



# Interim Report

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# Abstract

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This report identifies the challenges that British schools are currently facing with regards to the ICT curriculum which at present fails to stimulate or challenge students, leaving them bored and disinterested. The literature review in the report provides a general summary of what is currently taught in schools and will help to understand the problem. Interviews with Richard Clement and Gary Morgan, both of whom have been directly involved with ICT in schools, provide first-hand information on their experiences and how they believe the current ICT curriculum is out of date. Based upon the literature review and interviews conducted, a causal loop diagram has been developed focusing on key influences, including Government funding, teacher training and student interests and how some of these variables share a causal relationship. If Government funding was to increase, local authority funding would also hopefully increase and as a result schools budgets would rise. The information obtained through the causal loop diagram will be used later in the follow up report to identify the changes that could be made to the ICT curriculum and the effects they would have.

# Acknowledgements

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# The Impact of Potential Changes to the ICT Curriculum in British Schools

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## Introduction

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Over the last couple of years, there has been increasing concern with the content of the ICT curriculum for all key stages. This has led to recent Government reviews and suggestions from grass roots organisations such as Computing At Schools (CAS) for a return to more traditional Computing topics to be taught. In the last year alone, the number of students choosing to study ICT at GCSE has declined by 12.5%. [1] This significant decrease is following the same trend as the past 7 years where pupils just don't seem to be interested in continuing to learn the discipline. What is the reason for this? Within my research I intend to identify the possible issues behind the shortage of pupils opting to study formal examinations in ICT. Focusing on the enormous benefits that computing can offer, I intend to suggest possible changes that could be made to the current curriculum and compare the affect these could have. This report focuses on the first three aims of the project, to:

- Identify what changes need to be made to the ICT curriculum currently in place in British schools.
- Determine the reasoning behind the need for change and assess how successful previous changes have been.
- Outline the key factors involved in order to produce a Causal Loop diagram and the significance they have.

From this information I will be able to look into possible alternatives to replace the current curriculum which will be expanded further in the next report.

Within the first section of the report, I will provide a background on ICT in schools, starting from when it was first introduced to the present day. There will be a description of the current curriculum followed by the reasons why this is no longer suitable. I will also briefly summarise my conclusions from interviewing a retired ICT teacher and an advisory ICT teacher. The second section of this report is focused on the approach of the project. I will identify the reasons why I chose Systems Thinking as a tool instead of other possible methods and why it is best suited for this project. The next section will be the actual development of the Causal Loop Diagram including tables with variable explanations and relationships. I will determine the most important influences and expand on these later in the report. The final section will be conclusion on what I have found out so far in the project and how this information can be used further in my final report.

# The Challenge

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## Overview

Information and Communication Technology (ICT) is a distinctly different discipline to Computer Studies/Computing. Computer Studies became an academic subject in the late seventies, but during the late to middle 80's there was a dramatic shift towards Information Technology (IT) which later became Information and Communication Technology (ICT). ICT is considered to be "the application of appropriate technologies to information processing" (Addison-Wesley: 2000: pg2) whereas Computing is the study of computer architecture, configuration and programming. Computer Studies as a subject, started in schools using computer terminals linked to main frame computers. The advent of the personal computer, such as the Commodore PET, Sinclair Spectrum, Tandy TRS80, Research Machines 380Z, Acorn Atom but more specifically with the BBC Computer meant that schools were able to use limited applications within the classrooms. In the early nineties, the PC as we know it today became more affordable as well as Apple introducing their first personal computer, so school pupils were exposed to more professional systems and applications. This coincided with the gradual introduction of Information Technology replacing Computer Studies and then ICT being phased in around the same time as computer networks began to grow in schools.

ICT has been compulsory in secondary schools since the Education Reform Act in 1988 although what is actually being taught in schools today has been found to be inadequate. The Ofsted report "ICT in Schools 2008-2011" identified the number of students choosing to study ICT has fallen consecutively since 2007, especially the number of girls involved.[3] It appears the problems are continuing to worsen as developments in technology move in the other direction. This almost suggests schools are struggling to keep up. This is extremely worrying and prompts the question why are so many pupils avoiding studying ICT. There has been a lot of controversy regarding the current state of ICT in schools with the leading technology firms driving the debate. With so many institutions including IBM, Capgemini and Deloitte collaborating in backing the drastic need for change, the government have finally acknowledged this and have passed the responsibility of creating a draft programme of study over to governing bodies such as BCS, The Chartered Institute for IT. There have been rumours of removing ICT from the curriculum all together until a suitable Computing programme is fully functional. With the technology industry moving at such a rapid pace and the increasing need for IT graduates to cope with this, the number of students wishing to study ICT at school is falling. Pupils are not being provided with the necessary skills required to cope with modern day needs. E-skills UK (2011) have reported for the first time since 2008, the number of ICT jobs available in the market is currently exceeding demand with almost 101,000 vacancies being advertised. [4] With a massive lack of interest in this particular field, firms are having to recruit non IT specialists and spend time training them. ICT is at the forefront of most business sectors so technology related skills are no longer considered an advantage but more a vital requirement. With the current state of the economy and unemployment at such a high, why is it that something has not been done at grass roots level to improve ICT and provide students with an essential skill set which will enable them to succeed in the working environment?

## *The current situations with the ICT Curriculum in Schools*

When ICT was brought into the national curriculum, it had finally earned its place as a standalone discipline with the introduction of set programmes of study and attainment targets. It was clear ICT had enormous potential and with the increased access to the internet, technology was moving at a rapid pace. The initial ICT programme of study was intended to teach pupils how to apply and develop IT capabilities through the use of different software packages and applications while taking into consideration the social, economic, political and legal issues concerned with ICT. There was also a focus on utilising ICT in other subject areas. Large amounts of money were invested into improving technology in schools decreasing the child to PC ratio. See Appendix [A]. [5] With the status of ICT growing and it being offered as a discrete subject in most schools, various qualifications were becoming available through a combination of written examinations and coursework. [3] However, the number of students choosing to study ICT was continuing to decline and it seemed nothing was being done to address this issue.

