

**A study of Northern Ireland Key Stage 2 pupils' perceptions of using the BBC Micro:bit in STEM education**

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**Abstract**

This research investigated the perceptions held by Key Stage 2 (KS2) pupils, across two Northern Ireland (NI) primary schools, towards the use of the BBC Micro:bit that has been recently dispatched to United Kingdom (UK) primary schools. The study involved the researchers creating and implementing a teaching resource that included a range of different activities for the pupils to complete using the BBC Micro:bit. Upon completion of these activities, feedback was sought and obtained from the pupils via a questionnaire. The study is important as it is one of only a few pieces of research surrounding the BBC Micro:bit and to the authors' knowledge, it is the only research to date conducted in NI that focusses on pupils' perceptions involving the use of BBC Micro:bit.

What was most apparent in this study was the very positive response of the pupils towards using the BBC Micro:bit. Nearly all of the pupils who took part in this study responded that they found using the BBC Micro:bit easy, enjoyable and useful in relation to both programming and problem solving. A minority of the pupils also commented on how the BBC Micro:bit provided an opportunity to work as a team in order to overcome problems during the programming stage, promoting the important skills of team work and problem solving. Nearly all pupils expressed a keen interest in programming and indicated that they learnt a lot in such a short time. Furthermore, pupils expressed great enthusiasm towards using the BBC Micro:bit and expressed a desire to use it more often, both inside and outside of the school.

Based on these key findings and taking account of the strengths and limitations of this research, ideas for further research are presented alongside advice for teachers who may be considering the use of the BBC Micro:bit within their own lessons.

**Introduction**

*Teaching computer science should no longer be viewed as teaching a trade or providing training for coders. In many ways, it's becoming similar to needing to learn your native language in school. Teachers push pupils to analyse and construct poems, write short stories, or read theatre plays. They don't do this with the primary goal of creating the next generation of writers or poets*

(Schmidt, A. 2016, p.5).

Information Communication Technology (ICT) is becoming one of the most important subjects for primary schools across the world, playing a key role in educational, economic and social changes. There is therefore a need to develop teaching resources capable of meeting the demands of ICT education by means of both nurturing ICT literacy and skills, both in schools and as part of lifelong learning (Vanderline et al, 2015; Kozma, 2008).

The current Northern Ireland Curriculum (NIC) for Key Stage 2 (KS2) aims to develop the skills of the individual in regards to the cross-curricular skills of Using ICT (UICT) in order to improve pupils'

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thinking skills, as well as providing them with opportunities to become independent, self-motivated and flexible learners (CCEA 2007). As of 2017, the NIC does not directly reference coding or programming, however, teachers do have the option to teach it providing it is relevant to the NIC. That having been said, the teaching of coding happens very rarely in NI at either KS2 or KS3/KS4, which suggests that there may well be a lack of coding skills among teachers (Perry 2015).

Kazakoff (2014) suggests that children require early experience in programming in order to facilitate meaningful discussion on matters that bear relevance to what is happening in the world around them. Kazakoff further contends that the use of tangible items e.g. robots, may enable abstract ideas beyond their current cognitive abilities to become more concrete. Pupils should feel motivated and excited to create programs and by encouraging them to create their own unique programs, this can help develop their interest in Science, Technology, Engineering and Maths (STEM) related subjects, including computer science (Schmidt, 2016).

The use of robotics has also the potential to make programming relevant to the pupils' lives, allowing them to experience the many potential uses for programming. This contention is supported by Kazakoff (2014, p555) who maintains that, *'new technologies, in particular robotics, make different kinds of learning opportunities possible, including new ways for peer social interactions, and many opportunities for creativity, social, and cognitive development'*.

The BBC Micro:bit is a new and innovative educational tool which has been developed as an aid to assist teachers in the teaching of computer science and programming. It is a pocket sized programmable computer, which has been developed by the BBC for the purpose of providing a computing platform for school pupils which enables them to fully appreciate the potential of programming as an educational tool.

The BBC Micro:bit consists of a range of different technical features, such as LEDs, push buttons, an accelerometer and a compass (See Appendix 1). To program the BBC Micro:bit, the BBC has provided a range of different methods, ranging from Block Editors aimed towards beginners e.g. Scratch, to more advanced forms of programming such as Python (BBC Micro:bit, 2015). This range of software allows the teacher to set different levels of challenges in relation to the pupils' ability levels.

In their recent evaluation of the area of learning within the NIC titled the 'World Around Us' Perry and Irwin (2015) suggested STEM education was underdeveloped in just over 54% of the primary schools inspected by the Education Training Inspectorate Northern Ireland (ETINI). Schools highlighted a range of different issues whilst suggesting a lack of training and teacher confidence was the main reason for the lack of STEM education programmes.

This study will examine how the BBC Micro:bit can be used as a tool for developing pupils' problem solving skills as part of a pedagogical approach to STEM education. The focus of this research will examine KS2 pupils' perceptions of using the BBC Micro:bit and whether they view it as an enjoyable, challenging and educationally beneficial learning tool as part of STEM education.

## **Literature Review**

### *STEM Education*

STEM education may be viewed as an approach in which STEM subjects are integrated through a pedagogical method that uses design-based, problem-solving, discovery, and exploratory learning strategies (Fioriello, 2010; cited in Roberts, 2013). It can also be considered through the lens of a collective curriculum wherein the content can become integrated or fused as one subject, strengthening students' understanding of complex concepts (Morrison & Bartlett, 2009; cited in Roberts, 2013). Bybee (2013) argues that the acronym 'STEM' is widely used and applied within many different areas of both everyday life and school education, resulting in it becoming

increasingly difficult to understand. Bybee further contends that when focusing solely on education, the term STEM is often misinterpreted, resulting in the subjects being taught in isolation. Although Bybee criticises how the STEM acronym is used, he does defend the principle of STEM education, the importance of each subject and of their relevance to one another. However, Pitt (2009, p.41) offers a more definitive and critical overview of STEM education when claiming that, "*STEM as an educational concept is problematic, there is little consensus as to what it is, or how it can be taught in schools*". He further contends that there is no clear approach when it comes to teaching STEM, with many viewing it as made up of discrete subjects, whilst others feel that by having an activity that involves any STEM subject as being a STEM activity.

Benuzzi and Grace (2015) highlight the importance of cross-curricular teaching when it comes to STEM education, emphasising that the acronym itself highlights how STEM requires cross-curricular thinking, connections and teaching. Despite their arguments for the cross-curricular teaching of STEM, reports carried out by the Department of Education NI (DENI) and the Department for Employment and Learning NI (DELNI) (2009) and Perry and Irwin (2015) suggest that a lack of teacher confidence / training may be one reason for the disconnected teaching of STEM subjects.

#### *STEM Education in Northern Ireland*

In NI, STEM education is referenced within the foundation stage, with children between the ages of four to six being introduced to various elements of Science, Technology and Maths. At school, pupils have opportunities to build upon their previously acquired STEM skills through using Mathematics and ICT, as well as engaging in thinking and problem solving activities. The skills obtained are intended to be further developed in post-primary schools where pupils study Mathematics until the age of 16 whilst having the choice to study Science and Technology and Design (DE and DEL 2009). DE and DEL (2009), Roberts (2013), DEL (2015), and CCEA (2007) argue that by studying STEM based subjects, pupils will not only be provided with knowledge of the subjects they are studying, but also develop investigative and problem solving skills and an understanding of how they may be implemented in the real world, although evidence for this is sparse. It is interesting to note that none of the above authors refer to STEM education as an integrated approach, referring to the subjects in isolation.

The report of STEM Review (2009), commissioned by DENI and the DELNI, expresses concerns in relation to STEM education in NI. As a society we rely increasingly on aspects of STEM based knowledge and understanding to help us understand the rapid rate of technological change which we see around us today (DENI and DELNI, 2009; Roberts, 2013). However, the report by DENI and DELNI further argues that young people in NI are increasingly disengaged from STEM, resulting in a decreased uptake at both higher and further education, which, in turn, influences the growth of the future economy.

DENI and DELNI (2009) suggest three areas of concern for STEM education in NI. Firstly, how the lack of planning at primary and post-primary impacts upon pupils' progression. Secondly, the relevant Continual Professional Development (CPD) undertaken by teachers is very limited in its scope. Thirdly, the quality of careers guidance is questionable, with a limited amount of time allocated to providing careers guidance in the majority of schools limited (DENI and DELNI, 2009).

The Report of the STEM Review (2009) produced a 'vision' for the future of STEM education in NI, with the stated aspiration of '*Empowering future generations through Science, Technology, Engineering and Mathematics to grow a dynamic, innovative economy*' (DENI and DELNI, 2009, p. 11). From this, 20 recommendations on how this vision might be realised were outlined and subsequently summarised under four key areas:

1. Business must take the lead in promotion of STEM.

2. We must alleviate Key constraints in the STEM artery.
3. There needs to be increased flexibility in the provision of STEM education.
4. Government must better co-ordinate its support for STEM.

These recommendations mainly focus on the benefits that an effective STEM education policy might bring to the economy and comment on how educational success involving STEM may be improved. Suggestions such as further STEM education training for teachers, improvement to planning at KS2/KS3, STEM scholarships and cross-departmental structures at government level were made. The report also indicated that many primary pupils are developing negative attitudes towards science and technology, with many practical and investigative approaches used by teachers being viewed as underdeveloped.

#### *Teacher confidence*

The DENI and DELNI (2009) contends that as a matter of urgency, support offered to primary school teachers to ensure they develop the confidence and enthusiasm needed to successfully deliver effective STEM education programmes. This would appear to support the views, as indicated previously, expressed by Perry and Irwin (2015) in relation to teacher training, teacher confidence and teachers' ability to teach computer programming in primary schools.

