary.

## Findings and Discussion

| What ICT and Technology resources are available for pupils and teachers to use? | |
|---|---|
| Item | Number of times mentioned |
| iPad | 5 |
| Laptop | 5 |
| Camera | 5 |
| IWB | 3 |
| QR Codes | 1 |
| Tweets | 1 |

***Figure 3***

| Which of these are most commonly used within science lessons and how? | |
|---|---|
| Camera | 2 |
| iPads | 3 |

***Figure 4***

***Figure 5***

| How often do **you** use ICT or technology within science lessons in your classroom? | |
|---|---|
| Every lesson | 4 |
| Most lessons | 1 |
| Occasionally | 0 |
| Never | 0 |

***Figure 6***

| How often do **pupils** use ICT or technology within science lessons in your classroom? | |
|---|---|
| Every lesson | 1 |
| Most lessons | 2 |
| Occasionally | 2 |
| Never | 0 |

| Would you like to use technology in your lessons more often? If so, what factors currently make this difficult? | | | | | |
|---|---|---|---|---|---|
| Yes | 4 | | Knowledge of software | 3 | |
| No | 1 | EYFS | Funding | 2 | |
| | | | Time to set up | 2 | |
| | | | Being in EYFS | 1 | |
| | | | Opportunities to see good practice | 1 | |

***Figure 7***

***Figure 8***

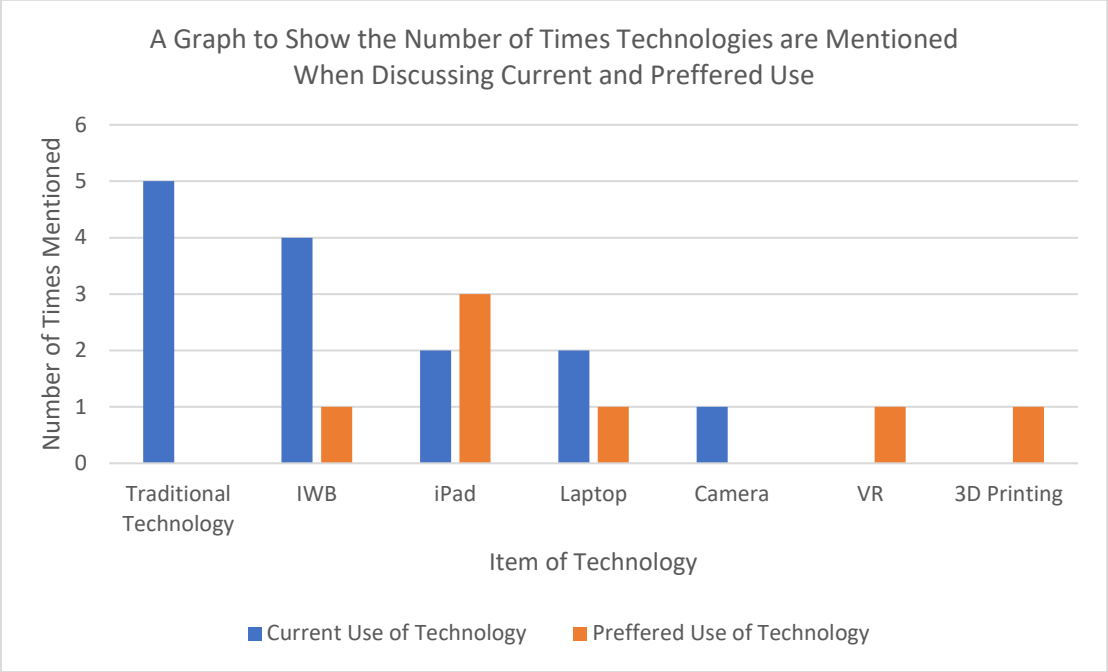
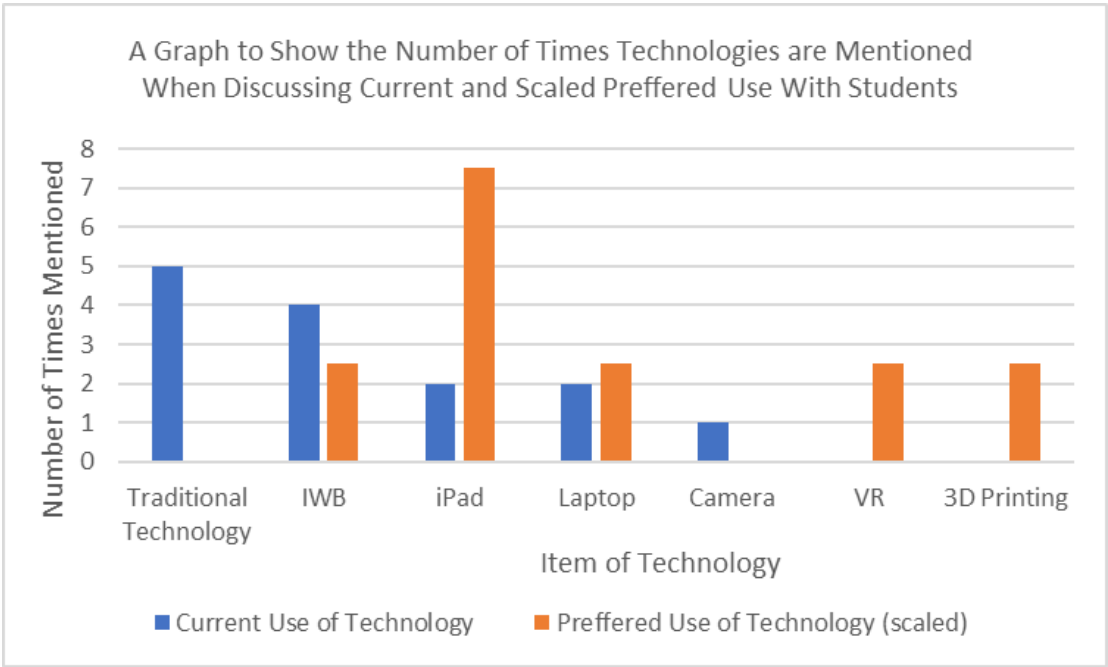