Some of the reasons behind this were a result of the teaching. For example, many teachers were not considered specialists in the field therefore had very little confidence in teaching anything new or particularly complex. [3] Government findings showed only 35% of ICT teachers were specialists compared to more than 80% for subjects like English and Maths. [6] This is despite the vast amounts of funding that went into teacher training in 1998-2002 as part of the National Grid for Learning Initiative. Unfortunately, some staff have been forced into teaching their non specialist subject which possibly leads to a lack of enthusiasm and passion for ICT. As a result, pupils were often left to make use of applications such as Microsoft Office with the basic tasks of data input and manipulation. Tasks were not challenging pupils neither was their progress measured. Teachers struggled to set a general pace for teaching meaning some students were left waiting for others to catch up which is where the boredom aspect set in. Frequently, you may find only one specialist teacher in an ICT department and the onus would be on this person to provide adequate continual professional development (CPD) to colleagues who required specific inset to keep abreast of current changes in the ICT curriculum.

The current ICT GCSE is not adequate to prepare students to continue their studies to Advanced Level Computing / Computer Science and with no GCSE in Computing currently available, this is unacceptable. The skills and knowledge needed to progress to A level Computing are far more complex than those being taught at KS4 and as a result the few pupils who are opting to continue to study are under prepared and lacking the fundamentals. With regards to Computer Science at University, a similar situation is occurring. The A Level syllabus for ICT is not in alignments with the degree scheme for Computing meaning students are struggling to keep up often through no fault of their own. There should have been better co-ordination between schools and universities but the consequences have left students to pay the price. With the number of pupils studying Computing at an all time low, in particular the ratio of boys to girls, the flow of students into universities isn't meeting the demand. [7]

A major criticism of the current curriculum is that it is too broad and much of the time is down to the interpretation of the teacher as to how it's delivered. This may end up with teachers playing safe using schemes of work which lack inspiration rather than challenging pupils with innovative and stimulating ideas.

Following a review by Michael Gove and the Department for Education it has been concluded that the programmes of study and attainment target are to be made non-statutory as the current ICT curriculum has been described as “harmful”. [8] The subject will still be compulsory for KS3 and KS4 but the strict content outlined in the previous regime will no longer exist as of September 2012. This passes the reigns over to teachers, allowing them to determine what pupils should be taught. The main objective is to encourage more innovating teaching with pupils using up to date mobile devices and developing more relevant IT skills. Teachers should focus on introducing coding from a young age to introduce pupils to logical thought processes. The purpose of the new ‘Wiki’ curriculum is to allow for more flexible and creative learning, teaching and assessment. [9]

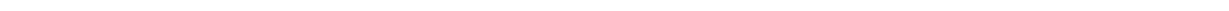
### *Initiatives currently in places to drive ICT in schools*

Within some Primary schools, computer technology is available but is not being fully utilised for the benefit of the children. Interactive whiteboards, laptops and even iPads are present in primary schools but the problem is closing the gap between ICT as a taught subject and ensuring that the skills learned are applied to learning in all other subject areas. In many cases, these children have access to either a PC or mobile device (laptop, phone, and tablet) at home and are more than confident using it. However, some Primary school teachers lack confidence in utilising ICT. The government launched an initiative to encourage implementation of ICT in primary schools and the effect on literacy. Funding from the National Grid for Learning (NGfL) has meant computing technology has been installed to improve teaching and use. Pupils have been able to participate in whole class activities such as shared reading and writing through the use of hardware like interactive white boards. Teachers are becoming far more confident using the technology and slowly building it into everyday learning.

As an example of this major technology revolution, the ESSA Academy in Bolton which was previously in special measures, was re-built and re-branded into an Academy in the hope to improve the status of the school. Not only was the school re-launched but the way pupils were taught and the manner in which they learned was as well. Every teacher has their own iPad and all 900 pupils have their own iPod touch. The teachers create their own textbooks that pupils can use, and make it easy to access pupils’ work as it is all electronic and even communicate to other teachers through the use of applications like Skype. Pupils can do their homework on their device, research online and learn simple skills like e-mail allowing communication with teachers not just inside the school hours. This initiative has saved the school £550,000 in paper, books and stationary as almost all of it is now done on the devices. Therefore although the initial outlay of buying iPods and iPads was costly, they have saved enough in one year alone to more than cover the cost. Not only are pupils far more interested and engaged in learning, they are achieving better exam results too, with a 60% increase in the number of pupils obtaining A\*-C grades at GCSE. [10]

‘Computing At Schools’ is an organisation set up by Computer Science teachers to encourage the use of computing in schools. They are focused on the challenge of moving from teaching ICT to teaching Computing and by working with the Government and other bodies like BCS, The Chartered Institute for IT, CAS are striving to find ways to make this change possible. BCS are in the process of setting up a scheme aimed at providing teachers with more vigorous training to create a new generation of exceptional Computer Science teachers. They are offering about 50 scholarships a year, worth around £20,000 each to really push the focus of teaching

from low level ICT to a new and innovative Computer Science subject. This scheme is also backed by some of the major technology companies including Microsoft and IBM. Improving pupils' Computer Science education will provide these companies with a wider selection of more intelligent and able students for future recruitment. [11]



# The Approach

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I conducted a literature review to broaden my knowledge of the current state of ICT in schools. It is a useful tool as it allowed me to familiarise myself with not only the specifics of the topic but also what other people have concluded from their own research. Reading other peoples' opinion on the problem spiked my interest in areas I hadn't even thought of. From researching the topic I was able to learn about the history behind how ICT became an established subject which helped in providing context for the direction of my project. Gaining a wider view of the issue at hand made it far easier to identify the influencing factors which are the basis of the Causal loop diagram.

Although doing a literature review is very helpful when focusing on a particular topic, on its own it is not sufficient. It provides the relevant background information needed to discuss the subject but it doesn't present a way of using the information. Background Information is vital as I learned a lot about how ICT developed as a subject and how the present curriculum came into play. However, this information cannot help in finding a solution. Also, in many cases, the research was repeating itself. Most of the relevant sources agreed that the current ICT curriculum wasn't satisfactory and had to be changed but failed to discuss possible ways of doing so.