Lessing and Witt (2007) suggested that teachers who they consulted in their research indicated that CPD courses could be an excellent means of providing teachers with the necessary confidence and competence in what they teach, with nearly all teachers agreeing that CPD programmes improved their confidence, knowledge and skills. Although DENI and DELNI (2009) suggest a need for more CPD courses and training for teachers in order to improve STEM education, research has shown that a lower number of primary teachers are taking CPD courses. Around 37% of teachers took part in STEM training and 24% opted for further CPD. It is highlighted that the cause of this problem is due to cuts to DENI funding (Perry and Irwin, 2015).

#### *Programming in Northern Ireland Primary Schools*

Computer programming could be described as a process, which involves the development and implementation of various sets of instructions, enabling a computer to perform a certain task, solve problems and/or provide human interactivity (Balanskat and Engelhardt, 2014; Kazakoff and Bers, 2014). The revised curriculum for NI has been in place since September 2007 with the aim to 'empower young people to develop their potential and to make informed and responsible choices and decisions throughout their live'" (CCEA, 2007, p.4). Balanskat and Engelhardt (2014) contend that the underlying concepts of programming will be valuable to the individual regardless of whether or not they make a career out of it. Papert (1980) further supports this view by claiming that a deep understanding of programming, in particular within the areas of analysis and debugging, will result in significant educational benefits in many domains of discourse, including those unrelated to computers and information technology.

Although computer programming is not referenced directly within the NIC at KS2, the cross-curricular element of UICT provides teachers and schools with opportunities and the flexibility to teach programming if they wish (Perry, 2015). As illustrated previously, various issues such as teacher confidence, CPD, funding and resources may result in teachers not being fully informed of the potential that teaching programming can have for their pupils. Fluck et al. (2016) and O'Kane (2016) maintain that the removal of barriers to learning programming concepts will not only benefit pupils as individuals, but eventually have benefits for the economy. For example, this may occur through the development of computer scientists who will sustain a competitive edge in a world driven by technology.

Perry's (2015) research on coding in schools within NI contends that the teaching of programming at primary or pre-GCSE rarely happens with many schools moving towards the informal teaching of

programming. This informal teaching is mainly offered as an extracurricular activity, operating during lunchtime, after school and during the holidays, which may result in only a minority of pupils attending.

Kozma (2008) contends that the use of computers within schools often has a significant role in the educational, economic and social changes that happen daily in an ever-advancing society. As a society, there is an ever-growing demand for effective STEM education that will help society understand the challenges that we may face in our everyday lives and to manage the rapid rate of technological change which we see around us (DENI and DELNI 2009; Fluck et al. 2016; Webb et al. 2015).

Contrary to the past, when children would explore and create artefacts from the materials around them, Flannery and Bers (2013) contend that materials have dramatically changed due the evolution of computers. Changes in simple activities such as games and storytelling have moved from needing physical resources to their incorporation within digital technology. Furthermore, Flannery and Bers maintain that advances in human-computer interaction allows young children to engage in digital creation through programming child friendly robots:

*Working with age-appropriate programming tools and curricula, children can creatively problem solve and explore powerful interdisciplinary skills and knowledge*

Flannery and Bers (2013, p.81).

In order for children to grow up digitally literate they need to understand basic computer functions, in particular programming, which will help them in their understanding of basic technological concepts that are needed to operate 21<sup>st</sup> century products (Kazakoff and Bers, 2014). Programming, with the addition of age-appropriate materials, will allow children to learn and apply core-computational thinking concepts such as analysis, decomposition and iterative design (Kazakoff and Bers, 2014; Lee et al. 2011). The study of computer programming has been found to influence a wide range of cognitive skills in early childhood, including computational thinking, meta-cognition, and transferable skills in the areas of problem presentation, problem solving and debugging (Papert, 1980; O'Kane, 2016; Kazakoff and Bers, 2014; Webb et al. 2015; Fluck et al. 2016).

#### *Educational Philosophy*

Papert (1980) maintains that children's creativity should not be stifled, instead an environment should be created where the perception that ideas need to be either true or false is less dominant. Furthermore, Papert suggests that educators often provide pupils with 'correct' theories before they have the chance to invent their own. Papert's views on cognitive development is in line with that expressed by Piaget.

Piaget's cognitive development theory focuses on the development of the child rather than their ability to learn concepts, proposing discrete stages of development, marked by qualitative differences (McLeod, 2015). Papert (1980) is in agreement with Piaget, proposing that children construct their own learning by means of exploring the world around them. According to Piaget and Inhelder (1958), learning should be centred around the pupil with the focus on active discovery learning. Furthermore, assimilation and accommodation require an active learner, not a passive one, because problem-solving skills cannot be taught, they must be discovered.

Papert's (1980) interpretation of Piaget's cognitive development theory within ICT, advises an interactive approach whereupon the learners can become constructive architects of their own learning. Flannery and Bers (2013) further support this by maintaining that the process of creation and problem solving will enable children to actively explore and develop cognitive skills and domain-specific content in developmentally appropriate ways. Kazakoff and Bers (2014) further argue that hands on experiences enable children to become the producers of content and not simply the

consumers of technology created by others. Knowledge should not be poured, so to speak, into the child's mind nor passively absorbed; instead, the child must construct the knowledge for him or herself (Piaget, 1970).

Papert used the Creative Hybrid Environment for Robotic Programming (CHERP) language whilst carrying out his research (Kazakoff and Bers, 2014). CHERP is a hybrid programming language which allowed children to transition back and forth between screen based (graphical) and tangible (block based) programming interfaces (Bers and Horn, 2010). This hybrid approach provided the individual with the opportunity to work with various styles of programmable actions, thus allowing them to iteratively analyse and adapt their work according to their discoveries (Horn et al. 2012; Flannery and Bers 2013). Following Papert's research, many developers have created developmentally appropriate programming environments for children (Kazakoff and Bers, 2014), for example, Scratch, an object based programming language that allows children to build their own stories, games and animations (Brennan and Resnick, 2012; Glezou, 2014).

Kazakoff and Bers (2014) agree with Papert's view of a 'constructivist programming' environment where children are engaged in thinking about their own thinking, thus resulting in abstract ideas becoming more concrete. However, they also suggest a different pedagogical approach in order to achieve this. Kazakoff and Bers contend that developmentally appropriate technological tools provide opportunities to scaffold learning that, through interactions from parents, teachers and peers, may enhance learning, drawing on Vygotsky's theory of the Zone of Proximal Development (ZPD).

Flannery and Bers (2013) maintain that children who are at different stages and sub stages of cognitive development would benefit from learning goals, activities and scaffolding, which have been designed specifically for their distinctive cognitive characteristics. Furthermore, Flannery and Bers propose that when interacting with younger children, a slower pace and expanded focus on the introductory activities allow more time for children to explore the various features of programming. This would enable the child to work towards solving short challenges, benefiting from teacher interaction who, through scaffold learning, may progress the child towards the concrete operational stage (Kazakoff and Bers, 2014; Flannery and Bers, 2013; Lee et al. 2011).

The review of the literature provides evidence to suggest that there are some barriers in relation to the implementation of STEM education by means of programming in NI primary schools. Teacher confidence, CPD, funding and resources are some of the issues highlighted in reports carried out by Perry and Irwin (2015), DENI and DELNI (2009) and DENI (2010). Despite the issues, arguments for programming have been made with Fluck et al. (2016) as well as O'Kane (2016) maintaining that the removal of barriers to learning and the introduction to programming concepts will not only benefit pupils as individuals, but also society at large.

Papert (1980), Kazakof and Bers (2014), Flannery and Bers (2013), as well as Lee et al. (2011) and Brennan and Resnick (2012), provide a good insight into what already has been trialled and proven to work. The reoccurring themes seem to focus on scaffolding and problem solving and the suggestion that through support from the teacher and the presentation of small, problem solving based activities, the child will progress towards the concrete operational stage where they no longer need assistance from the teacher.

As for issues surrounding teacher confidence, O'Kane (2016) maintains that through carefully planned training and support, teachers will develop the confidence to introduce programming into their classrooms, especially within the areas of literacy and numeracy. Although issues surrounding CPD exist, including funding and teachers' willingness to attend (Perry and Irwin, 2015), the availability of online CPD courses and on-site training offer teachers and schools the ability to overcome barriers in relation to funding and motivation (Cordingley and Temperley, 2005).

## Research Methodology

### *Aim of the study*

The aim of this research is to investigate NI KS2 pupils' perceptions of using the BBC Micro:bit in STEM education.

A learning resource for pupils was created in order to not only help facilitate in the completion of this research project, but to focus the pupils so they could adequately complete the questionnaire for the purpose of obtaining the data required to address the research question.

The overarching question guiding this research focuses on how the BBC Micro:bit can be used as a tool for developing pupils' problem solving skills as part of a pedagogical approach to STEM education. From this question, a number of sub-questions were developed that would help further guide and add quality to this research. The following sub-questions were asked of the pupils:

1. When programming the BBC Micro:bit, how enjoyable was it?
2. When programming the BBC Micro:bit, how difficult was it?
3. How useful is the BBC Micro:bit in providing opportunities for problem solving?
4. How relevant is the BBC Micro:bit to STEM subjects?

### *Research Design*

Three schools took part in this research programme which used the BBC Micro:bit;

**Table 1.** Type of schools taking part in the study.

School	Year/Primary Group	Type of School	Age range of pupils attending school
School A	Primary 6 (KS2)	Co-Educational Primary School	4-11
School B	Primary 6 (KS2)	Co-Educational Primary School	4-11
School C	Year 8 (KS3)	All Girls Grammar School	11-19

The research design has been greatly influenced by the overarching aim of the research question. The main aim was to try and ascertain the perceptions of those who participated in the research, focusing on how the BBC Micro:bit can be used as a tool for developing pupils' problem solving skills as part of a pedagogical approach to STEM education. This greatly influenced the research design as the pupils within each school had varying abilities when it came to programming skills. As a result, a set of control problem solving activities were developed that gradually increased in difficulty, building upon the skills previously obtained.

The views of the pupils were sought after completion of the activities on Day 2. The pupils were supplied with a questionnaire that aimed to obtain their perceptions regarding the activities they completed in relation to problem solving with the BBC Micro:bit.