***Figure 9***



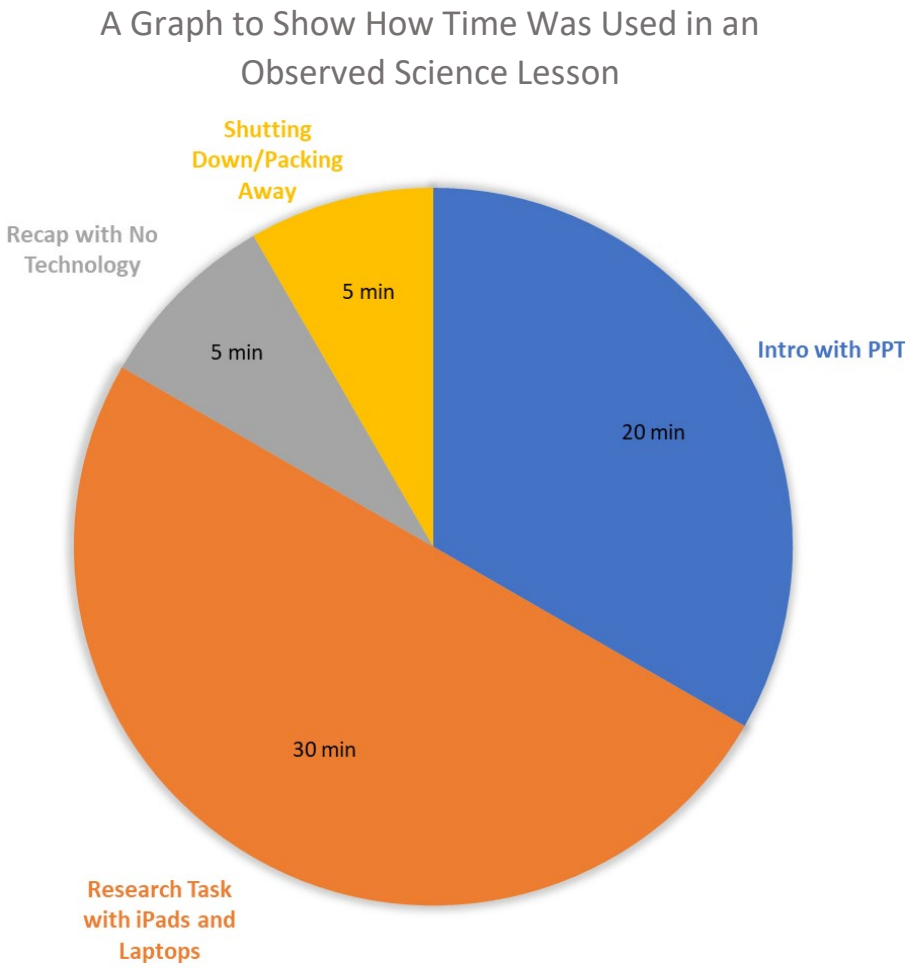



***Figure 10***

**1. To what extent is ICT, mobile and tablet technology used within science lessons?**

All three research instruments contributed to answering this research question.

Within the research setting, 4/5 teachers responded by saying they used ICT or technology every lesson and the remaining teacher responded by saying they use ICT or technology in most lessons (figure 5). It is worth noting that one of the questionnaire respondents works in the early years and this teacher's differing relationship with technology and ICT will impact results. Contrastingly, the results for how often pupils use technology or ICT indicated that this was not as common; 2/5 teachers responded occasionally, 2/5 most lessons and only 1/5 responded every lesson (figure 6). The frequency with which students interact with ICT and technology seems to contrast the views of Domingo (2016).

5/5 respondents made reference to iPads, laptops and cameras when asked what ICT and technology resources are available for teachers and students (figure 3). 3/5 made reference to the IWB (interactive white board). This is supported by the findings of the observation (figure 10) which showed the majority of lesson time was spent with children using the iPads and laptops. The second largest use of time in the observed lesson was the explanation of the task which utilised the IWB. In total, 83% of the lesson made use of technology.

However, the results of the focus group did not align with what is suggested by teachers. Students made reference to traditional technology and the IWB much more than iPads and laptops when asked what is currently used in their lessons (figure 8). Within this context, traditional technology was defined as items that are common to science lessons such as stopwatches or microscopes. There are several possible reasons these results do not correlate with the findings of the questionnaire and observation. The most likely of these is that the Hawthorne Effect (Thomas, 2013) impacted upon the use of technology within the observed lesson and that typical use, as the focus group suggests, is lesser than was witnessed.