As a result the majority of this project is based upon the use of Systems Thinking. The approach of Systems Thinking can be thought of as a way of testing human decisions in the same way as testing machine software. Systems Thinking is used to solve complex problems as it enables a developer to focus on the bigger picture not just individual aspects. It incorporates the likelihood of change and uses dynamic models to represent this. Systems Thinking is essentially used to help produce a more vigorous system to be built as it takes into consideration all influences involved. However the main reason I chose to base this project around Systems Thinking is that it provides an approach to a problem where the solution is unknown. It will enable me to simulate potential changes to the ICT curriculum and see the possible impact these changes will have. The problem and all relating factors must be identified for further analysis to be done.

As the project is focused on ICT in schools in general, there are a lot of variables that would affect this. Multiple external factors make the system far more complex which is why modelling the situation can make it easier to understand and visualise. Systems Thinking caters for this as all influences can be modelled in the causal loop diagram and even expanded on by determining their relationships. With the project covering such a broad topic, there are likely to be numerous sub-routines within the overall system and creating feedback loops makes these obvious and clearer to interpret. When thinking about possible changes that could be made to the curriculum, the dynamic model is ideal to simulate how each suggestion would have a different impact on schools. It is a crucial analytic tool in decision making which effectively is at the core of this project, deciding what changes could and should be made to improve the ICT curriculum.

I will develop a causal loop diagram which will identify all the influencing factors of the problem, both qualitative and quantitative. I will specify any causal relationships present which show the flow from one variable to another. By means of a model, a holistic view of the problem

is made clear and can identify extended links between different variables that would not be apparent through a written description. Focusing on the relationships between the variables helps to see the behaviour of the entire system not just individual aspects. If a number of variables connect in a loop, feedback can be received. Identifying balancing and reinforcing loops helps to better understand the relationship between the set of variables.

I will create a quantitative model of the system as variables can be given actual values in the form of stocks and flows and then simulated using the software iThink. The main reason for building a dynamic model is it will enable key areas of the problem to be simulated independently from the rest, therefore seeing how varying conditions affect the behaviour of the overall system. Developing a quantitative model makes comparison between alternatives far easier; if the variables are measurable it makes analysis more accurate and reliable. This approach is hugely beneficial in decision making as it provides you with all the information necessary to make an informed decision. Also, having the option to focus on either a sub section of the problem or the entire system provides a better perspective for long term solutions.

### Other Approaches

Soft Systems Methodologies (SSM) is another tool I could have made use of for this project. The main reasons I decided not to use SSM is that it focuses on situations where the problem is unclear and solutions unknown. This would not be suitable as in this project the problem is the main focus, the current ICT curriculum is outdated and unimaginative and improving it is essential. SSM would have been the better choice of tool had this project been focused on developing processes that would help deliver the ICT curriculum. The activities involved in this process would be modelled and compared with processes currently being done. The emphasis would then be on the gaps between the two. SSM can be used to structure thinking but doesn't always focus on solving a problem. The world view would be specific to a school which would not be useful for my project. The transformation process needs to be straight forward, "do X to achieve Y", however as I am unsure as of yet how the possible changes will affect the curriculum I cannot say for definite that changing one area will improve another. SSM doesn't provide a way of measuring success; therefore comparison is far more difficult. [12]

# Developing the Causal Loop

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I decided to interview people who are directly involved with ICT in education to gain a better understanding of what is actually happening in schools. Talking to them directly meant I was getting a firsthand statement which is far more reliable than reading a teacher's blog online. They provided me with in depth knowledge about their areas of expertise which brought the project to real life as opposed to just reading published statements from the Department for Education.

The main reason behind choosing to interview Richard Clement is that as an ICT Advisory Teacher, his role is to visit all schools in Cardiff that request assistance in ICT policy. He deals with primary and secondary schools, advising teachers on purchasing IT equipment and how best they can use it. He is very involved with developing ways of using iPads within the Primary curriculum and recently visited a flagship Academy in Bolton that has provided all 900 of its pupils with access to either their own iPod Touch or iPad. It was very interesting to hear what impact this had on the pupils learning and also get his opinion on the whole issue at hand.

From an interview with Richard Clement, An ICT advisory teacher for Cardiff Council, I learned how he views the current state of ICT in schools. In summary he identified the ICT curriculum was many years out of date. He believes staff should no longer be teaching students how to use packages like Excel and Word but focus on the basics of how a computer works. He says "students are no longer required to think logically during ICT lessons; they just follow instructions on a worksheet. Thinking skills are paramount in all areas of learning and particularly so in basic computer programming where logical thought processes are essential". When asked "Do you think teaching students to program is a good idea?" his response was "at least it would stimulate them. Students are likely to be fearful of the idea simply because it would be such a massive leap from what they are used to." Having had a lot of experience interacting with non ICT specialist teachers, Richard explained he sensed a real lack of confidence. He explained "Staff are hesitant to make use of ICT in their lessons in case it goes wrong. In many cases the pupils know more than the teacher and this feeling of inferiority puts them off using it at all. Having worked in a number of schools and seen how the standard of ICT varies drastically between them, it's obvious something isn't right!" The full interview can be found in the appendix. [B]

Teachers are the ones directly involved with teaching the curriculum and have firsthand experience of the current issues within it. Gary Morgan is not only a retired Assistant Head Teacher at Whitchurch High School but at the point when he retired, Gary was the most experience and successful teacher of ICT and Computing in Cardiff. Over 30 years he achieved 80% A-C grades at A-Level, 82% A\*-C at GCSE and also taught International Baccalaureate Computer Science where many pupils obtained the highest grade of 7. Gary was also responsible for the largest split site computer network in Cardiff and possibly Wales. Having such a lengthy and successful history working with ICT in schools, he was the perfect person to give me a detailed account of his experiences and knowledge gained over the years.

Gary identified that even having been an ICT and Computing teacher himself that he found the current ICT curriculum to be "boring, dull and too much geared to Office applications and business application". It was clear he wanted to see something being done to stimulate

pupils without scaring them off ICT for good. Gary explained he thought the Government's involvement was necessary but is concerned Michael Gove may be over committing to excessive programming. Gary was passionate about introducing programming into ICT and was confident it would change the way students view the subject. Having worked in a large school with a huge emphasis on ICT Gary was able to see the immediate benefits of the Government's decision to remove the set programmes of study. He said "it would allow the better teachers to devise their own curriculum and create more exciting, challenging tasks for students to do".