### *Mixed Methods Approach*

A mixed methods approach was adopted in order to obtain the information required for this research project. Mixed methods research entails a combination of qualitative and quantitative approaches with the objective to generate a more accurate and adequate understanding of the area being researched (Arthur et al. 2012). Johnston and Onwuegbuzie (2004) define mixed method research as the type of research that involves a researcher or a team of researchers who combine elements of qualitative and quantitative methods for the purpose of obtaining validated, in-depth data. Additionally, Denzin (2008) maintains that due to the disadvantages inherent within both qualitative and quantitative methods, the combination of the two can be viewed as a more faithful and reliable option. The use of a mixed methods approach is a "powerful way of demonstrating concurrent validity, particularly in qualitative research" Cohen et al (2011, p. 112). Furthermore,

Cohen et al. (2011) suggests that the use of a mixed methods approach adds to the validity of the data gathered, leading to the presentation of less bias and more accurate conclusions.

#### *Data Collection Method*

The main instruments in the mixed methods approach consist of both close-ended and open-ended questionnaires (Zohrabi, 2013). '*These different ways of gathering information can supplement each other and hence boost the validity and dependability of the data*' (Zohrabi, 2013, p. 254). The inflexibility of close-ended or fixed questions is that it allows for a meaningful comparison of data (Mack, 2005). However, Gibson and Hurry (2014) contend that, pre-set response categories determines the way in which the participant can answer the question, leading to answers that the participants would not think of if they had to create answers themselves.

Gillham (2000) maintains that open-ended questions can lead to a greater level of discovery. Although Alderson and Scott (1996) acknowledge the usefulness of qualitative data, they contend that open-ended questions make it more difficult to compare and analyse. Therefore, Zohrabi (2013) suggests that it is better that questionnaires include both close-ended and open-ended questions to complement each other. Cohen et al. (2011) stresses that questions posed should not be leading, reducing the possibility of bias or untruthful answers.

For this research, a questionnaire was created consisting of both open and close-ended questions. The questionnaires were distributed amongst the Primary six pupils after they had taken part in the BBC Micro:bit activities. Adequate time was provided for the pupils to complete the questionnaire and once finished, the researcher collected, analysed and compiled the data into a more manageable format.

#### *Ethical Issues*

In this research, all participants were provided with a letter of consent that contained information regarding confidentiality and an outline of the study. As this research project is focused on the pupils' perceptions, it was important to obtain consent from both the participant and their parent or guardian. Nicholson (1986) maintains that the gathering of parental consent must be sought when carrying out research with any child. Marrow and Richards (1996) further add that when carrying out educational research, consent from adult gatekeepers such as parents, teachers and principals, must be sought in order to prevent jeopardising the research project. Researchers should also provide all participants with a sufficient amount of information surrounding the purposes of the research and the nature of their involvement so they may make a decision that is informed (Denscombe, 2003).

Informed consent was obtained before the research had taken place. Consent from the principal, parents, teachers and pupils of both schools was obtained through the provision of a written letter. These letters outlined the nature of the study and the activities the pupils will be taking part in, with issues surrounding confidentiality and self-determination being addressed. A similar letter devised for the parents of the pupils taking part in the study was also provided and then collected the day before the activities took place. The information contained here again highlighted the purpose of the research, the involvement of the child in the study and the opportunity to provide consent or withdrawal from the research project. Finally, a letter to the pupils was presented at the beginning of the activities on day one. This explained the purpose of the research project, and again offered the opportunity for the participant to withdraw from the research project. The researcher must seek the consent of all participants before taking part in any research, with the participants being made fully aware of the implications of the research, as well as having a free choice as to whether or not to take part (Sheely et al. 2005).



### *BBC Micro:bit Resource Pilot*

Following the creation of the teaching resource, it was decided that a pilot would be beneficial in order to generate some feedback on how the pupils responded to the resource and whether or not changes need to be made.

The Head of Department (HoD) for Technology and Design at an all-girl grammar school (School C) was contacted in relation to delivering the BBC Micro:bit teaching resource to one year 8 (KS3) class. The HoD agreed and a meeting was arranged to discuss how the resource should be delivered as well as the areas in which the researchers needed to receive feedback on. The HoD delivered the resource and provided the researchers with feedback on the following:

- How well the pupils understood the resource.
- The presentation / layout of the resource.
- How enjoyable / challenging the pupils found the tasks and any changes that they had suggested.

Initially the resource was created similar to a step-by-step guide, gradually reducing the instructions as the pupils progressed through the resource. After the resource had been piloted, we arranged to meet with the HoD to discuss how the lesson went. Feedback from the HoD indicated that the pupils were overwhelmed with the amount of written information and found it difficult to follow the instructions. It was suggested by the HoD that with less writing and by allowing the pupils to have more freedom with what they can create would be more beneficial in improving the pupils' understanding of the BBC Micro:bit.

Following on from the previous points, the HoD also recommended the use of visual elements in the resource. As she previously suggested that the writing was somewhat overwhelming and difficult for the pupils to follow, the addition of visual cues would eliminate the need for writing, making the resource and instructions easier to follow.

The HoD finally added that the pupils thoroughly enjoyed the activities and wanted to use the BBC Micro:bit more often. The resource was challenging to understand, however with the simplification of instructions; the tasks would become more understandable and achievable. She added that although the resource was somewhat difficult to understand due to the amount of information being provided, the pupils, due mainly to their own efforts, did not take long before they had appeared to develop an understanding of how to program the BBC Micro:bit.

Following the feedback received from the HoD, adjustments were made to the resource in preparation for the visit to Schools A and B. It is important to note that the resource was piloted over a 1-hour period with year 8s. The updated resource was delivered to School A and School B over the course of two morning sessions lasting around 3-hours. The points for improvement have been summarised below:

- Decrease the amount of written instruction.
- Increase visual cues such as screen shots to help in guiding the participants through the tasks.
- Encourage independent exploration of the software as a way of developing knowledge and understanding as to the programming of the BBC Micro:bit.

### *Context of Study*

The method for the gathering of evidence within this report involved the pupils and staff of two primary schools. Before carrying out this research, meetings with the principals were arranged to discuss the nature of the study and all parties involved signed consent letters. It was suggested by

the researchers and agreed by each principal that it would be best not to overwhelm the pupils with information as they had little or no experience in using the BBC Micro:bit or taking part in programming activities. As a result, it was agreed that all activities would take place during the first half of the day, from 9:30am to 12:00pm with a 15-minute break at 10:30am.

#### *School A*

School A is a maintained primary school. In a recent inspection carried out by the Education and Training Inspectorate for Northern Ireland (ETINI), it was found that the use of ICT within the school was underdeveloped, with recommendations being made with relation to the improvement of ICT in supporting teaching and learning (ETINI, 2016). This study was carried out with two primary six classes, providing the researchers with feedback from 41 pupils, of whom 20 were female and 21 were male. Due to a request made by the principal, the research project was carried out with two different classes on two separate days, resulting in each class only participating in the day one activities. This resulted in the inability to observe the development made by the pupils on Day 2, as each class had only participated in Day 1 activities. It also had implications in relation to the resource being delivered to the pupils at school B, as the Day 2 activities had yet to be completed, resulting in the researchers being unable to observe any underlying issues (if any) in relation to the Day 2 resource. It is important to note that the incompleteness of Day 2 activities would have no effect on the opinions obtained through the questionnaire, as the development of skills was not being analysed.

#### *School B*

School B is a maintained primary school. In a recent inspection carried out by the ETINI, it was found that the pupils demonstrated a confidence in using ICT, in both an innovative and appropriate manner (ETINI, 2013). This study was carried out on a smaller scale in comparison to School A, with a composite primary 5/6 class involving 29 pupils taking part in activities; this class was made up of 12 females and 17 males. It should be noted that the participants in school B remained the same over the course of the two days, with pupils taking part in day one and day two activities.

#### *Conduct of Study*

After receiving feedback from the HoD, suitable adjustments were made to the BBC Micro:bit resource. A total of 70 pupils from two different primary schools took part in the research project. Over four morning sessions (9:30am - 12:00pm), two mornings per school, the pupils took part in activities that included writing and compiling various programs for the BBC Micro:bit, with the pupils at school A completing day one activities only, however the pupils at school B completed both day one and day two activities.

At the beginning of the activities, a short five minute presentation was given to provide the pupils with relevant information in relation to the BBC Micro:bit. The pupils were then sorted into groups of three, with each group receiving a resource booklet and a BBC Micro:bit. Each pupil was allocated a role to ensure every member of the group had the chance to experience programming the BBC Micro:bit.

The activities began with the creation of some simple code, gradually progressing to tasks that were more difficult. The researchers provided some assistance to the pupils during the activities; however, this assistance was gradually removed as the pupils progressed, encouraging the use of group work to solve problems. This relates to Vygotsky's ZPD and Bruner's Scaffolding theory, where hints or cues are provided by the educator as a way of helping the pupil achieve a specific goal (Copple and Bredekamp, 2009).

The first set of activities lasted an hour, the pupils then had a 15-minute break after which they took part in other activities that lasted a further 30-minutes. At the end of the activities, the pupils were

asked to complete a questionnaire this took approximately 20-minutes for the pupils to complete, the aim of which was to obtain their views and opinions on the BBC Micro:bit. The questionnaire focused on how enjoyable, challenging and valuable they found it. As well as this, their perceptions of the possible relationship between the BBC Micro:bit and the various STEM subject's was also obtained.