These three research instruments suggests that ICT and tablet technology are common in science lessons, although the focus group results cast some doubt on the accuracy of the findings of the questionnaire and observation.

2. **What are the benefits and constraints of using technology within science lessons in the views of:**
    - **A) Teachers**
    - **B) Students**

To answer part A of this research question, a questionnaire was given to teachers. The observation was also able to offer insight.

When asked how technology in their science lessons was most often used, one teacher said that iPads "allow children to conduct their own research". This supports the views of Hutchby and Moran-Ellis (2013) who state that technology increases children's access to information. Another teacher noted that cameras allowed them to "easily evidence work". Teachers were also asked if they would like to use technology more with 4/5 responding that they would (figure 7). Part of this question also asked respondents what current barriers existed and these can be viewed as potential constraints. The most common answer to this was that teachers lacked a knowledge of how to use software. This supports the views of Keengwe, Onchwari and Wachira (2008). This response also directly contradicts the findings of Baartman et al. (2014) who found teachers claimed they did not need help with using technology. Funding and time to set up were both referenced by 2/5 teachers as a constraint of using technology. The observation also alluded to setting up time being a potential issue.

During the observation, iPads and laptops had been set up before students began the lesson (figure 10). However, 8% of the total lesson time was used packing away and several students had problems with this process. As the lesson concluded, the teacher noted to the researcher that the following lesson would consist of children completing a similar task but instead making use a book for research. This teacher felt that students "should find [this] less complicated". This approach somewhat aligns with the views of Domingo (2016) and Furio et al. (2014) who state that some students learn better with the use of technology. While generally in support of technology's integration, this statement also suggests there are students whose learning is better facilitated by other resources.