Obviously allowing schools to experiment and try out new teaching methods is the reason behind the Government's plan. However, if it widens the gap between the better schools and those approaching special measures, it may have a negative effect in the long run. Gary expressed concern that "schools that are soft on IT will take the easy option and opt out of putting in the extra effort to improve the subject and will continue to just go through the motions".

From my interview with Gary Morgan, it was clear his main concern was the Government getting the balance right; the balance between ICT and Computing and the distinct links between the two subjects. He emphasised the point "pupils need to know how to use applications but also understand how the computer works to enable the application the run".

# The Causal Loop Diagram

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## How I approached the Causal Loop Diagram

After doing a lot of research around the ICT curriculum in schools, I identified key influences associated with why it is the way it is. Most of the influences I identified were sourced from news reports or published statements from relevant people, although a few were produced from general observation and my own knowledge of the education system. I created a table where the variables could be specified, explained and referenced to make the final causal loop diagram easier to understand. Using the variables identified, I mapped out the influences and connected them through the use of arrows. Creating these links allows causal relationships to be identified and loops to be formed showing how the effects usually end up meeting the cause. I identified if any loops were closed and what type of feedback could be gained from it. The majority were reinforcing loops which I was expecting due to the nature of the topic and the continuing worsening state of the ICT in schools. It was important to justify the reasoning behind each link and the reason the relationship flowed in the direction it does. I created another table to make understanding the model easier.

## Causal loop Variables

<b><u>Factor</u></b>	<b><u>Explanation</u></b>	<b><u>Reference</u></b>	<b><u>Measure</u></b>
Teacher training	Teachers need the appropriate skills and knowledge in order to provide pupils with the guidance they need.	[1] Michael Gove (April 2012).	Increase figure of only 35% specialist ICT teachers
Teacher confidence	With no set programmes of study, teachers must have the knowledge and ability to teach what they feel is appropriate. Without a good background in the subject and no curriculum to follow, students will just continue to receive the same “dull” lessons.	Appendix B Gary Morgan (2012)	
Standard of teaching	An advance in the level of teaching will improve the status of the subject. More innovative and exciting application of ICT will change its reputation. It is essential to raise the bar and bring all ICT teachers up to the same level to reduce the gap between schools.		

This table identifies just a few of the influencing factors drawn upon in the Causal Loop diagram. Teacher training is currently one of the major problems with ICT in schools. Teachers don't have the knowledge to go beyond the set programmes of study so removing them won't necessarily benefit all schools. Teachers can't be expected to automatically know about any changes with technology, as with everybody it must be explained and shown to them in order to learn. IT differs from other subjects as sometimes reading a book isn't sufficient, actual demonstration is



## *Influence Relationships*

The Causal Loop diagram instantly identified some interesting relationships between variables. I feel a key area of the diagram is the collection of influences all focused on teaching. This straight away suggests that teaching is a crucial element of the issues facing the ICT curriculum in schools. Government initiatives such as the £20,000 scholarship for new Computer Science teachers and the National Lottery grant a few years ago were used to ensure teachers had the training they required to adequately teach the syllabus. Schemes like these increased the amount of training that was available for ICT teachers as there was money being injected in order to fund it. The increase in teacher training meant teachers were far more confident. As with most skills, the more guidance and experience you have the faster you improve. With teacher's confidence improving, it meant the manner in which they taught improved too. ICT is a subject that is learnt through practice, knowledge will only get you so far. Teachers can use their experience to cover the necessary details but also provide an exciting means of learning and applying it to make the lessons more interesting for students. They will have the knowledge and self-assurance to teach the syllabus in more innovative and creative ways, improving the standard of teaching. As the standard of teaching improves, more teachers will become specialists in the area as they will have had the training and hands on experience necessary to teach ahead for the curriculum. Increasing the number of specialist IT teachers will improve the status of the subject and as a result attract more students to study above KS4 and be entered for exams. However, the increase in examination candidates for ICT is likely to have a negative effect on the level of teacher training. Schools will assume the increase in students opting to take ICT at GCSE and A-Level is a result of the previous training teachers received. Although this is correct, in order for the cycle to continue and the number of students to continue to increase, training must be reinforced regularly. However, this is not the case and as the number of exam candidates increase, schools will decrease training for teachers as they have seen an improvement in this area, head teachers will focus their attention on another areas in need.

These variables create their own causal loop which has a balancing feedback system. The sequence of event from improving teachers training until the number exam candidate's increases is a process seeking stability. Once the number of entrants has increased, training will reduce as the school's budget is unable to keep up with the continuous expenditure.

Another relationship worth mentioning is how increasing networking can improve teacher's confidence. Throughout my research, I noticed a number of occasions where ICT teachers have stressed concern that they have been given initial training on a topic and then left on their own to determine how to apply this knowledge in order to teach the students. Teacher confidence would increase massively if they were part of a network such as a Professional Learning Community (PLC). This is an area which allows teachers to interact and share their knowledge and experience in an online community to ensure they have access to all the resources they need for their role. [13] This constant support will improve teachers' confidence.

The number of Computer Science Applicants will have a positive impact on both the standard of teaching and graduate schemes. The key to both these relationships is that there will effectively be more Computer Science graduates looking for jobs once qualified. This will result in more capable people applying for teaching positions, increasing competition for the posts enabling schools to hire the most suitable person which would improve the standard of teaching. Also if the number of Computer Science applicants increases, technology companies

are likely to increase the number of graduate placements available. Firms are fully aware that the best time to recruit these students is straight out of university. It ensures they have suitable background knowledge in the area but allows companies to shape students' learning specific to how their organisation work. Both parties benefit which suggests a reinforcing loop may be present. If there are more graduate schemes running for Computer Science graduates than other disciplines, with the current employment market being so poor, this is likely to interest and encourage students to enter this field. The more students interested in Computer Science will effectively lead to an increase in the number of applicants to study it at university. The causal loop is complete and identifies change is being amplified. This is a classic example of the limit to growth archetype. The process will continue to grow until the constraint affects the limiting factor and a decline will be inevitable. There will only be so many graduate schemes available in the end so this figure cannot continue to rise as firms do not have the capital to continue to invest in recruitment if the market isn't steady.