### Data Collection

#### Analysis of Results

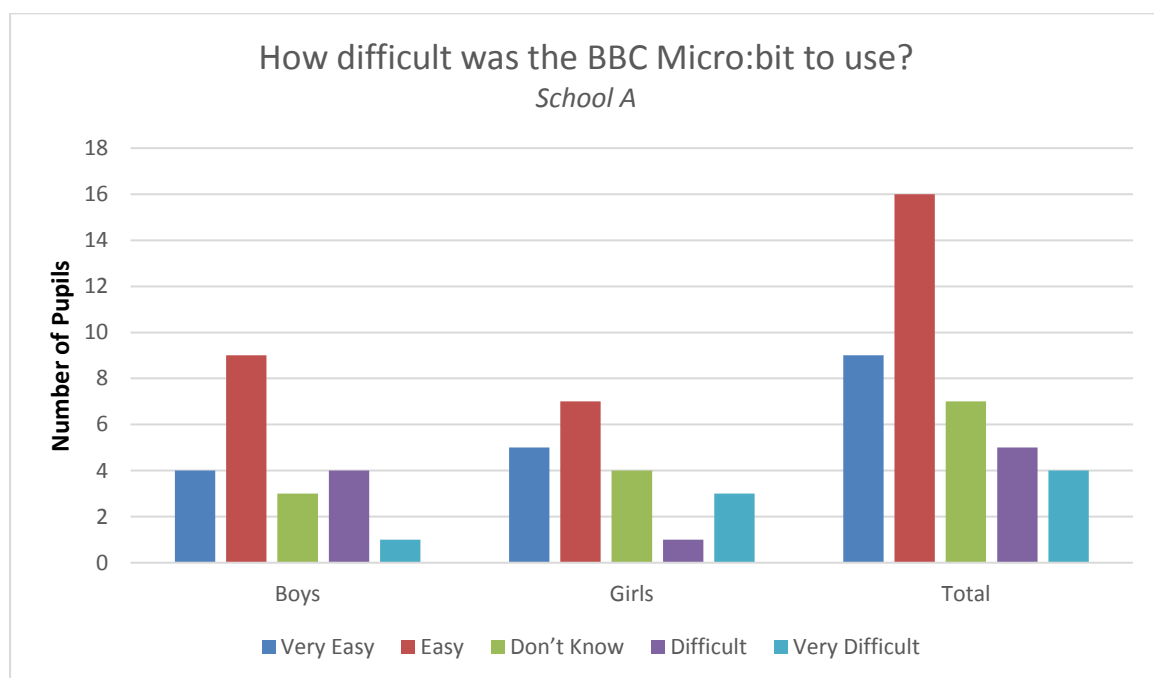
The data analysed have been presented in bar chart format. This format allows for the data captured to be graphically displayed, creating an interface that is quick to analyse and easy understand (Davino and Fabbris, 2013).

As noted in the methodology, four key sub questions were developed as a means for guiding and adding depth to the overall research question. The sub questions are as follows:

- When programming the BBC Micro:bit, how enjoyable was it?
- When programming the BBC Micro:bit, how difficult was it?
- How useful was the BBC Micro:bit in providing opportunities for problem solving?
- How relevant is the BBC Micro:bit to STEM subjects?
- The above themes guided the creation of the questionnaire and led to the development of a range of different qualitative and quantitative questions.

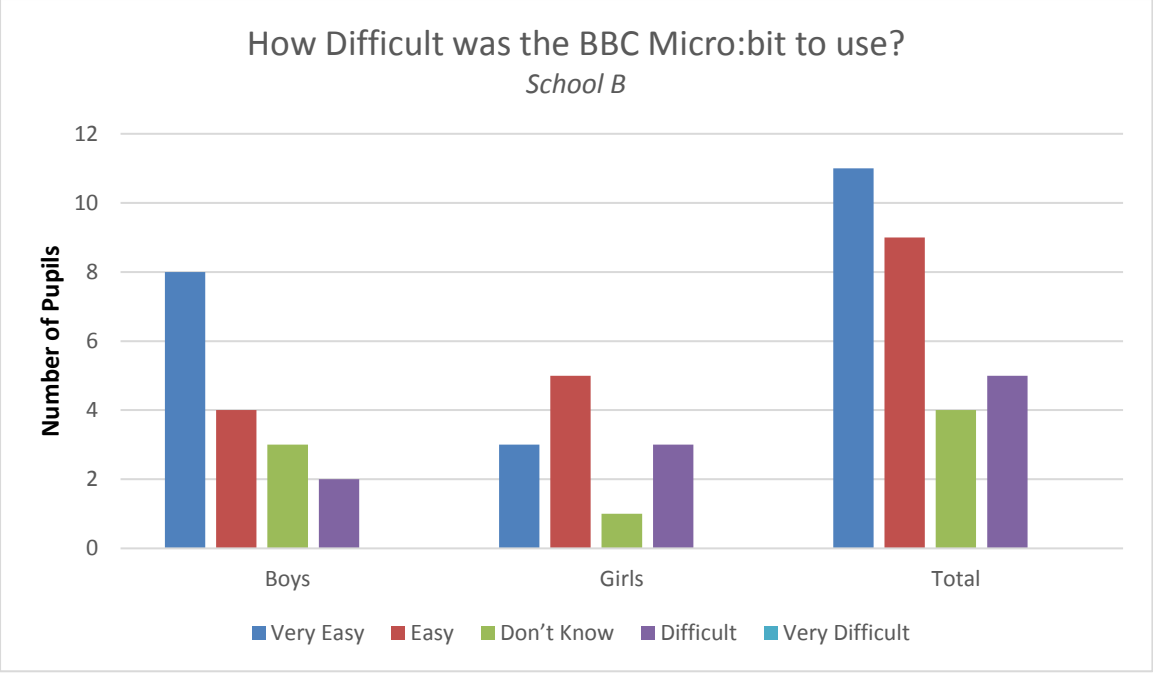
#### Quantitative Data

Question 1: How Difficult was the BBC Micro:bit use?



**Figure 1.** How difficult was the BBC Micro:bit to use? (School A).

At school A, a total of 41 pupils, comprised of 21 males and 20 females were surveyed. When asked how difficult they found the BBC Micro:bit to use, the majority of pupils, both male and female, found the tasks and use of the BBC Micro:bit easy. Of the total 41 pupils, 61% (25 out of 41) found the BBC Micro:bit to be easy or very easy to use, around 22% (9 out of 41) found it to be difficult or very difficult and the remaining 17% (7 out of 41) answered the question as 'don't know'.



**Figure 2.** How difficult was the BBC Micro:bit to use? (School B).

At school B, a total of 29 pupils, 17 males and 12 females were surveyed. Similar to school A, the majority of pupils at school B, both male and female answered the question as finding the BBC Micro:bit easy or very easy to use. From the 29 pupils surveyed, 69% (20 out of 29) found the BBC Micro:bit easy or very easy to use, 17% (5 out of 29) finding the BBC Micro:bit difficult to use and the remaining 13% (4 out of 29) answering the question as ‘don’t know’.

The data indicate that the majority of pupils found that the BBC Micro:bit was simple to use. With around 64% (45 out of 70) of pupils surveyed claiming the BBC Micro:bit to be easy or very easy to use, the data coincide with the information contained on the BBC Micro:bit website where it claims that the device provides a “super easy, non-intimidating user experience” (BBC Micro:bit, 2015).

Question 2: How Enjoyable was the BBC Micro:bit to use?

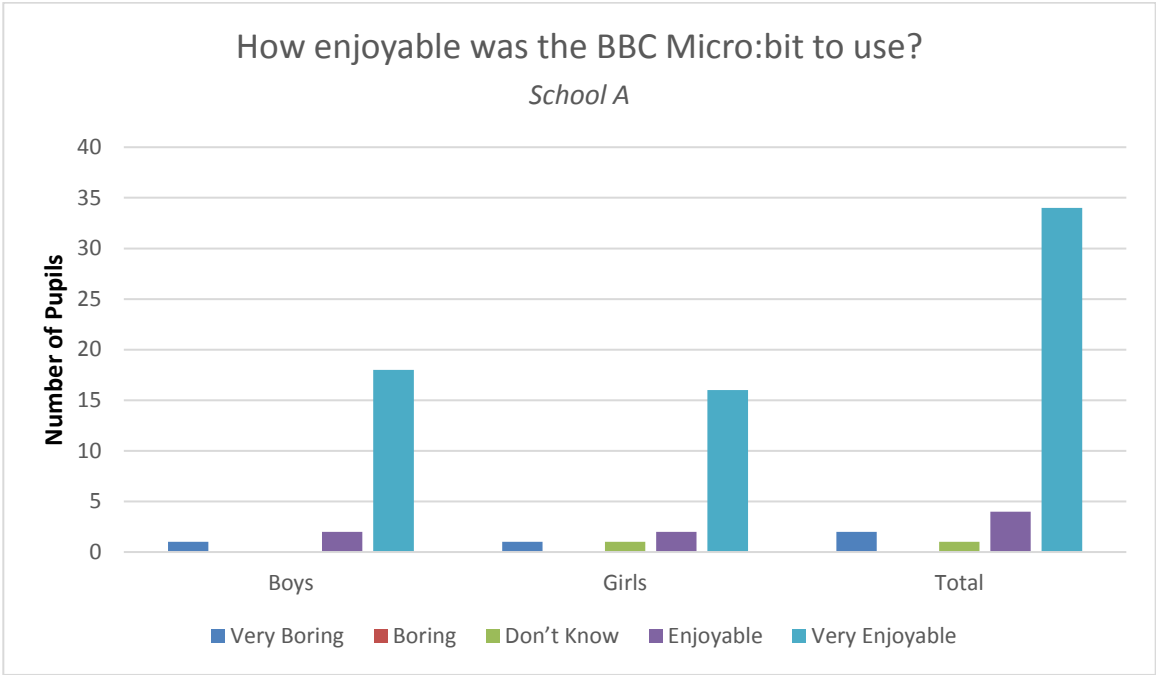
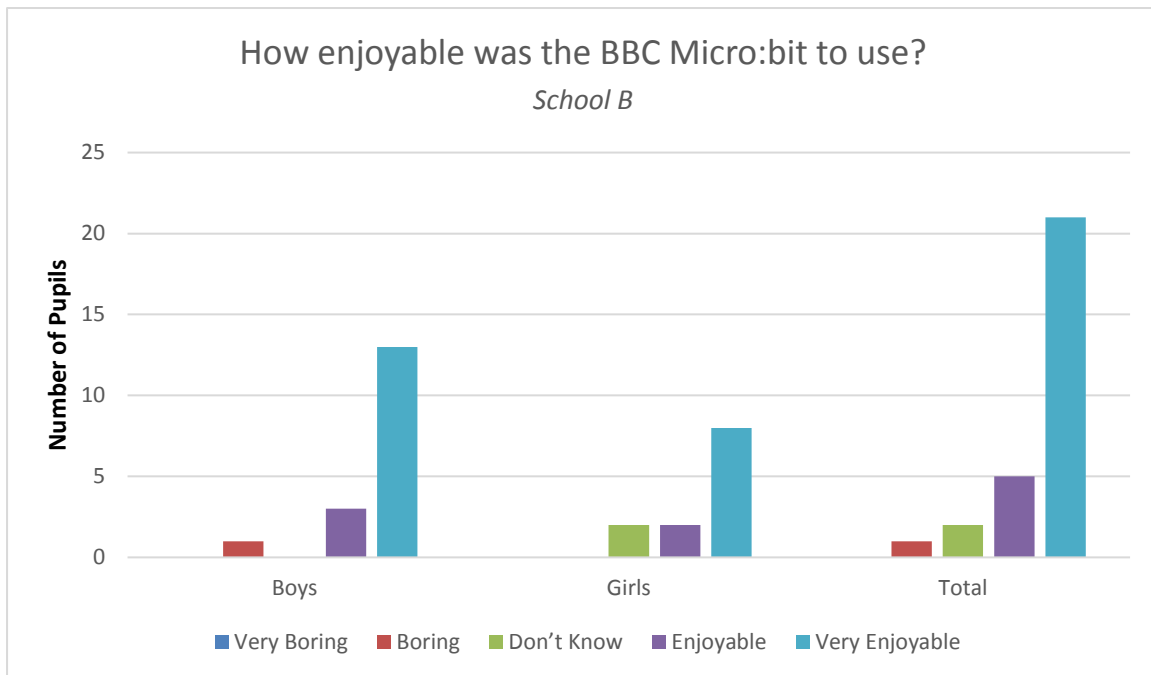