To answer part B of this research question, a focus group was conducted with students from Key Stage 2.

The focus group highlighted that the particular technology being used greatly impacts how students view its integration (figure 9). Students showed a clear preference for iPads and

newer technologies such as virtual reality headsets and 3D printers over traditional technology or the IWB. However, similarly to the view of teachers (figure 7), students were able to recognise that some technology may be too expensive. In line with the views of Domingo (2016), one child stated that "technology helps our independence". Interestingly, children suggested that science lessons that include planning or evaluating would not benefit from technology but are necessary. In suggesting that not all science lessons would benefit from the integration of technology, this mirrors the view of Gujral (2005).

Teachers and students agree on the potential benefits of technology to enabling the research process and increasing independence. Similarly, both teachers and students recognised the expense of technology as one of the major constraints.

**3. What impact does using technology in a science lesson have on children's motivation and engagement?**

To answer this research question, an observation of a science lesson in a year 5/6 class was carried out.

The first 20 minutes of the observed lesson had children recap previous learning with the assistance of a PowerPoint on the IWB (figure 10). Initial engagement was good and children were able to make use of key vocabulary shown on the IWB such as "inherit" and "extinct". However, towards the end of the 20 minutes, it was observed that some students began talking and the same pupils were answering questions. This links to the findings of the focus group as, although technology may increase motivation and engagement, this can depend upon which technology is being used (figure 9).

Once students moved to the researching activity, they were observed to be on task and were able to answer the set questions. In this way, technology and ICT were observed to further understanding, supporting the view of Hennesey et al. (2005). However, some students had difficulties using search engines in an accurate manner. The activity gave children specific questions to research on selected animals. One student was observed to search "artic fox" and did not include a term pertaining to the questions they were researching. This may suggest that a lack of understanding in correctly using technology, as found in the

questionnaire (figure 7), is not exclusive to teachers. This further supports the view of Keengwe, Onchwari and Wachira (2008).

In line with the view of Warwick et al. (2006), the observation found that motivation and engagement increased with appropriate use of technology. The observation, supported by the findings of the focus group (figure 9), seems to suggest that teacher's use of technology does not fully align with the preferred use of children which may limit technology's impact on engagement.

## Conclusion

This research project aimed to answer whether technology, including the use of ICT, is effectively utilised within the teaching of science. Both the questionnaire and observation suggest technology and ICT are commonly used in science lessons but findings of the focus group cast doubt on the rigidity of this statement. Students and teachers agree that the appropriate integration of technology has many benefits. Additionally, the vast majority of teachers were in favour of increasing their use of technology. In answering the second

research question, teachers cited a lack of expertise and funding as the primary constraints of technology. Despite their use not aligning with the preferences of students, these reasons begin to explain the overreliance on the IWB and traditional technology over their more modern counterparts. It is likely, although further research would need to be carried out, that increased use of student preferred technologies, such as iPads and 3D printers, would lead to an increase in motivation and engagement in the teaching of science.

The evidence suggests that technology is part of a wider toolkit of resources which teachers utilise when teaching science. However, it is difficult to know the extent to which technology is used from this project alone and this is an area for future research. The findings of this study do not suggest, however, that technology is *effectively* utilised, certainly not its fullest extent.

**Recommendations**

- Teachers require professional development in how to best use technology, particularly newer technologies.
- On a wider scale, schools should consider the integration of newer technologies and decide whether it may be beneficial for them.
- Literature shows government research in the field is outdated. Before technology can be more heavily integrated into the curriculum, from which a more widespread effect

may be felt, research must be modernised to assess a much broader definition of ICT and technology.

- Further research into new technologies such as virtual reality headsets and 3D printers is necessary, particularly looking at the effects on motivation and engagement.
- More time should be allocated in ICT lessons to ensure students have the proper skills to not only use technology but to do so in an efficient manner. An example being the use of proper terms in a search engine.

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