Specialist Computer Science teachers	Positive	Computer science curriculum	With more teachers becoming specialists in the field, the Government's plan to set a new Computer Science GCSE seems more feasible. In order for the new subject to take off, they must have the background in place like the teachers and equipment.
Computer Science curriculum	Positive	Pupils studying ICT/Computing	If a new subject is launched to replace the old, boring ICT, there is likely to be an increase in the number of pupils wanting to study it. With a new and different approach to IT, pupils are likely to want to try something different and erase their previous experiences of data manipulation in Office applications.
Pupils studying ICT/Computing	Positive	Specialist Computer Science teachers	The number of students studying is increasing therefore schools will require more than just one specialist IT teacher to cope with the rising demand.

As identified in the table, these three variables have an interesting relationship as they create a reinforcing loop. The feedback process shows a growing action as each influence has a positive impact on the next. There will be a continuing growth pattern among these variables as introducing a Computer Science curriculum will interest more pupils to study it. If more pupils study then there is likely to be an increase in specialist teachers as these pupils may go into teaching. If there are more specialist Computer Science teachers, the curriculum could advance further as the teachers are able to cope with it which effectively may interest even more students. This growth will continue to a certain point and will then plateau or decline as a result of other forces restricting it. A full table identifying all the variable relationships can be found in the Appendix (E).

# The Next Chapter

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Having built the Causal Loop diagram, the next stage will be to develop the quantitative model. As the majority of the influencing factors in this situation are measurable, it enables me to focus on turning the conceptual causal loop model into a dynamic computer simulation. This will provide more accurate and reliable information as relationships between variables can be represented with figures rather than just descriptions and updated and altered regularly to show the effects of different experiments. Having identified all the contributing factors to the problem, I now want to simulate what impact potential changes to curriculum would have.

Firstly, I will create a high level systems diagram that describes the problem of the current ICT curriculum in schools. The purpose of this is to break the situations down into its main sections to identify which aspects will be modelled. The high-level systems map will be developed using the systems dynamics software package iThink. Based upon my causal loop model, I will show the key areas in a potential simulation model and the direction of flow and information associations between these areas. Using the variables I previously recognized, I will produce stock and flow diagrams from the basis of the many causal loop diagrams identified. I will use the background information I gathered from my literature review and interviews in order to gather the necessary information to provide stocks and flows with accurate initial values. Using these initial stock values and after assigning relationships with parameter values, I will begin to build a dynamic simulation model through the use of iThink. [14] In order for the model to run, equations must be formed for the stocks, flows and converts which will enable me to generate a graphical representation to validate the simulation. I will be able to simulate the effect of each change and look at specific areas independently of the entire system. The model will be built incrementally as the results of each simulation are likely to directly impact one another and will each require validation. The findings from the model will allow recommendations to be made for a proposed system to support decision making in schools and will be fully expressed in the final report.

# Conclusion

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The current ICT curriculum in schools is out dated with content that doesn't need meet the needs of industry and doesn't excite the pupils in the classroom. The curriculum is in desperate need of a revamp and throughout this report I have identified many areas of concern. Through the use of a literature review, I was able to research into the background of the ICT curriculum and the programmes of study. From this it was clear changes have to be made, in particularly to what the curriculum involves and also how it is being taught. Through the use of systems thinking, I created a causal loop diagram that recognized influencing factors of the problem like Government influence and funding and how they were directly related. The development of the causal loop diagram will be the basis for my quantitative model in the final semester. From my research and model I will be able to suggest possible changes to the current ICT curriculum and model their effectiveness through the quantitative iThink model.

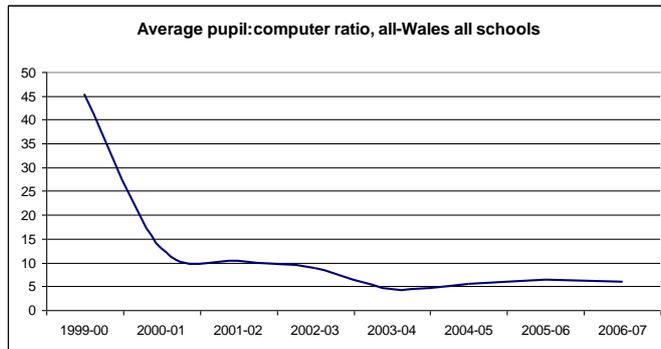
In conclusion, I was able to successfully meet all of my aims and objectives set for this report. I have identified some potential changes that could be implemented which I intend to expand on in the final report. I decided not to include questionnaires from students as having initially spoken to a small number of them I instantly received the same answers from an extremely biased viewpoint. To keep my research neutral, I took the students' viewpoints into consideration when writing my report but didn't feel their responses were worthy of inclusion.

# Appendix

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## A

### A Table to show the average pupil to computer ratio in schools



[5]

## B

### Interview with Richard Clement

#### **1. What is your opinion on the current ICT curriculum?**

- Having been at a conference in Swansea last week, a colleague of mine said "They aren't teaching spreadsheets properly". My response was, why are they teaching spreadsheets at all? I believe the curriculum is 20 years out of date with some schools still teaching word processing as part of GCSE.
- Students are not coming out of schools with the skills they need and the industry need because they are not being taught how to think and process information logically.

#### **2. How do you feel about the Department for Education removing the curriculum in England allowing teachers to use their own approach?**

- I believe it is good idea, though I am not convinced about rushing head first into teaching programming. I feel there are other aspects that need focusing on too, for example the creative aspect e.g. designing apps for mobile devices..

#### **3. Do you think teaching students to program would interest them more than the current lessons in applications?**

- Yes but I also feel it may scare them off.

#### **4. Do you think the changes to the curriculum will encourage more pupils to study ICT?**

- Something drastic will have to be done to change students' opinions.

**5. Are teachers provided with adequate support and training to teach more advanced ICT/computer programming?**

- Some schools would take the opt out and choose not to go into as much depth as others.
- This may be down to teachers' knowledge and ability but also as a way of making their job slightly easier.

**6. Apparently only 35% of ICT teachers are specialist as opposed to Maths and Science at 85%. Does this surprise you? Have you had any experience with this?**

- That does not surprise me at all; I have met many ICT teachers that have fallen into teaching the subject rather than being qualified to do so.