Figure 3. How enjoyable was the BBC Micro:bit to use? (School A).

It is evident that from the 41 pupils who took part in the research project at school A, nearly all of pupils, both male and female, found using the BBC Micro:bit Enjoyable. Around 92% (38 out of 41) of the pupils surveyed claimed that the BBC Micro:bit was either enjoyable or very enjoyable to use. There was however a small number of pupils, around 5% (2 out of 41) who found using the BBC Micro:bit very boring.



**Figure 4.-** How enjoyable was the BBC Micro:bit to use? (School B).

Similar to school A, the results show that most of the pupils, both male and female, found using the BBC Micro:bit enjoyable or very enjoyable, with 90% (26 out of 29) of the pupils surveyed suggesting this. Again a very few (1 pupil) found using the BBC Micro:bit boring, while the remaining 7% (2 out of 29) answering the question as 'don't know'.

When analysing the total number of pupils surveyed, a small minority (4% or 3 out of 70) found the tasks to be boring or very boring. This could be due to many different factors, from working in groups, using ICT or simply the nature of the tasks themselves. Selwyn et al. (2010) argues that it is not ICT per se that pupils find boring but rather the use it is being put to, leading to the pupils having a negative view towards the use of ICT in schools.

It is encouraging for the researchers and the BBC Micro:bit that nearly all of the pupils (64 out of 70) found enjoyment from using the device. As suggested previously by Kazakoff and Bers (2014) the use of both practical and hands-on activities will enable children to become the producers of content, providing them with learning experiences that are both valuable and enjoyable. The head of BBC Learning, Sinead Rocks, further adds that the BBC Micro:bit is not only a device to teach programming, however it is being used as a way of developing other skills such as teamwork, attention to detail and problem solving (Rocks, 2016).

Question 3: How Useful was the BBC Micro:bit when solving problems?

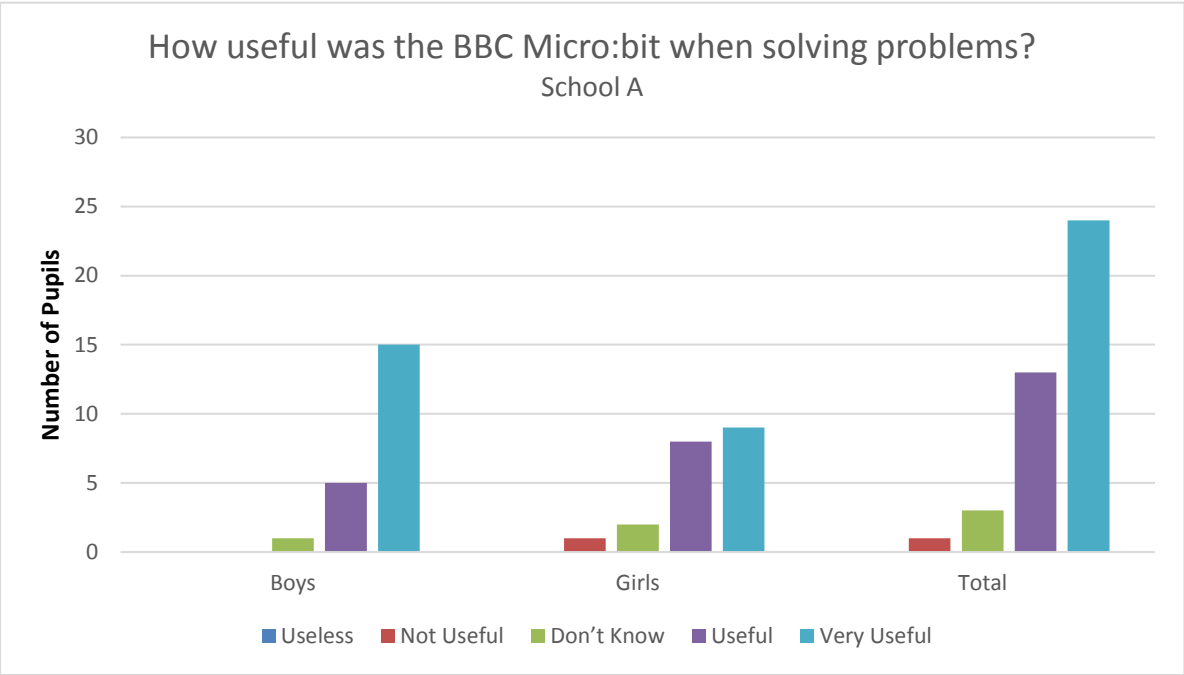
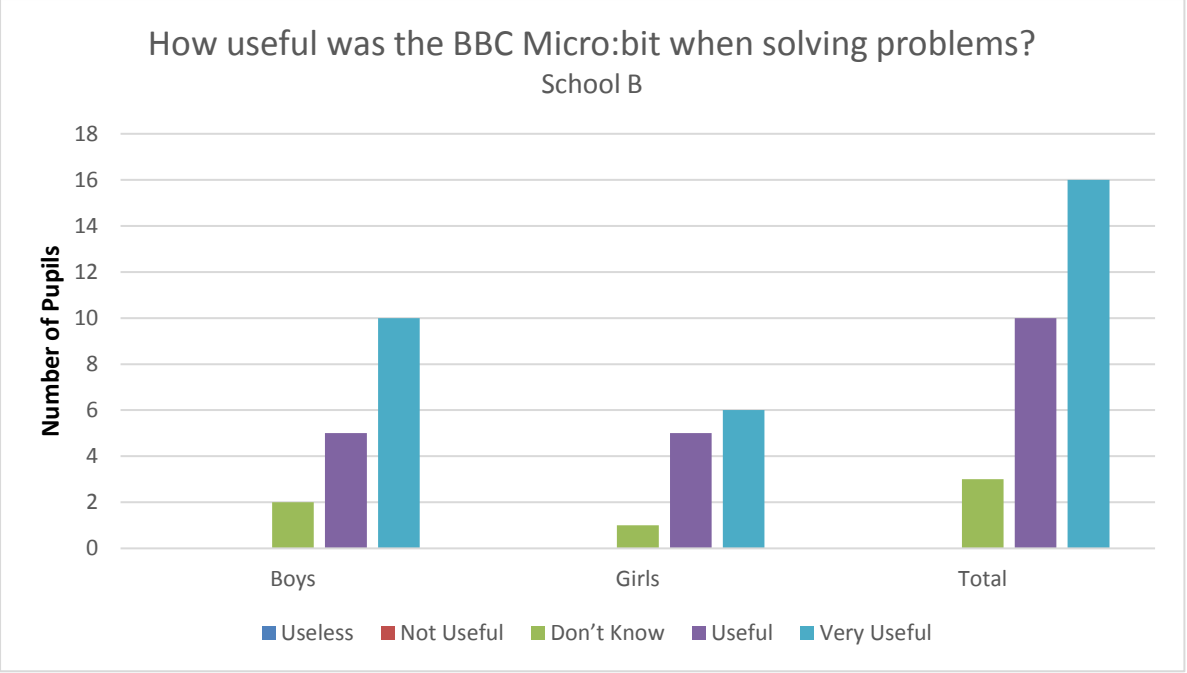


Figure 5. How useful was the BBC Micro:bit when solving problems? (School A).

From the 41 pupils who took part in the research project at school A, it is evident that nearly all of the pupils (90% or 37 out of 41), both male and female, found that the BBC Micro:bit was useful to them when solving problems. Only one pupil claimed that using the BBC Micro:bit was not useful in problem solving, and the remaining 7% (3 out of 41), answered the question as 'don't know'.