**7. Do you feel the Government is doing enough to improve the current situation in schools?**

- The government have looked at certain schools in trouble and pushed for improvements to be made.
- I feel companies in industry are pushing ICT in schools far more than the Government as they are aware how it will benefit them in the long run. Not only will schools be ordering more hardware or software from themselves, if more pupils choose to study ICT further, they will have a better crop of graduates to employ.

**8. Does the amount of funding schools receive affect their view on ICT?**

- The funding for new ICT kit is not coming from capital, but revenue funding ie their everyday budget.
- Yes, massively, in many schools especially those in "Special Measures", their main objective is to improve numeracy and literacy, therefore any extra money in the budget is targeted towards those areas.
- What teachers don't realise is, investing in ICT can actually benefit core subjects as well.
- Companies are offering deals specific to schools to encourage them to invest in new technology for pupils.
- Many iPad apps are free or at least discounted

**9. What difference would it make if all pupils had access to their own device?**

- Having access to an iPad and making proper use of an iPad are completely different things.

**10. How can ICT benefit the school?**

- I visited a school in Bolton where every child had an Ipad as did the teachers and even the receptionist. As a result they save £550000 on paper, books and stationary as everything could be done interactively.
- So ICT can not only be used to improve learning but to improve the schools in general.

**11. Are you aware of some teachers being fearful of using ICT in other subjects?**

- Many teachers believe ICT belongs in the ICT suits for lessons on word processing etc not for everyday use teaching maths. When Smartboards were brought into schools, some teachers took advantage and began to see their uses.
- Teachers have had too much experience with IT “going wrong”
- Staff are scared the students will know more than them, they don’t want to be out shone.
- Teachers should make use of the pupils’ knowledge and embrace the fact they may be more educated than staff in certain areas.
- With wireless being installed in schools, ICT could be used everywhere
- Some teachers feel areas like literacy and numeracy need improving before ICT can be looked at.

## C

### Interview with Gary Morgan

#### **1. What is your opinion on the current ICT curriculum?**

- I feel the current curriculum is boring, dull and too much geared to Office applications and business application. There is not enough stimulus for the students.

#### **2. How do you feel about the Department for Education removing the curriculum in England allowing teachers to use their own approach?**

- I feel this is a very dangerous move; it gives schools that are soft on IT almost an option to opt out of it. It will just widen the gap between the better schools and the poorer schools and there are no guidelines for them to follow. I understand the thinking behind it; they want to experiment before the new Computing curriculum is introduced in 2014.

#### **3. How do you think teachers will cope with no set programmes of study in place?**

- I feel the better teachers will devise their own curriculum and create more exciting, challenging things for students to do. However, those teachers that just go through the motions will continue to do so, they won’t change anything.

#### **4. Do you think removing the curriculum will encourage more students to opt to study ICT?**

- Eventually maybe, but at the moment the subject has been branded as dull and repetitive therefore something has to be done to show students this is no longer the case.
- However, in the schools that deliver ICT in a better way, the teachers will take advantage of not having set programmes of study which may change the opinions of those already studying it. This will just continue to widen the gap.

#### **5. Are teachers provided with adequate support and training to teach more advanced ICT/computer programming?**

- Probably not, especially if they intend to teach programming in the new curriculum. Something has to be done, they have to start in teacher training and make sure there

are specific ICT teachers coming out not converting other non specialist teachers that have a slight interest in the subject. The focus must be on training ICT teachers.

**6. Apparently only 35% of ICT teachers are specialist as opposed to Maths and Science at 85%. Does this surprise you? Have you had any experience with this?**

- That is not surprising; the majority of ICT graduates are keen to enter the private sector of business rather than public school teaching. Something needs to be done within teacher training to either convert other teachers to specialise in ICT or some kind of government initiative to encourage more ICT graduates to enter the fields of teaching.
- This may have stemmed from students not enjoying their own experience of ICT in schools therefore they have no desire to continue to study further. The problem is many schools don't have the ability to offer ICT or computing at A-Level which is where it does get more interesting and stimulating.

**7. Do you feel the Government are doing enough to improve the current situation in schools?**

- I felt Michael Gove is going a bit strongly at the situation; I hope he doesn't push the programming aspect too hard as in my opinion it will kill the subject, there has to be the correct balance between how computers work and the applications.
- I do appreciate that the Department for Education is now fully aware of how bad the situation of ICT is in schools and they are working hard to correct it.

**8. Does the amount of funding schools receive, affect their view on ICT?**

- That all depends on how the school head teacher decides to spend the money. The budget is split between many areas according to what is at the top of the "to do list". For example in Whitchurch, the school I used to teach in, a large amount of the budget was often dedicated to IT as the head teacher could see the benefits from it.
- There have been occasions where schools have received grants for ICT.

**9. What difference would it make if all pupils had access to their own device?**

- Yes, if pupils had access to iPads or iPhones and could use them safely I feel this would really stimulate them. The students are more than capable of using the technology, it's the staff that are the problem.

**10. What can be done to clear up the miss conceptions between ICT and Computing in schools?**

- For KS3 and KS4 I believe a subject should be created that incorporates aspects from both of these areas called and renamed Computing rather than Computer Science or ICT. At A-Level I feel it is important to distinguish between the two disciplines as the students will have the knowledge of both areas and will be able to make their own decision on what path they wish to follow. Whether they are interested in ICT or Computer Science for those who have an interest in logic gates and programming.
- Computing has been watered down since it initially started as now the only true Computer Science syllabus is the International Baccalaureate.

**11. If students understood what Computing involved and were taught how to program, do you think this would interest them more?**

- Yes, teaching them simple web programming or even developing games, they will get a stimulus out of it and will understand how computers work.

**12. Do you think pupils take a backwards step from KS2 to KS3 in regards to ICT?**

- Definitely in some schools, some primary schools have better access to ICT facilities than many secondary schools which obviously isn't ideal for learning progression. Many primary schools are investing in iPads for the students whereas secondary schools are still a while away from this which may result in some students losing out as they are effectively moving backwards.

**13. Are you aware of some teachers being fearful of using ICT in other subjects?**

- Not so much scared of ICT but worried about using computers in front of pupils due previous experiences where equipment has failed, internet access gone down or too slow to use. All of these things deter a non specialist ICT teacher from risking using ICT in a lesson.