**Figure 6.** How useful was the BBC Micro:bit when solving problems? (School B).

Similar to school A, out of the 29 pupils surveyed at school B, most of the pupils (90% or 26 out of 29) found the BBC Micro:bit to be either useful or very useful in helping them to solve problems. The remaining 3 pupils were unsure whether the BBC Micro:bit was useful to them in solving problems, answering the question as 'don't know'. No pupils at school B answered the question as not useful or useless.

In total 90% or 63 out of 70 pupils surveyed found the BBC Micro:bit as being useful or very useful in the solving of problems. Only 1 pupil out of the 70 surveyed claimed that the BBC Micro:bit did not aid in developing their problem solving skills. This data would suggest that practical work is an activity that helps pupils develop their problem solving skills or to discover information for themselves and develop independent thinking skills Delargy (2001).



Question 5: Did the BBC Micro:bit link with STEM Subjects?

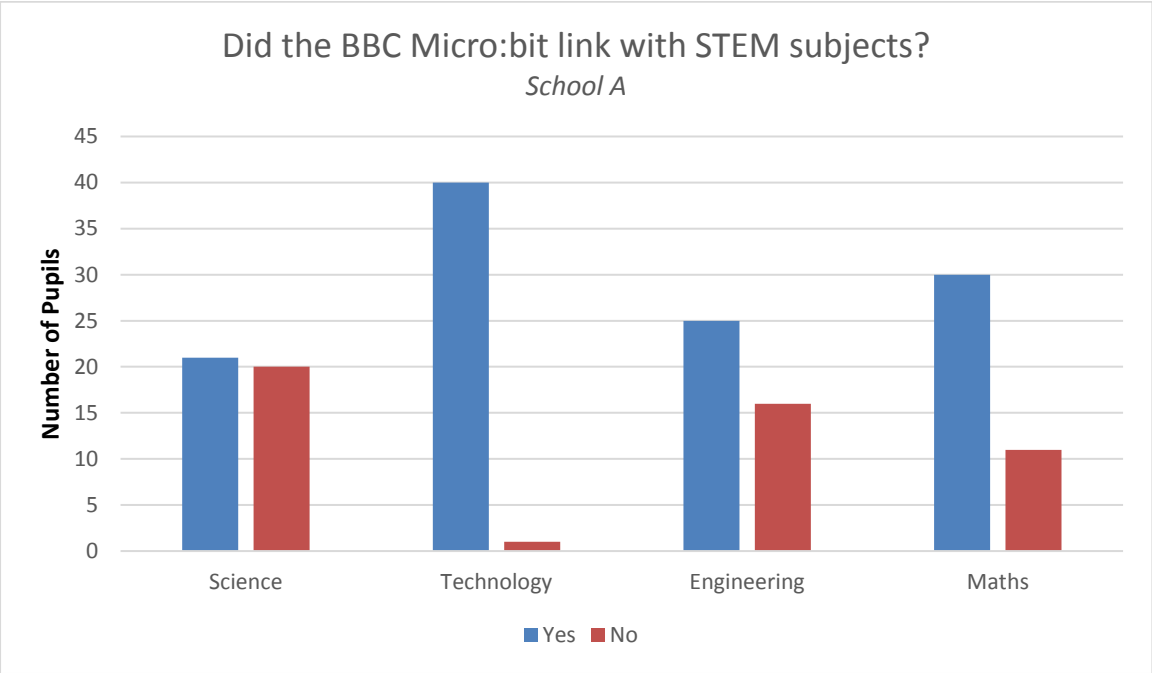


Figure 7. Did the BBC Micro:bit link with STEM subjects? (School A).

From the 41 pupils surveyed at school A, the most of the pupils found the BBC Micro:bit had links with Technology, Engineering and Maths. However, the results indicated that less pupils found a link with Science, with only 21 saying Yes and 20 saying No.

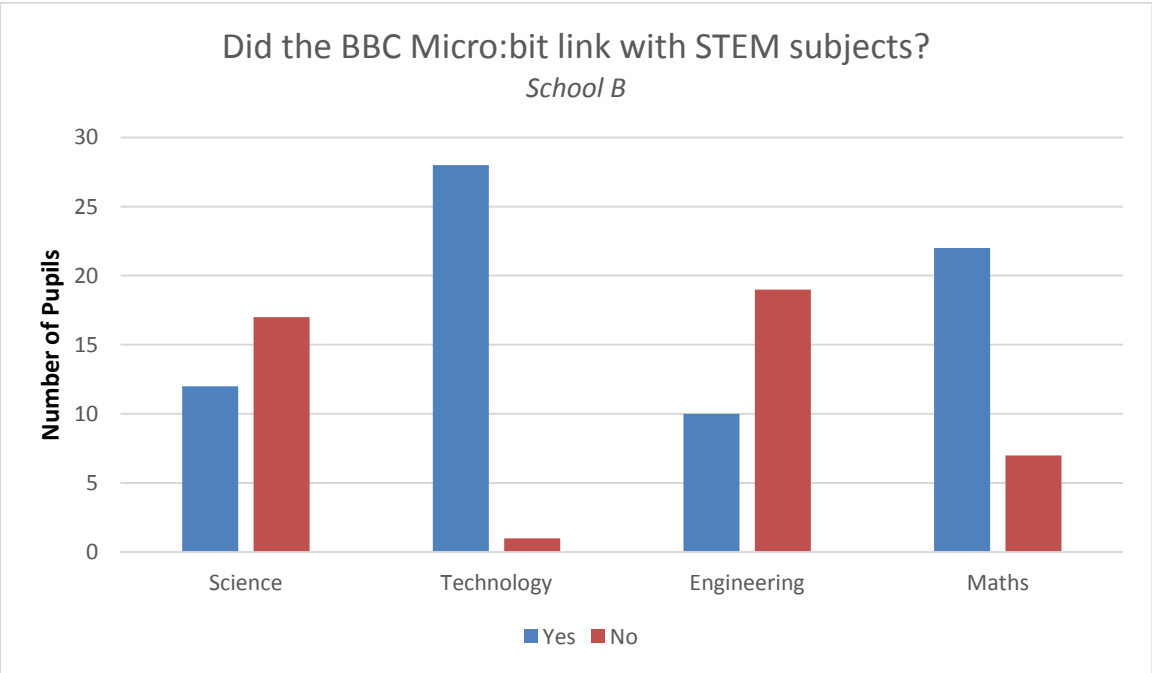


Figure 8. Did the BBC Micro:bit link with STEM subjects? (School B).

Similar to school A, links with Technology and Maths were clear and this is evident in the results from the 29 pupils surveyed in school B. There is a notable difference in the number of pupils making links with Science and Engineering, with a significant minority seeing no links with these subjects. Table 3 summarises all of the data gathered surrounding the link between the BBC Micro:bit and STEM subjects.

**Table 2.** Statistics for links with STEM subjects (Total).

Subject	Yes		No	
	No. of Pupils	%	No. of Pupils	%
Science	33 out of 70	47%	37 out of 70	53%
Technology	68 out of 70	97%	2 out of 70	3%
Engineering	35 out of 70	50%	35 out of 70	50%
Maths	52 out of 70	74%	18 out of 70	26%

The pupils commented on how the BBC Micro:bit linked with technology, viewing the device as a physical piece of new technology. They then added that they could make links with maths, with most of the tasks completed involving the use of numeracy skills including logic (+ / - / > / < / =).

As for Science and Engineering, these were the subjects that produced the lowest result. Whilst conducting the research it was evident that a number of pupils were unsure as to what Engineering was or entailed. This may be due to the age (KS2) at which the tasks were delivered. It is somewhat understandable that the pupils did not see a clear link with Science as the tasks presented were not tailored around the KS2 science curriculum. This is an area that could be further developed in future research projects involving the use of the BBC Micro:bit, were the STEM curriculum is more involved in the activities completed by the pupils.

#### *Qualitative Data*

Question 4: Why do you think the BBC Micro:bit helped in solving problems?

From the quantitative data gathered, it was clear to see that the majority of pupils from school A and B found the BBC Micro:bit useful in helping them to problem solve.

Most of the answers to this question suggested that the use of teamwork helped in solving problems when writing a program for the device, with many of the answers containing the words 'team work' or 'group work'. One pupil stated that, 'I worked as a team and we used the booklet to help us program the Micro:bit'. Another pupil further added that when 'we had a problem we were able to work as a team to fix it'.

The pupils' comments suggested that the opportunity for them to develop their programming skills also enabled them to enhance their problem solving skills. One pupil argued that, "I think the BBC Micro:bit helps solving problems because it helped us to learn how to code.... using the block editor programming software". This reinforces the idea that the BBC Micro:bit develops other skills as well as programming (Rocks, 2016).

A group of pupils in School B further suggested that the BBC Micro:bit could be used by the school council in a situation where "some people had a disagreement it could help you vote and solve the problem", the pupils suggested using the BBC Micro:bit to vote on non-uniform days, school dinners and more ICT lessons. In addition to this the pupils considered some real world problems, suggesting that the BBC Micro:bit could be used to save the school money and that 'instead of buying new things like a stopwatch, we can just re-program the Micro:bit to do what we need'. This demonstrates how well the pupils were able to contextualise their learning, making links as to how the BBC Micro:bit can have a positive influence on their learning and solve problems.

Question 6: Did you learn anything new from today's BBC Micro:bit challenge?

Most of pupils commented on how they learnt new programming skills as well how to program the BBC Micro:bit. A pupil from school A stated that *'I learned lots of new things like how to use the BBC Micro:bit and how to program it'*, while another pupil from school B further added, *'It helped me learn how computers work'*.

Aside from learning new programming concepts, some pupils commented on how the BBC Micro:bit challenge changed their perceptions on the STEM subjects involved with a pupil from school A claiming that, *'I learned that Technology and Maths can be fun'* with another pupil adding that *'today I learned that you can do anything with technology'*. This display of enthusiasm as well as the promotion of imagination and creativity in learning has the potential to enable pupils to develop both their thinking and problem solving skills. Following on from this point, some pupils expressed how the skills they have obtained during the activities might be useful in the future. A pupil from school A stated that *'the BBC Micro:bit learnt us how to code and when we are older we might need it for computer'*.