**14. What do you see at the solution to solving the problem of the current ICT curriculum?**

- The schools have two years to get it right before the potential Computer Science GSCE is introduced in 2014. They need to get a balance of teaching pupils to use applications but also learning how computers work for the applications to be able to run.
- I think introducing students using their own devices would make a massive difference.

<i><b>D</b></i>	<i><b>Table of Variables</b></i>		
Factor	Explanation	Reference	Measure
Government influence	They finally realised teaching how to create a spreadsheet is not efficient use of ICT lessons as it doesn't teach pupils the real benefits of ICT. E-skills carried out a study that identified a real need for change.	[15] Michael Gove (April 2012).	Number of students opting to continue to study ICT
Initiatives	Graduates are being persuaded into training to become Computer Science teachers with the lure of £20,000 bursary.	[17] Jeevan Vasagar (2012)	Number of qualified Computer Science teachers
Teacher training	Teachers need the appropriate skills and knowledge in order to provide pupils with the guidance they need.	[15] Michael Gove (April 2012).	Increase figure of only 35% specialist ICT teachers
Teacher confidence	With no set programmes of study, teacher must have the knowledge and ability to teach what they feel is appropriate. Without a good background in the subject and no curriculum to follow, students will just continue to receive the same "dull" lessons.	Appendix B Gary Morgan (2012)	
Standard of teaching	An advance in the level of teaching will improve the status of the subject. More innovative and exciting application of ICT will change its reputation. It is essential to raise the bar and bring all ICT teachers up to the same level to reduce the gap between schools.		
Specialist Computer Science teachers	With more specialists in the field, the content of teaching will improve and allow pupils to learn new aspects including algorithms and logic which they wouldn't have had the chance to learn in ICT lessons.	[18] The Guardian	Number of COMSC graduates entering into teaching
Networking	Although teachers may be provided with the initial training in ICT, it is important this support continues.		
Exam candidates	Number of students opting to study ICT at exam level is currently at an all time low. With technology being a part of our everyday life, now is not the time you would expect this to happen.	[19] Jennifer Scott	Difference in exam results before and after change to curriculum
Girls Interest	The ratio of boys to girls in the average ICT class is poor. For some reason the current ICT curriculum is failing to capture the attention of girls, leaving a huge gap. This is having a knock on effect in industry, in IBM only 19% of		Number of girls studying ICT at GCSE level

	their workforce is female. This obviously doesn't look good for their reputation but if there simply aren't enough girls in the field what are they expected to do.		
Programmes of study	In previous years, the Government and Department for Education have worked together to devise a set ICT curriculum,. However, recently this has been removed and teachers have been left to their own devices to determine what pupils should be learning	[20] BCS	Exams results alter as a result of removing set programmes of study
Innovative teaching	Teachers have the opportunity to teach ICT in a way they feel will interest and attract students to study. Teachers have to have the knowledge and experience to fully take advantage of not having set programmes of study.		
Pupils studying ICT/ Computer Science	The number of students opting to continue to study the subject after KS4. This figure will continue to decline if nothing is done to attract pupils.		Number of GCSE students
Computer Science curriculum	Having a separate Computer Science GCSE will encourage those pupils who enjoy ICT but find it dull and boring to advance their learning. It will combine aspects of the ICT course but also include programming and algorithms.	[15] Michael Gove (April 2012).	Compare exam results from original ICT GCSE and the new Computer Science exam.
University Computer Science applicants	The number of students that want to continue their learning in Computer Science. Not only is this figure low, many students are dropping out of their first year of study as they feel they are not suitably prepared.	[7] CAS	Number of applicants to study COMSC at university
Graduate schemes	Companies looking to employ a number of university graduates straight after qualifying.	[16] Jane Wakefield (July 2012).	Number of graduates recruited
Student interest	No desire to continue with discipline at present as the curriculum is boring and not actually teaching them ICT but more business studies	[15] Michael Gove (April 2012).	Number of students that choose to continue to study ICT at GCSE and A-Level
Technology companies	Firms like IBM, Microsoft and Google are all working to help restructure ICT as they know the more students that enter into the field of computer science provides them with a wider choice of potential employees	[15] Michael Gove (April 2012).	Number of students that successfully complete Computer science degrees
New technological	Hard to keep up with how fast technology is moving. Often the curriculum become out of date too quickly so teachers stick to teaching content that remains quite consistent.	[15] Michael Gove (April 2012).	

	With so many technology companies fighting to be the best, more and more exciting and innovating products are being developed.		
Funding	More money invested in education in schools.	[15] Michael Gove (April 2012).	Proportion of the budget to education.
School Budget	The money a school receives from their local authority. Usually this is spent on improving the most essential areas of the school.	[15] Michael Gove (April 2012).	
Investment in IT	How much of the school's budget is dedicated to IT to improve their use of technology.	[15] Michael Gove (April 2012).	Amount of money a school invests in IT
School leadership	The influence the head teacher has on the school. Their opinion on ICT is usually what has the most impact.	Appendix B Gary Morgan	

E**Table of Influences and their relationships**

<b><u>Variable 1</u></b>	<b><u>Relationship</u></b>	<b><u>Variable 2</u></b>	<b><u>Linkage</u></b>
Government influence	Positive / Same	Funding	The UK coalition Government has finally realised how dyer the current ICT curriculum in secondary schools is. In order for the Government to make substantial changes to current perception of ICT, a large increase in funding would be required. The more the Department for Education involve themselves in this area, the more they will realise how bad the ICT situation is in schools meaning more money will be allocated to Education
Funding	Positive / Same	School budget	If schools receive more money from local authorities, they have more money available to invest in areas that need the most improvement.
School budget	Positive / Same	Investment IT	If more of the schools budget is allocated to ICT, they would be able to invest in more computers meaning the current ratio of 1:6 desktop per student would be reduced. This would have a huge impact on the way ICT can be utilised to improve learning.
School leadership	Positive / Same	Investment in IT	Head teachers of the schools are effectively the driving force behind ICT. They determine how much money is invested in the subject. If the school's leadership is focused on improving ICT and is willing to spend in order to gain then computers could become part of pupil's day to day learning.
New technology	Positive / Same	Investment in IT	With new technology being designed every day and the development of new machines like iPads and other tablets, schools are starting to see how these can be utilised to improve learning. If they can see the benefit of these new products, they will want to invest in them for pupils.
Investment in IT	Positive / Same	Student Interest	The better ICT equipment schools have, students are far more likely to want to make use of it. It is likely to spark an interest in what ICT can do for them, it is to be expected that this will increase the numbers of students opting to study ICT at a higher level. More and more young people have access to the internet at home these days and often on more than one device. If students are used to using computers at home and see how useful they can be, it will have a positive impact on their interest to study ICT in school.
Student Interest	Positive / Same	Technology companies	As students become more and more interested in the subject, they are more likely to come up with their own creative and innovative ideas and in some cases likely to build their own rival companies.
Technology companies	Positive / Same	Graduate schemes	With the technology industry being one of the only areas of the market moving forward and expanding in the current economy, the need for more qualified graduates is also growing. Companies need the staff to keep up with the rate of growth and taking on Computer Science graduates means they are more than suited to the roles.