Question 7: Would you like to use the BBC Micro:bit more often?

The reoccurring theme that appeared when analysing the answers to this questions was the term *'Fun'* and *'Enjoyable'*. The majority of replies consisted of these words with pupils answering with statements such as, *'yes, I want to use it again because it was fun and enjoyable'*. Statements similar to this add value to the concept of practical activities and programming within the classroom. Huang et al. (2007) maintain that through increased enjoyment in learning, pupils' behaviours towards subjects perceived to be difficult would change dramatically, with motivation and willingness to participate improving. This point also relates to the comments made by a pupil when answering question 7, when it was stated that through using the BBC Micro:bit, he/she discovered that *'Technology and Maths can be fun'*.

Nearly all of the pupils commented on how they would like to use the BBC Micro:bit again because they enjoyed the challenge it offered, *'I would like to use it more often because it is so fun but also challenging'*. In agreement with Huang's views on enjoyment improving participation in learning, a pupil from school A stated that they would like to use the BBC Micro:bit again because *'it was enjoyable but challenging'*. Another pupil further added that *'it was fun but hard to do it, so I would like to use it more often to learn more about programming and the Micro:bit'*. These comments suggest that although some of the pupils found the BBC Micro:bit challenging, many of them would like to continue using it to improve their skills due to the device being enjoyable to use.

Enjoyment was not the only factor encouraging pupils to want to use the BBC Micro:bit again, with a small number of pupils suggesting they would like to use the device in order to teach others. One pupil stated that *'yes, I would like to use it again so I can teach my brother and cousins how to use it'*, while another added *'I could show my friends how to use it and I could play and create different faces and objects and it would be fun'*. This willingness to further their own knowledge and understanding as well as others can have major benefits for not only the pupil but also the environment in which they are learning. The views of the pupils reflect the views of Tien et al. (2002), whose research into peer led learning and teaching discovered that it could have a positive impact on the individuals (both teacher and learner) achievement, attitudes and persistence, leading to an improvement in the ability to explain concepts and better understand different perspectives on approaches to solving problems.

The imagination and creativity of the pupils is something that the BBC Micro:bit can help develop and improve. BBC Micro:bit (2015) claims that *'The Micro:bit is an educational and creative tool to inspire a new generation of young people'*. This statement was validated whilst carrying out this research with nearly all of the pupils finding the creative element of the device appealing, with one

pupil in particular answering that, *'It helped me use my imagination instead of sitting on the iPad and watching TV'*.

Question 8: If you could change anything about this challenge, what would it be?

When using the programming software, many pupils discovered the music features that allowed you to create music using various digital tones. This resulted in some pupils suggesting changes that included the incorporation of music into the tasks. Comments such as *"I would like to create music and have the Micro:bit play it"* and *"I would like to make the Micro:bit play music and the LEDs dance"* were made by two pupils, with a small number of others simply writing the word *'Music'* as their answer. Another hardware change the pupils suggested was in relation to the LEDs. A minority of pupils from School A and B had answers such as, *"I would like to change the colour of the LEDs"* and *"I would change the colours of the LEDs so I could make cooler logos and better badges"*. Some of the changes suggested by pupils, such as changing the colour of the LEDs, may not be possible to implement by the educator using the device as a teaching resource. However, if the BBC Micro:bit has been incorporated into an appropriate scheme where the pupils are learning new concepts each week, perhaps the use of more advanced features such as music, may be more achievable and appropriate to implement.

### **Data analysis - Conclusion**

The data obtained show that nearly all of the pupils who took part in the study emphasised how easy the BBC Micro:bit was to use with only a small number finding it to be difficult. These findings appear to support the idea that the BBC Micro:bit is a device that provides a *'super easy, non-intimidating user experience'* (BBC Micro:bit, 2015). The next question focused on obtaining the pupils' perceptions and discovering whether the pupils found the BBC Micro:bit to be enjoyable to use. Most of the pupils surveyed claimed that the BBC Micro:bit was enjoyable to use, with only a small number claiming it to be *'boring'*. Nearly all of the pupils surveyed perceived the BBC Micro:bit to be useful when problem solving, making links as to how the BBC Micro:bit could potentially be used to address real life problems. The pupils also made links to STEM subjects, with nearly all of the pupils making links to Technology and Maths, and a small minority making links to Science and Engineering.

Shown below is a list of the key points summarised from each quantitative question which relates to the pupils' perceptions on the use of the BBC Micro:bit:

- The BBC Micro:bit was easy to use.
- The BBC Micro:bit was enjoyable to use.
- The BBC Micro:bit was very useful when problem solving.
- The BBC Micro:bit was useful in making connections with STEM related subject knowledge.

The qualitative data captured aimed to obtain a more in-depth view on the perceptions held in relation to the device. When asked to expand on the topic of problem solving, most of the pupils emphasised how working with their peers helped them to overcome problems, with most of the pupils' answers containing the terms *'team-work'* or *'group work'*. Most of the pupils also commented on how the development of their programming skills made it easier for them to solve problems in relation to the code they were writing. Most of the pupils were also able to make links to issues that affect their own lives, discovering how programming could potentially interact with their everyday lives. Suggestions that the school council could use the device to record votes was made as well as the BBC Micro:bit being used by the school to save money, with the device being re-programmed to create different devices, such as a stopwatch, so the school would not need to purchase said device.

The pupils who took part in the study had no prior experience with programming, meaning that feedback gathered from the question surrounding 'new learning' was interesting. Nearly all of the pupils' answers referenced the term 'programming' with answers such as "*today I learnt how to program*". It is understood that this style of answer is quite vague and provides little clarity as to the knowledge the pupils actually acquired during the activities. Most of the pupils expressed their development and understanding of topics as it improved through completion of the activities.

Following on from the previous points, nearly all of the pupils commented on how they would like to use the BBC Micro:bit more often due to the enjoyment they got from it. It is encouraging to see how enjoyable the pupils found using the device and how they thoroughly enjoyed developing their programming skills. Most of the pupils commented on how they would like to use the BBC Micro:bit to teach others, stating that they would like to teach their friends and family how to use it. The overall response and enthusiasm shown by the pupils towards using the BBC Micro:bit is very encouraging. When enquiring about possible changes, most of the responses related to the programming of the device and how the pupils would welcome the inclusion of more advanced features such as digital music tones. A small number commented on the hardware of the BBC Micro:bit itself and how they would like to change the colour of the LEDs. Although this is not a current feature of the BBC Micro:bit (as of December 2016), it is encouraging to see the creativity and imagination shown by the pupils in how they would change the device.

This study has a number of strengths. It is one of a small number of research projects into the use of the BBC Micro:bit and to the researchers' knowledge it is the only research conducted to date in NI that focuses on the perceptions of pupils using the BBC Micro:bit.

It is understood that this study has a number of limitations. Due to time restraints, this research was conducted on a relatively small scale. Although 70 pupils took part in the research and completed questionnaires, the study only took place in two schools. With the study focusing on the perceptions of KS2 pupils in NI, it could be argued that the inclusion of more schools and a larger sample of participants may lend itself to the capturing of data that are more credible in addressing the main research question. As the researchers had a leading role in delivering the activities to the pupils, the relationship developed between the pupils and the researchers may have influenced the feedback obtained through the questionnaires. This may have resulted in the pupils providing information they felt would please the researchers and therefore not expressing their true opinions. As the study relied solely on the data gathered by means of questionnaires may also be perceived as a weakness as there was no provision made for triangulation, with interviews and observations not being included as a method for data capture in this study. During the analysis of data, the researchers became aware of questions that may have been useful to include in the questionnaire, as well as different ways in which questions could have been worded. In hindsight, a pilot of the questionnaire would have been useful in determining the appropriateness of the questions, in both the wording and relateness to the study.

This is, to the researchers' knowledge, the first study into the perceptions of NI KS2 pupils towards using the BBC Micro:bit. Given the recent distribution of BBC Micro:bit devices to schools across the United Kingdom (UK), it was considered important to investigate the pupils' perceptions regarding this device. It is believed that this research adds to the current understanding of how the device has been received by pupils; however, in no way does it claim to provide a definitive conclusion, but rather an important insight into a sample of pupils' perceptions, thus encouraging further study across a wider sample of pupils.

Recommendations for further research in this field could include the involvement of a larger sample of pupils and schools as a way of providing more support for the conclusions. This larger sample would help in validating conclusions made whilst addressing the research question. It may also be

beneficial to contact schools that have already used the BBC Micro:bit and carry out research with these pupils. As the pupils would have already used the BBC Micro:bit for a longer period of time, they may have different perceptions in relation to the device.

From what has been learned from carrying out this research, further study into the BBC Micro:bit could help in providing a better insight into how this device has been received and implemented by schools, providing insight into how the device has been more effectively used and how improvements could be made. As stated previously, to the researchers' knowledge, this is one of few pieces of research in this field; resulting in a number of different areas waiting to be investigated. Research surrounding the areas of teachers' perceptions, the perceptions of a larger sample of pupils (including those who have used the device for a longer period of time) and the use of the BBC Micro:bit in developing problem solving skills, are just a small number of suggestions for further research.

### **Conclusion**

The overall aim of this study was to investigate the perceptions of NI KS2 pupils towards the BBC Micro:bit as used within STEM education. The data obtained, analysed and presented throughout this research document provide a clear outlook on the perceptions of the pupils who have experienced using the BBC Micro:bit and should provide encouragement for any educator considering implementing programming into their lessons through using the BBC Micro:bit. In order for pupils to develop their problem solving skills through programming, an approach including the use of tangible resources alongside activities that require critical thinking is crucial. With no direct reference to coding or programming within the NIC, it is recognised that this will involve new challenges for teachers who wish to implement programming into their teaching yet have limited experiences. However, it is believed that based on the evidence presented within this study, programming has the potential to contribute to the development of a range of skills including teamwork and problem solving, generating a sense of enthusiasm towards learning. This will provide enrichment to the learning environment, whilst also providing pupils with the opportunity to engage in authentic problem solving activities that are not only applicable to their everyday lives, but also to their understanding of STEM education.

The findings of this research document provides a thorough insight into the positive perceptions held by the pupil participants regarding the use of the BBC Micro:bit, with the data suggesting group work to be a key element in not only developing programming skills but also problem solving skills. The results from this research also assert that pupils believe that the BBC Micro:bit is an enjoyable, easy to use device that is beneficial when learning how to code, with various other skills being developed in tandem. This concurs with the comments made by the head of BBC learning, Sinead Rocks, who believes that the device is not only a fun and enjoyable way to develop programming skills, but also problem solving skills (Rocks, 2016).

With an ever advancing technological society, and the future success of the NI economy becoming increasingly dependent on the number of skilled computer programmers (Sentinus, 2015), the BBC Micro:bit could arguably be an effective educational tool in not only promoting computer programming, but also help in developing the interest towards the various STEM subjects.

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Appendix 1. BBC Micro:bit Technical Details.

Language < My scripts Sign in  
BBC micro:bit Create Code About Getting Started Teachers and Parents Help Q

## Hardware

All the bits and pieces that make up your BBC micro:bit



**FRONT**

- Bluetooth Smart antenna
- 32-bit ARM Cortex-M0 CPU
- 16K RAM 16MHz with Bluetooth Low Energy
- Micro USB connector
- battery connector
- 2 programmable buttons
- 3 digital/analogue input/output rings
- 25 individually programmable LEDs
- power port
- ground back port
- accelerometer and compass
- 20 pin edge connector

**BACK**

### Lights

#### What are the red lights on the front?

The red lights are LEDs (light emitting diodes) and form a 5 x 5 grid. They can be set to on/off and the brightness can be controlled.

#### What is the yellow light on the back of the micro:bit?

It is the status LED. It flashes yellow when the system wants to tell the user that something has happened.

### Buttons

#### What are the buttons for?

Buttons A and B are a form of input. They detect when the button is being pressed. When you press one of the buttons, it completes an electrical circuit. The BBC micro:bit can detect either of its two buttons being pressed and un-pressed and be programmed to act on that or send the information to another device.

Button R on the back of the BBC micro:bit is a system button. It has different uses. When you have downloaded and run your code onto your BBC micro:bit, press Button R to restart and run your program from the beginning.

When you plug in your BBC micro:bit, it should appear as MICROBIT. If you accidentally hold down the reset button as you're plugging in your BBC micro:bit, the BBC micro:bit will appear as a MAINTENANCE drive instead of MICROBIT. This is known as maintenance mode."

To continue programming your BBC micro:bit YOU MUST unplug your USB and reconnect it. Check that the drive now shows as MICROBIT.

"Use with caution. If you click on the drive while it shows as MAINTENANCE, you can see which version of firmware you have running on your BBC micro:bit. Firmware on your micro:bit should be up-to-date already. You can find the version of firmware in the 'version.txt' file on the micro:bit. Further information on the firmware can be found here:

<https://developer.mbed.org/platforms/Microbit/#firmware>

### Compass

#### Why is there a compass on the BBC micro:bit?

The compass can detect magnetic fields such as the Earth's magnetic field. As the BBC micro:bit has this compass, it is possible to detect the direction it is moving in. The BBC micro:bit can detect where it is facing and movement in degrees. This data can be used by the BBC micro:bit in a program or be sent to another device.

### Accelerometer

#### Why is there an accelerometer on the BBC micro:bit?

There is an accelerometer on your BBC micro:bit which detects changes in the micro:bit's speed. It converts analogue information into digital form that can be used in BBC micro:bit programs. Output is in milli-g. The device will also detect a small number of standard actions e.g. shake, tilt and free-fall.

### PINS

#### What are the rings labelled 0, 1, 2 on the bottom edge of the BBC micro:bit?

These are labels for the input/output pins P0, P1, P2, which you can attach external sensors to such as thermometers or moisture detectors. The pins can be a form of input or output. You can read more about large and small pins [here](#).

#### How do I connect the BBC micro:bit to my computer?

It can be connected to your computer or device with a micro USB. Data can be sent and received between the BBC micro:bit and the computer so programs can be downloaded from Windows and Macs onto the micro:bit via this USB data connection. You can read more information on how to run scripts on your BBC micro:bit [here](#), and about the error messages you might get [here](#).

### Batteries

#### How do I power my BBC micro:bit?

When your BBC micro:bit is connected to your computer with the micro USB, it doesn't need another power source. When your BBC micro:bit isn't connected to your computer, tablet or mobile, you will need 2 x AAA 1.5 V batteries to power it.

### 3V GND

#### What are the rings labelled 3V and GND?

The pins labelled 3V and GND are the power supply pins. You can attach an external device such as a motor to these and power it using the battery or USB.

## Bluetooth

### What is a Bluetooth Low Energy Antenna?

You will see this labelled BLE ANTENNA on the back of your BBC micro:bit. It is for a messaging service, built for the Internet of Things so that devices can talk to each other. The BBC micro:bit is a peripheral device which can talk to a central device like a smart phone or tablet that has Bluetooth Low Energy (BLE). The BBC micro:bit can send signals and receive signals from a central device so another BLE device can control the BBC micro:bit or the micro:bit can control another BLE device.

### What is Bluetooth Low Energy?

Bluetooth wireless technology was developed as an alternative to data cables and allowed wireless communication between devices such as PCs, smartphones and tablets. Bluetooth® Smart or Bluetooth Low Energy is a power-friendly version of Bluetooth wireless technology.

### What is the Internet of Things?

The Internet of Things (IoT) was first talked about more than 15 years ago, when it was speculated that objects and people would be able to connect wirelessly over the internet. Objects can be detected and controlled remotely, allowing greater integration between the physical and computer based world. It will let you to remotely control your alarm system, thermostat or lights in your home. It has many applications in different fields including manufacturing, health and fitness, consumer electronics and the home.

### Technical Information

The BBC micro:bit has been designed to be a bare-board micro controller for use by children aged 11-12. It is an open development system and we have enabled debugging so that advanced users can interrogate the device.

The device has been through extensive safety and compliance testing to the following standards:

#### Safety

IEC 60950-1:2005 (Second Edition) + Am 1:2009 + Am 2:2013

#### EMC

EN 55032: 2012

EN 55024: 2010

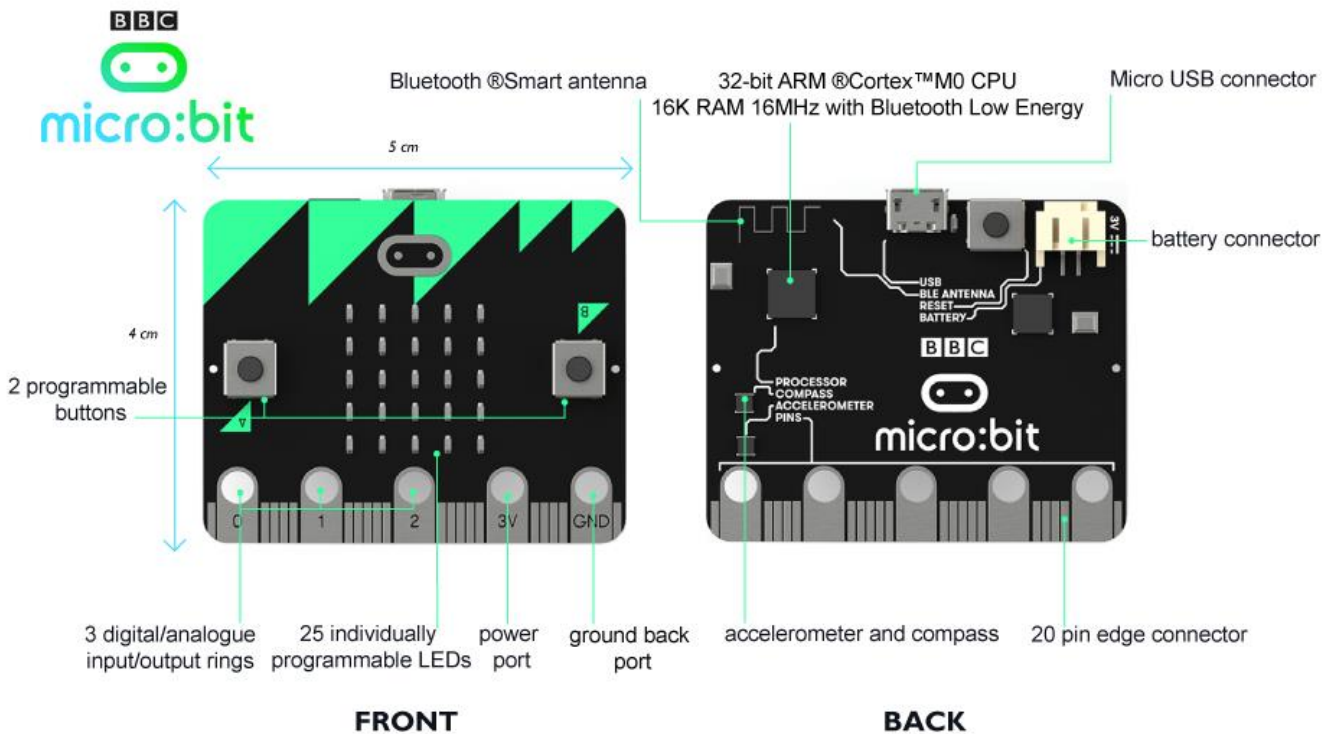
EN 55022:2010

EN 301 489-1 V1.9.2 (2011-09)

EN 301 489-17 V2.2.1 (2012-09)

#### Radio Spectrum

ETSI EN 300 328 V1.9.1 (2015-02)



Sourced from, BBC Micro:bit (2015) <https://www.microbit.co.uk/device>