Graduate schemes	Positive / Same	Student Interest	Students go to university to broaden their knowledge in the hope of getting a job. If there are certain fields in the market that have a high demand for graduates, this will encourage students to study in that area. Therefore if technology companies are offering a large number of ICT graduate placements then students are more likely to want to study ICT/ COMSC in university to ensure they have the necessary qualifications for the job.
Government influence	Positive / Same	Initiatives	As the Government becomes increasingly more aware of the situation in schools and how the current curriculum is almost discouraging pupils from studying ICT rather than encouraging them to study, they are thinking of new ways to fix this. The more involved the Department For Education is becoming, the more ideas and schemes that are put in place.
Initiatives	Positive / Same	Teacher training	Different types of initiatives and schemes are being put in place to attack this problem from different angles, for example £20,000 scholarship for COMSC graduates to go into teaching.
Teacher training	Positive / Same	Teacher confidence	If there is an increase in teacher training, whether it be learning about new aspects of technology or just reinforcing the current syllabus, it will give teachers more confidence to branch out.
Teacher confidence	Positive / Same	Standard of teaching	Teachers can use what they know and make the lessons more interesting for students. They will have the confidence to teach the syllabus in more innovative and creative ways, improving the standard of learning. They have the knowledge and confidence to cover the necessary details but provide an exciting means of learning and applying it.
Standard of teaching	Positive / Same	Specialist Computer Science teachers	The better the standard of teaching becomes, the more teachers that will become specialists in the area. No longer will IT lessons be taught by a non specialist who has an average interest in the subject and happens to have a free period to cover a class but a properly trained and qualified teacher.
Specialist Computer Science teachers	Positive / Same	Exam candidates	The more teachers that are specialists in the subject will effectively increase the number of students opting to take the subject at GCSE and A-level. The better the teacher's knowledge, the better the tuition the students should receive encouraging them to opt to study it further.
Exam candidates	Negative / Opposite	Teacher training	The more students studying COMSC at examination level, the less training teachers are likely to receive. As funding is so limited within education, it is likely the head teacher and local authorities will take the view if more students are sitting the exams and doing well, teachers must be more than coping with the previous training they had therefore do not require it so often.
Initiatives	Positive / Same	Girl's interest	The scheme 'Computer Club for Girls' (CCforG) was set up to encourage girls to get involved in ICT and remove the stereotype that technology is geared towards males. Within the technology industry, only 30% are represented by women therefore initiatives like this allow same sex groups to work together to see the uses of ICT and broaden their knowledge past what is taught in core lessons. The more

			schemes running like this the more likely it is going to increase the number of girls opting to study.
Girls interest	Positive / Same	Exam candidates	If more girls are getting involved in ICT then the number of exam entries will increase. If girls realise how useful IT can be, they will be more inclined to continue their studies further.
Government influence	Negative / Opposite	Programmes of study	The more the Government has become involved, the more the ICT programmes of study have been scrutinised and eventually removed.
Programmes of study	Negative / Opposite	Innovative teaching	The less structured curriculum with the removal of the programmes of study has allowed teachers to get creative and interpret the syllabus how they see fit. It takes enlightened and forward-thinking teaching staff to do this successfully.
Specialist computer science teachers	Positive / Same	Computer Science curriculum	With more teachers becoming specialists in the field, the Government's plans to set a new Computer Science GCSE seems more feasible. In order for the new subject to take off, they must have the background in place like the qualified teachers and equipment.
Computer science curriculum	Positive / Same	Pupils studying ICT/Computing	If a new subject is launched to replace the old, boring ICT, there is likely to be an increase in the number of pupils wanting to study it. With a new and different approach to IT, pupils are likely to want to try something different and erase their previous experiences of data manipulation in Office applications.
Pupils studying ICT/Computing	Positive / Same	Specialist computer science teachers	The number of students studying is increasing therefore schools will require more than just one specialist IT teacher to cope with the rising demand.
Innovative teaching	Positive / Same	Pupils studying ICT/Computing	The more exciting and creative the teachers make learning the syllabus, the more students they will have at GCSE and A-Level wanting to study the subject further.
Computer science curriculum	Positive / Same	Student interest	The Computer Science curriculum will include learning how computers work, how to write basic code, understanding algorithms and logic, not only that but learning various skills they can draw on in any situation. This would be the complete opposite to the current situation where students are data logging and creating presentations. Therefore a change in direction would really spark student interests and encourage more to get involved.
Student interest	Positive / Same	University COMSC applicants	The more students that are interested and stimulated by Computer Science, the increased likelihood of them applying to continue to study the subject further in University. It is the school's responsibility to excite students enough to show the true capabilities of computing and push them to further their knowledge in the area.
University COMSC applicants	Positive / Same	Standard of teaching	With more and more students applying to universities with the interest of studying COMSC, there will be an increase in the number of graduates. It is likely many of these students who have a real passion for the discipline will go back to

			schools to teach, producing a batch of very qualified teachers.
University COMSC applicants	Positive / Same	Graduate schemes	If there is an increase in the number of students going in for a COMSC degree, firms are likely to take advantage of this and increase the number of graduate placements they offer to capture the most qualified and specialist students to employ.

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